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Design Education Forum of Southern Africa

DE+ AFRIKA+ 4IR+

DESIGN EDUCATION /AFRIKA/4TH INDUSTRIAL REVOLUTION

16th DEFSA CONFERENCE
5 - 7 OCTOBER 2021

CONFERENCE PROCEEDINGS

Hosted virtually by
University of Johannesburg &
Inscape Education Group

Editors

Prof Desiree Smal
Mr Herman Botes
Dr Safia Salaam

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DEFSA 16th Conference Proceedings

DEFSA contact details

Mr Herman Botes
DEFSA President (2019 –, 2021)
botesh@tut.ac.za

Prof Desiree Smal
DEFSA President-elect (2019–2021)
dsmal@uj.ac.za

Introduction

Conference overview and publication of proceedings

The 16th DEFSA Conference was hosted by the University of Johannesburg and Inscape Education Group from 5 to 7 October 2021. The conference was the first virtual conference hosted by DEFSA. The theme of the conference: DE+AFRIKA+4IR+: DESIGN EDUCATION/ AFRIKA/4TH INDUSTRIAL REVOLUTION, challenged design academics to self-reflection and explore forward-thinking approaches by addressing the past, present, and future of design education while considering the fourth industrial revolution in the context of Afrikan scholarship.

The initial call for abstracts was published on the DEFSA website and circulated to member institutions, resulting in the submission of 55 abstracts. The editors accepted 45 abstracts for full papers, nine for short papers, and one was rejected. The final 36 full papers were received for a second review. Over the two days of the conference, the 36 papers were presented, representing 11 public and private higher education institutions that offer design education in South Africa and Kenya. As this was the first digital conference, registration for the conference was free for DEFSA members. Over the two days of the conference, an average of 75 attendees were in the digital room. Additional to the proceedings, an online welcoming event was held on the evening before the start of the conference, and a live interview with a few key DEFSA members enabled reflection on the rich history of DEFSA. The interviews highlighted the importance of DEFSA and future visions for the organisation.

All abstracts and full papers for the conference and subsequent publication were selected using a double-blind peer-review process that ensured that both authors and reviewers remained anonymous during the process. The double-blind peer review of the full paper was completed prior to the conference by a group of academics drawn from nine institutions, representing the disciplines of architecture, communication design, education, fashion design, fine art, graphic design, jewellery design, interior design, photography, and visual studies. A list of the peer reviewers is included in the conference proceedings. Authors received feedback in the form of peer review reports. The improvements and corrections to the papers could be implemented before the conference and were necessary for acceptance in the conference proceedings. Authors were asked to reflect and report on the reviewers' comments by highlighting their changes in response to the report. Ultimately, 34 papers are published here in the *16th DEFSA Conference Proceedings*.

Foreword by editors

The conference theme was decided by the DEFSA Management Committee in 2020. At the end of a very challenging year in design education due to the COVID-19 pandemic, the need to reflect on the impact of isolation and teaching in a digital space led naturally to the need to consider the future of design education in relation to the fourth industrial revolution (4IR). Therefore, the call for papers allowed researchers to explore the unique context of design education in Afrika. At past DEFSA conferences, design educators would reflect the conference theme through their context, lived experience, and specific design discipline. The 16th DEFSA Conference allowed for self-reflection and encouraged forward thinking to address the past, present, and future of design education while considering the fourth industrial revolution in the context of Afrikan scholarship. The title of the conference was specifically chosen to further the focus on local contexts and reflect on the envisioned future of design education.

This year, the call for papers deliberately did not specify focus areas and rather allowed the discussion in the papers to inform the focus areas of the conference. Three themes emanated from the papers received, namely *design teaching strategies*, *design-discipline-specific teaching*, and *design education and 4IR.* The themes determined the nine sessions of the conference, each with a specific focus. All the presentations were pre-recorded, and the session was led by a moderator who introduced the session's papers and authors. Sessions were concluded with engaging discussions with all the authors in the virtual room.

Due to the high number of discipline-specific focused papers received, a third of the sessions focused on design-discipline-specific teaching in the jewellery design, interior design, and fashion design disciplines.

The remaining sessions spoke to broader design-education-related issues and focused on specific themes:

- Complexities in an Afrikan context
- Disrupted spaces and the Afrikan [online] university
- Digital pedagogies, ethics and design, 4IR for design education
- Thinking through 4IR – reflections on teaching in the digital space
- Physical spaces for 4IR functioning
- The human side of 4IR – shaping design education for the future.

Complexities of an Afrikan context considered the impact of transdisciplinary and/or multi-disciplinary educational approaches have on developing critical and creative thinking competencies while considering ways of improving the ethical quality of projects, unequal access, and the lack of student social presence. *Disrupted spaces and the Afrikan [online] university* considered the perceived change in employment opportunities. *Digital pedagogies, ethics and design, 4IR for design education* considered how to prepare design students for the world of 4IR and the types of skills required in production processes, theory, epistemological curiosity, intellectual tools, authorship, commodification, representation, and distribution. *Thinking through 4IR – reflections on teaching in the digital space* addressed emerging 4IR systems. *Physical spaces for 4IR functioning* acknowledged the capacity of 4IR to negatively and positively disrupt. *The human side of 4IR – shaping design education for the future* highlights the resultant urgent need to ensure that systems are integrated into the human world in a way that enhances the human condition through human-centred design (HCD), ensuring sustaining the planet.

Sustainability requires a recasting of the traditional role of design. One of the main concerns of the fourth industrial revolution is the effect of the revolution on gender equality. Speculative design and Afrofuturism afforded a deepened understanding of gender equality and centrally positioning Afro-diasporic speculative design (ASD) episteme in South African higher education design.

A reflection on design pedagogy and teaching in digital spaces remained the central theme of the conference. Educators reflected on how they were challenged to align with shifting conditions and had to re-think traditional strategies of teaching design. 4IR is characterised by rapid automation and high demand for technological, social, and emotional and higher cognitive skills. 4IR requires that design thinking positions human and societal needs at the centre of crucial and critical technological innovation. Collaboration, interdisciplinarity, and multidisciplinary were forefronted as important strategies.

Keynote speaker

Saki Mafundikwa is the founder and director of the Zimbabwe Institute of Vigital Arts (ZIVA).* Mafundikwa is a well-known African scholar specialising in visual communication and design education. He is an author, filmmaker, and farmer in Zimbabwe who dedicates his life to sharing Zimbabwean culture through design, film, and education. As Mafundikwa states: “Afrika has to find Afrikan solutions to her problems, otherwise we will always be colonised by others,” Mafundikwa is a TED speaker and is invited to lecture at well-known design schools worldwide. He is best known for his work in Afrikan typography, emanating from his graduate studies. His expertise in the written traditions of the many Afrikan alphabets and their symbolic representation resulted in his comprehensive review of African writing systems.

* ‘Vigital’ is the teaching of visual arts using digital tools

Peer reviewers

The 2021 DEFSA conference peer review group have more than 700 years of combined experience in higher education. The peer-review process for the 16th DEFSA Conference and the publication of the conference proceedings followed two phases. In the first phase, abstracts were submitted and peer reviewed in a rigorous double-blind peer-review process. Then, the peer reviews and reports were verified by the peer review committee. Based on the outcomes, approved abstracts were accepted into the conference, and authors received feedback. In the second phase, full papers were submitted by authors and again went through a double-blind peer-review process before the conference. Reviewers received a review guideline and review reports were completed online to a secure location on the DEFSA website. The papers selected and approved through this process were presented at the conference are then published here in this conference proceedings.

The double-blind peer-review process ensures that two people review each abstract and paper and that authors and reviewers who are experts in their fields remain anonymous.

Surname	Name	Ti	Ab	Fu	Qualification	Institution	
Balkanska	Alexandra	Ms	X		MSc Sustainable Product Design	Interior Design, Greenside Design Centre	Lecturer
Barnard	Michelle	Mrs	X	X	MTech Photography MA Higher Education Studies	Department Design and Studio Art, Central University of Technology	Acting Head of Department
Bolton	Martin		X	X	MTech Industrial Design	Department of Industrial Design, FADA, University of Johannesburg	Lecturer
Cadle	Bruce	Prof	X		MTech Graphic Design	Department of Visual Arts,	Design Research and Postgraduate

						Nelson Mandela University	Studies Coordinator
Carsten	Lizette	Ms	X	X	MA Information Design	The IIE Vega, Faculty of Humanities and Social Sciences	National Programme Manager, Digital Design, Game Design and Development
Cullinan Cook	Shashi	Dr		X	PhD Education	Department of Jewellery Design, FADA, University of Johannesburg	Lecturer
De Klerk	Anneke	Dr	X	X	PhD Visual Arts	Department of Visual Arts, Vaal University of Technology	Senior Lecturer
De Lange	Rudi	Prof		x	PhD (Didactics)	Department of Visual Communication, Tshwane University of Technology	Associate Professor: Visual Communication
Deminey	Marisca	Ms	X	X	MT Interior Design	Department of Interior Design, FADA, University of Johannesburg	Lecturer
Di Ruvo	Monica	Ms	X	X	MA Interior Design	Applied Design, Cape Peninsula University of Technology	Head of Department
Economou	Inge	Ms	X	X	MTech Graphic Design	Faculty of Digital Design and Technology, Inscape Education Group	Dean
Erasmus	Suzanne	Mrs	X	X	MTech Fine and Studio Arts	Greenside Design Centre	Lecturer
Giloi	Sue	Dr	X	X	PhD Education	Inscape Education Group, Academic	Chief Academic Officer
Fenn	Terence	Mr	X	X	MARTDESED, MPhill (IT)	Department of Multimedia Design, FADA, University of Johannesburg	Senior Lecturer
Fisher	Steffen	Mr	X	X	MTech Arch Prof	Interior Design, Greenside Design Centre	Lecturer
Haese	Adrie	Dr	X	X	PhD Visual Arts	Department of Graphic Design,	Senior Lecturer

						FADA, University of Johannesburg	
Harvey	Neshane	Prof	X	X	PhD Education (Fashion Design Education)	Department of Fashion Design, FADA, University of Johannesburg	Head of Department
Hendricks	Marina	Ms	X	X	Master in Architecture (March)	Interior Design, Greenside Design Centre	Head of Department
Jordaan	June	Dr	X	X	PhD Architecture	Cape Peninsula University of Technology	Lecturer
Kempen	Elizabeth	Prof		X	PhD Philosophy	Department of Life and Consumer Science, University of South Africa	Lecturer and researcher (full professor)
Maharajh	Reshma	Ms	X	X	MA (Fine Arts)	Department of Visual Art & Design, Faculty of Human Science, Vaal University of Technology	Lecturer: Graphic Design
Martins	Esther	Ms	X	X	Master in Interior Architecture (Prof)	Built Environment Faculty, Inscape Education Group	Lecturer
Meyer	Armand		X	X	Masters in Interior Architecture (Prof)	Interior Design, IIE Vega	Lecturer
Munro	Allan	Prof		X	PhD in Theatre	Retired	Researcher
Myers	Hadassah			X	MA Digital Arts (interactive Media)	Department of Multimedia, FADA, University of Johannesburg	Lecturer
Nel	Lisa	Ms	X	X	MTech Design	Faculty of Humanities, Department of Design and Studio Art	Programme coordinator, Lecturer
Newman	Dave		X	X	MTech Fine Arts	TUT	Programme Leader, Jewellery Design
Potter	Mary-Anne	Dr	X	X	D Litt et Phill (English)	Postgraduate Studies, Inscape Education Group Faculty of Commerce, Law and Management	Lecturer

						(T&L Centre), Wits	
Salaam	Safia	Dr	X	X	PhD Education	Design Academy of Fashion, Fashion Department	Academic Head
Stolz-Urban	Carin	Dr		X	PhD	Inscape Education Group	Quality Assurance Manager
Strydom	Mareitte	Dr		X	PhD Apparel Product Development, Entrepreneurship	UNISA	Senior Lecturer
Van Zyl	Izak	Prof	X	X	PhD Communication Science	Faculty of Informatics and Design, Cape Peninsula University of Technology	Associate Professor of Transdisciplinary Studies
Van Zyl	Ria	Dr	X	X	PhD Management in Technology and Innovation	IIE Vega	Academic Manager, Lecturer

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SESSION 1: Complexities in an Afrikan context

DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Dismantling boundaries: Does a transdisciplinary and multi-disciplinary tertiary education approach support the development of creative and critical thinking for an Afrikan design and business context?

Heather Goode, *Inscape Education Group*
Mary-Anne Potter, *Inscape Education Group*

Abstract

In this paper, we examine the impact that transdisciplinary and/or multi-disciplinary educational approaches have in developing critical and creative thinking competencies in a bachelor's degree context. Strategies relating to integrated assessments within research-based modules are used to explore how transcending disciplinary boundaries in different fields are approached – one a business qualification and the other a creative/design-based qualification. This is also particularly significant in terms of an emerging call to contextualise curricula for Afrika, including adopting more decolonised transdisciplinary research approaches. Focus will fall on the educator rather than the student experience in this regard, as educators not only design and assess these modules, but are being called on to facilitate student experiences on new and innovative teaching platforms. In particular, we hone in on how the convergence of developing critical and creative thinking competencies through integrated assessment strategies prepares students for the contexts of the fourth, and emerging fifth, industrial revolutions and how these, in turn, require real-world approaches to various problem-solving contexts. Through this, we seek to determine how liberating students from disciplinary boundaries, as envisaged by a transdisciplinary and/or multi-disciplinary approach, enables a focus on the application of knowledge and competencies with greater impact.

Semi-structured interviews with educators from two private higher education institutes are used, triangulated by a review of module outcomes and curriculum documents related to specific research-based modules, in order to explore the constructed and enacted theory of educators. This paper further explores whether professional development is needed to better equip educators with the necessary tools to align their knowledge and competencies to transdisciplinary strategies that would enable a more confident integration within virtual platforms.

Keywords: Creative thinking, critical thinking, fourth industrial revolution, transdisciplinarity, multi-disciplinary

Introduction

Marshall (2014, p. 104) asks the question "If our goal is to make education more dynamic, integrated, and meaningful for students, what models should we follow? What qualities should we embrace?" In higher education in South Africa, there is no doubt that the Afrikanisation of curriculum and more contextually sensitive approaches to empowering and enabling our students must be part of what we embrace. For example, the Report on the Second National Higher Education Transformation Summit (DHET, 2016) affirms that higher education in South Africa has "played a fundamental and critical role in giving expression to the rights and values in the South African Constitution and Bill of Rights". At this event, the then Deputy President, Cyril Ramaphosa, emphasised that quality higher education was essential for economic development, social development, cohesion, and a requirement for transformation (DHET, 2016). Minister of Higher Education and Training, Blade Nzimande, picked up on this theme and emphasised the role of higher education in promoting and protecting multi-culturalism (DHET, 2016). Further policy expressed in the NDP 2030 (The Presidency, 2011), and the National Framework for Enhancing Academics as University Teachers (DHET, 2018) affirms this and reminds us that "[e]ffective undergraduate and postgraduate student learning requires a scholarly and professional approach to teaching".

This paper is approached in light of this context and mandate, in examining the impact that transdisciplinary and/or multi-disciplinary educational approaches have had in developing critical and creative thinking competencies in a bachelor's degree context. Within qualifications focused on fields with associated professional practices, students are required to demonstrate integrated knowledge and problem solving to reflect on and address complex problems critically, and to apply evidence-based solutions and theory-driven arguments (SAQA, 2012). Third-year research-based modules are benchmarked against these exit-level outcomes, often as alternatives to work-integrated learning modules.[1] Strategies relating to integrated assessments within research-based modules are used to explore how transcending disciplinary boundaries in different fields are approached within both a business qualification and creative/design-based qualification. This study is also particularly significant in terms of an emerging call to contextualise curricula for Afrika, including adopting more decolonised transdisciplinary research approaches. Focus falls on the educator rather than the student experience in this regard. Educators not only design and assess these modules but are also being called on to facilitate student experiences on new and innovative teaching platforms and take responsibility for further professional development – more so now with the need to operate within virtual learning environments.

We consider how the educator's ability to liberate students from disciplinary boundaries through the requirements of the research modules that draw on a predominantly transdisciplinary approach, enables a greater scope of knowledge and competency application. Key to this is understanding how the convergence of developing critical and creative thinking competencies through integrated assessment strategies prepares students for the contexts of the fourth, and emerging fifth, industrial revolutions[2] (here referred to as 4IR and 5IR respectively), and how these, in turn, require real-world approaches to various problem-solving contexts.

4IR and Afrika

The 4IR,[3] as building towards the 5IR, provides the contextual backdrop of our study. Though regarded as universal phenomena with global impact, in considering the two private higher education institution (PHEI) contexts, the scope of consideration of the impact of 4IR and 5IR is limited to their emergence within Afrika. While the 4IR has seen the intensification of smart technology, greater automation, and increased connectivity (Schwab, 2016), in countries like South Africa, there is

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[1] Ethical clearance was received from both Institutions to evaluate courseware material, related policy documents for reference purposes, and to interview the relevant educators with informed consent.

[2] Agreed definitions and characteristics of the 5IR are still emerging in literature as new trends evolve and research is initiated. Therefore this is not prescribed or addressed and is not the focus of this paper.

[3] Schwab (2016) defines 4IR as a way of describing, "the blurring of boundaries between the physical, digital, and biological worlds" and "a fusion of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, genetic engineering, quantum computing, and other technologies".

inconsistency in how these aspects are both available and appropriated. There are those who are able to fully access the growing digitisation and those who cannot access this due to more rural locations. In addition, there are areas that are leapfrogging parts of the Third Industrial Revolution, such as fixed networks, to use benefits available from satellite and other connectivity developments through both the 4IR and the 5IR. Interestingly, discussions regarding the 5IR focus more on the human-technology interface, the impact of the growing digitisation on humanity and how we, as Africans, can harness the impact of technology for humanity. These discussions range from sustainability to digital addiction to the impact of the pandemic for remote work, globalised work competition and the calls for a 'new normal' and greater wellness. This bodes well for educational contexts as being more human-oriented, in terms of application, but more versatile in terms of modes of connectivity.

In addition, the reactions to the 4IR and the COVID-19 pandemic (and the resulting impacts) seem to align well with Afrikan values, such as more humane approaches to work and community, and Ubuntu philosophies where the awareness that we are in community (i.e. social accountability) and what we do affects one another has been amplified during the pandemic. Assié-Lumumba (2017) refers to Goduka (2000) in describing Ubuntu as a worldview that embraces "oneness of humanity, a collectivity, community, and set of cultural practices and spiritual values that seek respect and dignity for all humanity". In coupling this with the Report on the Second National Higher Education Transformation Summit and the call for transformation within higher education associated with decolonising curricula, the 4IR offers opportunities to establish connectivity and collectivity in being, as Hughes (2021) describes, "more inclusive, and more interculturally responsive". There is, therefore, an opportunity to shape and align the emerging 5IR in the Afrikan context as more aligned to Afrikan values.

Curricula are typically focused on as points of investigation into how to transform the higher education landscape. The capacity of the educator as motivating the student to critically and creatively engage – not only with the work of their discipline, but to direct this towards the greater needs of community through collaboration – should not be underestimated.

Disciplinarity, multi-disciplinarity, and transdisciplinarity

In having contextualised our study within the context of the 4IR and Afrika, we must also consider how best to define disciplinary approaches that are typically enacted within PHEI contexts. For our purposes here, three approaches will be identified and defined in relation to the curricula that are enacted through them: a discipline-based curriculum approach; a multi-disciplinary approach; and a transdisciplinary approach. Though there are a variety of definitions and interpretations of, in particular, what transdisciplinarity is – proposed by the likes of Nicolescu (1997; 2010) and Leavy (2011) – the definitions provided by UNESCO (2021) provide the most suitable platform for understanding the distinction between these approaches.

A discipline-based curriculum approach, according to UNESCO (2021), may be defined as follows:

> *The term 'discipline-based or 'subject-based covers the full range of distinct subjects or fields of study… The instructional emphasis of discipline-based curriculum tends to be on specific, current, and factual information and skills as it emerges from the discipline experts.*

This is the most typical way in which higher education engages students in their qualification studies and around which faculties, departments and schools are organised.

A multi-disciplinary approach is regarded as "an approach to curriculum integration which focuses primarily on the different disciplines and the diverse perspectives they bring to illustrate a topic, theme, or issue. A multi-disciplinary curriculum is one in which the same topic is studied from the viewpoint of more than one discipline" (UNESCO, 2021). Perspective, rather than collective action, drives this approach.

UNESCO (2021) defines a transdisciplinary approach "to curriculum integration which dissolves the boundaries between the conventional disciplines and organises teaching and learning around the construction of meaning in the context of real-world problems or themes". The value of the transdisciplinary approach lies in its ability to transcend traditional disciplinary boundaries for a common cause and so demonstrates a stronger capacity to generate connectivity and collectivity through fostering a collaborative environment. Many scholars, including Nicolescu (1997; 2010) and Leavy (2011) advocates for the value of adopting a transdisciplinary approach. Nicolescu, further notes that "transdisciplinarity is nourished by disciplinary research" and that "disciplinary research is clarified by transdisciplinary knowledge in a new, fertile way" (2018, pp. 74). So, transdisciplinarity positions itself as amplifying existing knowledge-building potential because it invites participation holistically and inclusively. Nicolescu identifies two types of education amplified through transdisciplinarity: 'learning to know' and 'learning to do' (2018, pp. 75–76).

Nicolescu (2018, pp. 75) describes 'learning to know' as being able to distinguish "what is real from what is illusory, and to have intelligent access to the fabulous knowledge of our age", which aligns with the development of critical thinking competencies in students as aspired to by HEI's (Goode, 2020). In this context, we align with UNESCO (2020) defines critical thinking as a process involving:

> *[A]sking appropriate questions, gathering and creatively sorting through relevant information, relating new information to existing knowledge, re-examining beliefs and assumptions, reasoning logically, and drawing reliable and trustworthy conclusions.*

In addition, when weighing up knowledge-building against transdisciplinarity, Nicolescu equates this to "establishing bridges – between the different disciplines, and between these disciplines and meanings and our interior capacities" that will result in the "emergence of continually connected brings" who are able to adapt themselves to the changing exigencies of professional life" (2018, pp. 75–76).

In 'learning to do', Nicolescu (2018, pp. 76) proposes that specialisation within the current context is problematic and that we should rather acquire a "flexible, interior core" with the capacity to access key competencies. He goes on to promote 'learning to do' as "an apprenticeship in creativity" that "signifies discovering novelty, creating, bringing to light our creative potentialities" (2018, pp. 76). This aligns well with the development of creative thinking competencies in driving towards innovation: where organisations like UNESCO (2020), comment that "[t]raditionally creativity has been seen as an ability to respond adaptively to the needs for new approaches and new products". Creative thinking is thus frequently defined as "the ability to bring something new into existence purposefully" (UNESCO, 2020) and is applied in this way at both PHEIs. Transdisciplinary approaches also require collaboration or inclusion of community participation, and so non-academic or non-professionally aligned stakeholders are encouraged to participate in problem solving.

Within institutions that identify as either transdisciplinary or multi-disciplinary, how educators enact the dismantling of disciplinary boundaries in their teaching and learning practice is, therefore, worth considering as an act of Ubuntu. Another aspect worth considering is how presenting the Ubuntu values of Afrika drive the imperative to activate multi-disciplinary and/or transdisciplinary communities within the context of the 4IR, in the global sense, and the two PHEIs, in a narrower sense. For transdisciplinarity, this is certainly affirmed by Veldhuizen (2012, p. 53), who posits the value of transdisciplinary collaboration in terms of its alignment to "the nature of knowledge, notions of causality and 'inference', as well as processes of knowledge creation in Africa". Veldhuizen (2021, pp. 53) also determines that new knowledge is collectively and holistically created and disseminated as an act of Ubuntu.

Research question and aim

For the purposes of our research, here in focusing on the narrower context of two South African PHEIs, the following research question emerged as driving the primary research undertaken:

> *Does the application of transdisciplinary or multi-disciplinary approaches in higher education enable the development of critical and creative thinking competencies and the contextualisation of curricula for Afrika in a bachelor's degree-research context?*

The aim was to explore a bachelor's degree research-module context and the impact of educator practices fostering student learning of research practices. The applicable degrees assume a professional context where fixed disciplinary boundaries may obstruct problem solving and understanding of the respective fields. These two qualifications – one within a business field and the other across various design fields – draw on an integrated assessment approach. These integrated assessments are normally required within a research-type module and the respective institutions affirmed transdisciplinary or multi-disciplinary curriculum approaches respectively. In affirming a transdisciplinary or multi-disciplinary approach, the core curiosity point was how these approaches were affirmed from the educator's perspective and through their enacted teaching and learning practice.

In response to the literature reviewed and the research question above, this research, therefore, took a qualitative approach, using semi-structured interviews with relevant educators from the two PHEI. These interviews were triangulated through a review of module outcomes and curriculum documents related to specific research-based modules in order to explore both the constructed and enacted theory of educators. As explored by Goode (2020), educators construct their theory and practices in relation to their professional experience, qualifications, and professional development, as well as to the requirements of the modules. This study further hopes to encourage teaching and curricula reflection in anticipation of new and innovative approaches required within these third-year research modules. This is because the context through which research is enacted is shifting, and new research methodologies are constantly emerging.

Institutional contexts and population

Both PHEIs draw on practice-based or practical workplace preparations for employability and specialisation purposes. This means that modules within the respective bachelor degrees include discipline-based modules and practice-based modules, as well as modules that transcend disciplinary norms and apply a transdisciplinary or multi-disciplinary approach.

The institutions concerned have been anonymised by the dominant field of study offered, i.e. a design education institution (D1) and a Business Management Institution (B1). The design education institution (D1) identifies as multi-disciplinary and offers a range of qualifications from higher certificates, diplomas, degrees, advanced diplomas, and honours programmes. The module names are anonymised to sustain the ethics of confidentiality and impartiality. The Business Management Institution (B1) identifies as transdisciplinary and offers qualifications at all higher education levels, from higher certificate, bachelors, and PGDip to master's and doctoral programmes with a transdisciplinary business management focus. These PHEIs, like their public counterparts, seek to offer education that is relevant and applicable within the Afrikan contexts. Both institutions implicitly and explicitly incorporate key aspects of the 4IR, such as the technology of things, and the B1 already surveys the emergence of trends beyond the 4IR.

This research sought to engage in semi-structured interviews with at least three educators directly involved in the teaching of these research-based modules per institution, though only two educators agreed to participate from D1. As these roles are fulfilled by qualified educators and appointed by the PHEIs, participant selection was thus purposive within the constraints of ethical clearance, permission from the relevant institutions and informed consent from the respective participants. In addition, to reveal the constructed theory of these educators, the related course module outcomes and curriculum documents were reviewed to explore whether the inclusion of transdisciplinarity, creativity, and critical thinking are integral and how these are assessed.

The participants were interviewed through online platforms and recorded audio-visually, transcribed, and then analysed thematically in the form of words. Prior to the interviews, participants were approached to obtain informed consent. At the onset of the interview, the interviewer confirmed consent and responded to any queries before the interview commenced. Responses were compared across participants and institutions. The respective institutions and research participants were anonymised through the use of pseudonyms. Data that identifies participants is stored confidentially using passwords before anonymisation.

The demographic profile of participants (anonymised) is summarised as follows:

Table 1: Demographic profile of participants

Pseudonym	Educational background	Professional specialisation	Lecturing experience (in HE) in years	Lecturing experience related to Research module	Highest qualification	Publication history
Institution: Design D1						
Amanda, female	Commerce	Marketing Management	Five years	Four years	Master’s	Dissertation, non-academic
Sarah, female		Graphic Design (specialising in Illustration)	Six years,	Four years	Master’s	Dissertation
Institution: Business B1						
Mike, male	Commerce	Business Management,	Six years, prior history of guest lecturing and corporate speaking, consulting	Six years	MBA, Busy with PhD	Articles, Dissertation, non-academic, Course material and resources
Paul, male	Commerce	Business Management with specialisations in Organisational Development, People Development, Change management	20+ years, consulting	Six years	PhD, MBA, BCom (Hons), BCom;	Dissertation, non-academic, Course material and resources
Sam, female	Humanities	Corporate communication		3 years	BA, BA Hons, PGDip Business Management, Busy with Master’s	Non-academic

					degree in Business	

Aligning the bachelor's research modules to SAQA level descriptors

As stated above, this research aimed to examine two PHEI's transdisciplinary educational approaches in a bachelor's degree context and their impact in developing creative and critical thinking competencies. These draw on the use of an integrated assessment in two differing qualifications: one a business management qualification and the other a design-based qualification. These integrated assessments are normally required within a research type module. Preparing students for the contexts of the 4IR and emerging 5IR requires real-world approaches to context exploration and problem solving. Liberating students from disciplinary boundaries as envisaged by a transdisciplinary approach enables a focus on the application of knowledge and competencies. One of the PHEIs has a clearly articulated commitment to transdisciplinary approaches, while the other assumes an implicit multi-disciplinary approach as required in design educational approaches. These modules are offered in the context of the SAQA NQF level descriptors at level 7 in the third year. At this level, the scope of knowledge requires that students demonstrate integrated knowledge of the central areas of their fields, disciplines, or practices, including an understanding of and the ability to apply and evaluate the body of knowledge relevant to the field of studies and the larger disciplinary or field contexts (SAQA, 2014). Both PHEI approaches emphasise the imperative of ensuring real-world problem solving and application of knowledge in the national context.

Both PHEI research modules are offered as integrated assessments (SAQA, 2014, p. 16), where students' conceptual understanding of their field of study is evaluated through the approach they take in applying it practically within this research project. Students are expected to research a current challenge, innovate, and/or conceptualise solutions for a real context. Recommendations or insights are presented through their research. These modules are, therefore, aimed at assessing applied competence.

The current regulatory context of higher education in South Africa supports disciplinary boundaries and policies such as CESM (DOE 2008; DHET 2018b), which make the registration and accreditation of transdisciplinary approaches challenging. While policy like the earlier Education White Paper 3: A Programme for Higher Education Transformation (DOE 1997) identify transdisciplinary, which can be upheld in SAQA level descriptors (2014), the orientation of bachelor qualifications remains towards applicability within a career, field or discipline using the CESM disciplinary categories.

The module offered at D1 explicitly includes creativity and critical thinking in the assessment criteria, however, the outcomes imply a greater emphasis on critical thinking through "well-formed arguments" (2021). Creativity, indicated as one of the thematic criteria for evaluation, is only implied through design decisions, communication, and the context of the field of study. Stronger critical thinking-based descriptors are indicated under the theme of creativity, which makes an alignment to the distinction between creativity and criticality more problematic. Based on the wording of key outcomes and assessment criteria, despite creativity being a key criterion, there is a stronger emphasis on honing critical thinking skills and prioritising these in key tasks. However, this does seem to be aligned to the research focus of the module in complementing the more creatively aligned modules in concept development.

The module at B1 includes components of critical thinking (Goode, 2020) such as 'define', 'analysis', 'judgment', 'predictions', but refers explicitly to creative thinking, not critical thinking. However, the assessments focus more on critical thinking and the application of theory.

The material at D1 has not recently been updated, while B1 has recently re-curriculated and re-accredited their BCom in the past three years and is in the process of rolling out updated material courseware set to the third-year students. In the curriculum process, feedback is being solicited from educators on the first offerings to third-year students for refinement.

Summary of findings

Though several key thematic points of interest emerged during the analysis of the interviews, below are the three most significant findings concerning the research question posed:

Descriptions of professional practice

When asked "How do you describe your professional specialisation or expertise?", the educators from B1 referred to non-academic descriptions, which overlap between professional competence and academic work. For example, Mike describes his consulting and academic work as follows:

> *[M]y business is about challenging thinking and that's the consulting business, and that's my competitive advantage. I suppose I go in as someone who doesn't know your process, but I certainly know that you can think about your process differently, and my job is to help you do that.*

In contrast, Paul referred extensively to facilitation displacing lecturing and andragogy in his discussion, and Sam described that her corporate work and experience informs her lecturing by keeping her in touch with her field of expertise. It became evident that the educators from B1 not only align to the B1 brand but also have developed a unique branding for their teaching pedagogy as derived from their corporate experience. This was not noted in either of the research educators for D1 who position their teaching pedagogy squarely within the PHEI brand with no alignment to their own 'brand'.

Within the context of D1, both Amanda and Sarah derived their academic expertise and experience in relation to their professional qualifications and grounded their knowledge-confidence in this. Both educators indicated that their teaching experience has required that they diversify in accessing and developing other core competencies that deviated from their initial academic specialisation. In this sense, both position themselves as design educators and appear to draw on multiple disciplines instead of integrating and going beyond disciplinary contexts. Thus, they align more strongly with the multi-disciplinary focus of the institution.

The approach to identifying professional expertise as educators is not grounded within a specific context of application, but rather in relation to their own competency development and agility in incorporating new skills. No specific Afrika-centred context is given for this and most educators interviewed tend to regard their professional expertise and the development thereof within a global context.

Multi and transdisciplinarity as fostering holistic development

The responses to the consideration of how the holistic development of third-year students is enacted produced various insights. For the less experienced educators within the research modules, there was a stronger focus on working within a prescribed framework that sets clear boundaries. Within the context of D1, the boundaries enacted were restricted in terms of directing students towards conceptualisation within a specialised design field. Both Amanda and Sarah noted this, though Amanda indicated that the reason was that students were more likely to want to extend beyond their respective design specialisations in trying to impact a greater scope of change than they are necessarily capable of. Sarah also elaborated that the possible reason for the more fixed scope of application of research was because of students' lack of research capacity at the third-year level. This could indicate that, within a multi-disciplinary context, the need for disciplinary boundaries emerges more in terms of regulating student learning from the perspective of the educators interviewed. In restricting what Nicolescu (2018, pp. 75–76) refers to as 'learning to know' in terms of critical engagement, 'learning to do' is also restricted in terms of a creative application being directed towards and refined within a framework of specialisation. Disciplinarity, therefore, emerges as dominating the approach advocated in the research module and responds directly to the specialised design field within which the concept is developed.

In the context of B1, Sam found it difficult to articulate what constituted the holistic development of students but did note that being able to apply learning is critical. However, she also noted that this competency in translating research into application required a specific type of student to value the research journey. The two more experienced educators at B1, Mike and Paul, were more confident in extending what defined the holistic development of students. Although both referenced the ability to apply what has been learned, as was indicated by Sam for B1 and Sarah for D1, Paul specifically noted that holistic development should also be measured against the students' ability to be agile in applying their learning. Paul's observation aligns well with Nicolescu's understanding of transdisciplinarity in relation to both 'learning to know' as grounded in criticality and 'learning to do' as grounded in creativity (2018, pp. 75–76). Agility is prioritised and, therefore, affirms the value of transdisciplinarity within B1. Paul's competence and confidence as an educator, therefore, enables him to align the research-based curriculum more meaningfully to the institutional values. Mike, as an equally experienced educator, was able to do the same but extended the value of applying learning to greater community responsibility and engagement: another characteristic of transdisciplinarity that promotes the inclusion and participation of community stakeholders. Mike, therefore, actively aligns his teaching pedagogy to the institutional values of B1, but further honours the spirit of Ubuntu in extending the application of learning with a wider context.

Lack of distinction between multi and transdisciplinarity

While there is a lack of clear distinction between multi- and transdisciplinarity definitions by the educators interviewed, all describe approaches that are clearly more non-disciplinary in emphasising a problem-based approach and tend to support students as they evolve towards a transdisciplinary approach. This is more clearly seen in D1 where vocational fields and specialisations are used to describe curriculum streams more than disciplinary boundaries for modules and subjects. Educators link these approaches to volatile and dynamic contexts of the 4IR, which require constant evolution of content applicability. The 4IR context seems to account for the more broad assessment criteria being applied to these modules in order to remain flexible in anticipation of this quickly evolving context and the diversity of research topics explored by students.

Research by authors like Brodin (2018) has shown that different teaching strategies and interdisciplinary were pointed out as factors that enhance creativity. On the other hand, the participants described the perceived benefits of a multi- or transdisciplinary approach as enhancing the application of both creative and critical thinking to enable students to think "outside the box": more specifically beyond disciplinary boundaries. Educators at B1 reported that students considered impacts of recommendations beyond their department or role. For D1, Sarah particularly noted that the critical thinking required in engaging in design research has a creative conceptual goal, as knowledge is used to influence and justify key design choices made.

Building on this, all participants strongly felt that both multi and transdisciplinary research approaches are associated with systems thinking. This affirms the holistic development of students and the contextual awareness of the research undertaken. This finding has not been well documented in the literature, other than authors like Marshall (2014; 2016), who align a transdisciplinary approach with systems thinking. The emphasis on systems thinking is intriguing, as this is aligned to the SAQA CCFOs (pre-2009) and later level descriptors (SAQA, 2014) but seldom seems prioritised or articulated as clearly in undergraduate degrees.

The B1 institution has realised that there are varying definitions and understandings of transdisciplinary approaches to knowledge creation and has been clarifying descriptions of transdisciplinary and related core constructs in the process of updating policies and educator professional development documents (for example, the Teaching and Learning policy, [Private Institution B1], 2021). This needs to be further implemented in the learning material, which is starting a revision cycle.

The D1 institution, though identifying as multi-disciplinary, has not explicitly entrenched core definitions and understandings of this within the curriculum documents reviewed in relation to the third-year research modules. This can be read as needing to direct students according to their design specialisation in order to focus on solution building within this framework. However, in aligning student learning with institutional values to better position students as advocates for multi-disciplinarity, more explicit indications of this would be needed.

Conclusion and recommendations

From the responses in the interviews, the lack of explicit direction on critical and creative thinking, and clear definitions of multi or transdisciplinary research approaches, has resulted in the educators describing filling in the gaps through their own experience and theory and enacting this through their practices. This results in non-disciplinary approaches rather than multi-disciplinary where educators seek to explicitly overcome disciplinary boundaries and draw on more than one discipline’s theory and insights. However, they advocate for problem-centred approaches to research to inform methodology as opposed to clear multi- or transdisciplinary approaches. The context informs the research more than the research designs of multi or transdisciplinary approaches. This is a surprisingly successful way of scaffolding students to overcome disciplinary thinking, focusing on the problem and context to inform research approaches instead of disciplinary bodies of knowledge. When combined with a system-thinking approach, the contexts are well described and considered in multiple facets, however, this is inspired by transdisciplinary thinking, rather than enacting transdisciplinary approaches.

Therefore, this paper recommends professional development better equip educators with the necessary educational resources to develop clearer outcomes, aligned assessment criteria and additional strategies to align their knowledge and competencies towards transdisciplinarity that would enable a more confident integration with the 4IR Afrika context and the fields of study. This is amplified within virtual platforms, where the lack of explicit definitions of multi- or trans-disciplinary research approaches and related resources leaves space for variations in educator theory and practice across several groups.

From the material submitted, it is apparent that the core source of information for students in how to proceed in these modules are the educators and their own research activity. This seems to reflect an approach that holds space (i.e. non-prescriptive) for students to determine the nature and direction of their studies. However, the disadvantage of this is that, for inexperienced research educators, there is a lack of material and resources to anchor and align consistently across educator groups with different educators. From feedback to educators, as described during the interviews, some students relish the freedom of research permitted and others seem to prefer and request more guidance and direction. Further research can explore whether these preferences correlate to work experience, age, gender or field of study.

The more experienced educators, Mike and Paul, were able to articulate clearly what qualities of holistically developed students in cohesive ways, whereas the less experienced educators struggled to describe clearly this outcome of the research modules. This can be addressed in orientation or professional development aligned to the Institutional graduate outcomes. Respondents felt that the application of transdisciplinary or multi-disciplinary approaches supports the development of critical and creative thinking competencies in a bachelor's degree context, which was explicitly assessed in B1 assessment rubrics. These educators reflected that this research module was an effective approach to achieve the development of these competencies. D1 echoed similar sentiments, though directed more towards the practical concept-based outputs into which that research feeds.

At B1, it seems that the participatory spirit within the socially accountable transdisciplinary research approach to their research module affirms the Afrikan values expressed as community-based and Ubuntu-based approaches. The spirit of Ubuntu is also present in the focus on real-world community-based problem solving within the D1 research modules. This aligns with recommendations from Mokhele and Pinfold (2020), who similarly explore transdisciplinary approaches at CPUT to overcome "the inability of professionals to comprehensively analyse community problems" and enable students as future professionals to transcend disciplinary boundaries to analyse diverse societal problems.

In light of the above, this study recommends that professional development is needed to better equip these educators to align their knowledge and competencies to transdisciplinary or multi-disciplinary strategies. Clear definitions and research approaches need to be documented for consistency across multiple lecture groups at each institution. In addition, future studies, involving classroom observation, case studies, and psychometric measurements, are also suggested.

The mandate to evaluate the multi and transdisciplinary nature continually is emphasised by authors like Mononen (2017), who comment that:

> *In the prevailing society, creativity and innovation-related skills are becoming ever more crucial for designers. They have to be able to find and solve ill-defined problems in order to create new solutions, products and services … However, as the world grows ever more complex and problems become harder to define, designers need skills to perceive wholes and contemplate phenomena from several perspectives.*

This seems appropriate to both the design and business fields and supports the continuation of offering integrated research modules that draw on multi and transdisciplinary approaches.

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Research ethics in South African visual communication design: A principlist approach to non-anonymity

Rudi W de Lange, *Tshwane University of Technology*
Rolf J Gaede, *Durban University of Technology*

Abstract

Keeping participants anonymous is a core principle in research ethics and accepted as international best practice. In this paper, we consider ways of improving the ethical quality of visual communication research in the 'new normal' situation created by the COVID-19 pandemic. Specifically, we use an argumentative discourse approach to discuss issues and concerns surrounding anonymity from a principlist perspective. The first section provides an orientation on international best practices and core research ethics principles. The second section reflects on South African research ethics committees, their functions, and the poor fit between a health research-orientated approach and research in art and design departments. Section three discusses some examples of how research students responded to the 'new normal'. In the final section of the paper, we argue for a situation where study participants may choose their preferred level of anonymity and the researchers then honour this choice. If we treat persons as autonomous, should we not allow participants to choose to remain anonymous or not, or choose their level of anonymity? Such an approach raises the participant's autonomy and, in so doing, adds to the credibility of the research results.

Keywords: Autonomy, anonymity, design research, research ethics, visual communication research

Orientation

Earlier DEFSA ethics papers considered the status of ethics and research at academic institutions (Munro, 2011), issues of accountability (Toffa, Osman & Bennett, 2015), community participation (Chmela-Jones, 2015), intervention for design education (König & Kahn, 2015), a dual mandate for research ethics committees (Gaede, 2015), and ethics and photography (Sullivan & De Lange, 2019). This paper adds to this corpus by critically reflecting on non-anonymity as an alternative ethics norm in visual communication research.

The COVID-19 pandemic and the nationwide lockdown at the end of March 2020 affected postgraduate students' data collection processes. Face-to-face data collection was no longer possible. Postgraduate students shifted to online data collection processes in compliance with COVID-19 safety protocols. The shift towards online data collection methods has raised legitimate concerns relating to the issue of anonymity. Keeping participants anonymous is a National Health Research Ethics Council (NHREC) norm, and a standard requirement set by South African university research ethics committees. The NHREC norms and standards are, however, primarily aimed at health research. However, visual communication design concerns itself with the development and use of design artefacts and operates in a humanities and social sciences environment and not within a health sciences or health research environment. As such we endeavour to answer whether participant anonymity, primarily oriented towards health research, is always appropriate for visual communication research ethics.

The aim

The paper aims to propose a method of improving the ethical quality of visual communication research given the new normal.[1] One such method would be to acknowledge a participant's autonomy[2] by allowing the participant to choose their own level of anonymity and honouring that choice.

The method

We used an argumentative discourse approach to propose that non-anonymity is a valid and appropriate research ethics principle for visual communication research. There are four sections to this paper. The first section provides an orientation concerning international best practices and core research ethics principles. The second section reflects on South African research ethics committees, their functions, and the poor fit between a health research-orientated approach and the type of research conducted in art and design departments. Section three discusses examples of how research students responded to the new normal. Fourthly, we put forward our argument that providing participants with a choice on anonymity raises their level of autonomy and allows for non-anonymity. We conclude by proposing non-anonymity as an alternative to anonymising participants in visual communication research.

International best practice and core ethical principles

The World Conferences on Research Integrity, the European Code of Conduct for Research Integrity, and the World Medical Association are international bodies that advocate and promote universal research ethics principles.

The World Conferences on Research Integrity (WCRI) has taken the lead to develop principles to promote research integrity on a global scale. The WCRI's second world conference produced the Singapore Statement on Research Integrity. The Singapore Statement aims to promote research integrity worldwide by advocating honesty, accountability, professional courtesy, fairness, and good stewardship (WCRI, 2010). The WCRI's fifth world conference led to the adoption the Amsterdam Agenda (WCRI, 2017a). This Agenda established a registry for responsible research conduct. The registry aims to improve the quality of research by encouraging researchers to make their research aims, methods, and assessments transparent. Researchers are to preregister their projects on open platforms (WCRI, 2017b). The Hong Kong Principles for assessing researchers appeared two years after the Amsterdam Agenda (WCRI, 2019). These principles provide criteria for evaluating researchers. The Hong Kong principles strengthen research integrity, help institutions to minimise perverse incentives and curb questionable research practices (WCRI, 2019; Moher, et al., 2020).

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[1] We use the term 'new normal' to refer to the switch to online teaching and learning due to the national lockdown measures (Motala & Menon, 2020).

[2] Respect for research participants is to value a person's dignity and autonomy. Researchers must treat participants with respect and allow self-determination. See DoH (2015), item 2.1, page 15.

The European Code of Conduct for Research Integrity provides a self-regulatory framework for all disciplines (ALLEA, 2017). The Code is similar to the WCRI's statements and principles, with the addition of a comprehensive section on the violation of research integrity. In addition, ALLEA promotes the Code as a global model for research conduct.

The World Medical Association's (WMA) Declaration of Helsinki provides principles for medical research involving human subjects and is primarily aimed at physicians (WMA, 2013). Their principles on privacy and confidentiality, informed consent, research ethics committees, scientific requirements, risk-benefit ratio and vulnerable groups apply to research where human participants are involved.

The core research ethics principles advocated[3] by the WCRI, ALLEA and the WMA provide a suitable platform for visual communication research. A thread throughout these codes and statements is integrity, doing good and the protection of participants. The section below provides a brief reflection on some of the research ethics principles embedded in these universal principles and as advocated by scholars in research ethics.

Core research ethics principles

A publication that has played a seminal role in shaping international best practice over the years is the book *Principles of Biomedical Ethics* by Beauchamp and Childress (2001). In this publication, the first edition of which dates back to 1979, Beauchamp and Childress (2001) strongly argue for principlism in applied ethics. Principlism may be defined in general terms as a type of ethical reasoning which is primarily based on a framework of four universal and basic ethical principles (Beauchamp & Rauprich, 2006). The four principles elaborated on in greater detail by Beauchamp and Childress (2001) are autonomy,[4] non-maleficence, beneficence, and justice.[5] As summarised by Singh (2018), (a) the principle of autonomy primarily requires that in the course of a research project, the rights and dignity of study participants, as well as all other human persons involved, must be both respected and protected; (b) non-maleficence seeks to avoid any harm emanating from the research project, mainly to the study participants, but also to all human persons and living beings in general; (c) beneficence emphasises that research should make a positive contribution and increasing the welfare of all; and (d) the principle of justice requires that both the risks and the benefits associated with a research project should be fairly distributed among all persons involved or affected.

The strengths and limitations of principlism have been extensively debated, and several authors have supplemented the four core principles by proposing additional ones, such as the principle of compassion (Gallagher, 1999). However, a full discussion of whether the four principles should be expanded is beyond the scope of this paper. More importantly, what stands out in a discussion on how these core principles apply to the field of nursing by Jecker (1997, p. 31), is that turning towards ethical principles is especially useful in a profession where the key role players "frequently encounter situations in which they are uncertain about what action to take, or in which members of the health care team disagree about the best course of action. In such instances, identifying the underlying values at stake leads to a more thoughtful resolution of the case". In other words, returning to the core ethical principles is especially helpful in previously unknown, fluid, and rapidly changing professional settings. This is particularly relevant in the context of Southern Africa and the high levels of diversity and historical complexities that characterise it. In essence, the main strength of principlism (Beauchamp & Rauprich, 2016) lies in the fact that:

[3] The principles from WCRI, ALLEA and WMA came to the fore from 2010 onwards.

[4] See Saad's (2018) counter-argument against autonomy from a bio-medical perspective.

[5] The four principles of autonomy, non-maleficence, beneficence, and justice are sometimes collectively referred to as the 'Georgetown mantra'.

[T]he principles are universally applicable, not merely local, customary, or cultural rules. They are correlative to basic human rights and set limits to what is ethically acceptable in all societies, but they are also sensitive to particular conditions in societies and cultures that may account for legitimate differences in the ethics of medical research and practice.

South African research ethics committees use these universal core ethical principles when deciding on ethical matters. The section that follows reflects on South African research ethics committees, their functions and the poor fit between a health research-orientated approach and research in art and design departments.

South African research ethics committees

Section 72 of the National Health Act 61 of 2003 established the National Health Research Ethics Council (NHREC). The NHREC is the South African national statutory research ethics body tasked with ensuring that research is conducted ethically and responsibly. Section 73 of the Act stipulates that universities that conduct health research must establish health research ethics committees. These university research ethics committees, in turn, must register with the NHREC. Universities' research ethics committees (RECs) must independently review, approve, and monitor research that involves humans, animals, and the environment within a framework of universal research ethics guidelines. The Act requires that RECs set norms and standards, adjudicate complaints, refer violations to statutory health professional councils, institute disciplinary action, and even act in an advisory capacity to national and provincial departments on ethical research issues (South Africa, 2003). RECs must further ensure that applications for ethical review stand up to scientific and ethical scrutiny, that research projects duly promote worthy social and ethical values, that applicants are held accountable for their work and, lastly, they should assess whether researchers are suitably qualified and technically competent (DoH, 2015).

Some universities have several research ethics committees; some may be geared towards animal research and health research, while others may be concerned with social and humanities research. University research ethics committees, in turn, establish faculty-based sub-committees that would typically adjudicate low-risk research projects. Faculty research ethics committees usually report to a university ethics committee. These university ethics committees, in turn, adjudicate medium to high-risk projects. University research ethics committees "must ensure that research proposals stand up to scientific and ethical scrutiny appropriate to the disciplines concerned", "hold researchers accountable for their research activities"' and "promote important social and ethical values" (DoH, 2015, p.11).

The NHREC developed norms and standards[6] and made these norms and standards available in an informative guide published by the Department of Health (DoH). This NHREC guide (DoH, 2015), aimed at all researchers, provides detailed guidance on ethics in research, operational procedures, research ethics committees, health research ethics infrastructure, and qualitative research. The ethical principles are the same as those found in the Georgetown mantra, namely respect for persons (dignity and autonomy), beneficence and non-maleficence, and distributive justice (equality). The norms and standards, as listed and described by the NHREC are relevance and value, scientific integrity, role-player engagement, a fair selection of participants, fair balance of risks and benefits, informed consent, ongoing respect for participants (including privacy and confidentiality) and researcher competence and expertise. These norms and standards apply to "all forms of research that involve humans or use of animals" and also "health and safety issues include those that may arise in the

[6] See DoH (2015), section 2.1, pages 14 to 16.

environment of research, for example, viruses, parasites, bacteria, as well as the air, water and land" (DoH, 2015, pp. 9, 14-16).

Design concerns itself with the development and use of design artefacts and usually operates in a humanities and social sciences environment, not within a health environment. The National Health Act and the NHREC norms and standards are primarily aimed at health research and research involving humans, animals, and the environment. The NHREC, incidentally, does address this concern. Sections 1.1.6 and 1.1.7 in the NHREC guide, for example, specify that "[t]hese guidelines do not advocate the so-called 'medical model' of ethics review, especially not for social science, behavioural or humanities research" and "[t]he core ethical principles outlined in these guidelines apply to all forms of research that involve living human participants and use of animals, placing their safety, welfare and interests of both humans and animals as paramount" (DoH, 2015, p. 8).

What is clear from the above is that the core research ethical principles apply to all research that involve living human participants and the use of animals, but that research ethics committees do not necessarily have to use the 'medical model' of ethics review for visual communication research. The following section provides examples of research students' response and the poor fit of using the 'medical model' to assess such research projects.

Students' response to the new normal

The concerns relating to a poor fit between a medical model ethics approach by university research ethics committees in South Africa and the type of academic research conducted in university art and design departments were compounded by the onset of the COVID-19 pandemic. Shortly after the outbreak of COVID-19, governments worldwide announced curfews and lockdown measures and South Africa followed suit. Soon thereafter it became apparent that these developments would affect local art and design postgraduate students in two ways.

First, the lockdown and curfew measures pushed some postgraduate students' personal lives into disarray. Apart from the psychological burden caused by the lockdown, having to adjust to a reduced income, and coping with unforeseen additional responsibilities such as caring for family members, postgraduate studies were increasingly seen as a luxury that had to wait for a time of greater stability. As a result, the number of postgraduate students who applied for termination or an interruption of studies increased. Second, those students who with their projects were forced to re-evaluate their data collection approach and to take pragmatic decisions were needed. For students who were working on their proposals or literature review chapters, this usually meant following the advice of research ethics committees to insert a caveat phrase in the proposal that the envisaged data collection procedures may need to be conducted online if possible or adjusted in other ways in response to COVID-19 pandemic measures. This is not to suggest that online data collection methods are a new approach. However, with the onset of the COVID-19 pandemic, their importance moved to the foreground.

Such a caveat phrase avoided the time-consuming process of applying for an amendment each time minor adjustments had to be made to the data collection processes. In this regard, it is debatable and requires further discussion whether a shift to online data collection methods – assuming that the questions to be posed to the study participants remain unchanged – constitutes a 'minor change', as potential study participants who do not have internet access may now be excluded from the study, unless alternative arrangements can be made, and because the quality of internet access may vary significantly between participants. In contrast, students who were about to commence, or who were already busy with fieldwork when the lockdown measures were announced, were in many cases faced with a situation where (a) the lockdown meant that they no longer had access to the envisaged study participants; and (b) where access to the envisaged study participants was still possible online, there was a relatively high risk that a large number of the prospective participants would either choose not to participate or that participants would withdraw in the course of the data collection process due to personal reasons related to the COVID-19 pandemic. This could ultimately lead to a low participation rate meaning that the data collection phase of the study would have to be repeated.

Some examples of how postgraduate students had to adjust to the 'new normal' include a researcher who planned to collect data in a sample of university students using a questionnaire that contained multiple intricate visual illustrations. The implementation of the lockdown measures resulted in the closure of the university campus, which required a shift to an online data collection approach. The researcher planned to make the questionnaire available to the study participants in a digital format in one of the computer rooms on campus and collect the responses via an online form. While it was still possible in principle to proceed with the study by interacting with the study participants in an online environment, in practice, it was no longer possible to ask the participants to complete the online questionnaire on campus where the workstations have a reliable internet connection and large, high-resolution computer screens. In other words, even though the questionnaire itself remained unchanged, the level of control the researcher had over the data collection conditions changed significantly. As the intricate visual illustrations in the questionnaire were not suitable for a smartphone screen, asking the study participants to complete the questionnaire on their own devices with their internet connection meant that the overall level of fairness during the data collection process, which was in place when each study participant had access to the same type and quality of workstation in the computer room on campus, could no longer be guaranteed.

In other cases, postgraduate students had to significantly adjust the information contained in the information leaflet that they distributed to prospective study participants before the data collection commenced, and on the basis of which those who were invited to participate decided whether or not to give their informed consent. A postgraduate student who had planned to visit study participants in their homes, make video recordings of personal interviews and then anonymise the transcripts prior to the COVID-19 pandemic lockdown measures came into effect had to change to online meetings as the primary data collection tool. In line with the protection of personal information (POPIA) guidelines published by Universities South Africa (USAf), the researcher intended to 'de-identify when you can', to 'be transparent' and to 'keep information safe' (USAf, 2020). Regarding the latter, it was no longer realistic, however, to indicate in the information leaflet that the video recordings would be password-protected and stored in a safe manner and the researcher being the only person with access to the recordings. This was the case because during online meetings, a meeting may be recorded by anyone who is part thereof (by means of screen recording software, for example). The implication is that, for all practical purposes, researchers can no longer control who has access to meeting recordings, as all who joined the meeting collectively own any recordings thereof. At best, the researcher can appeal to all who joined the online meeting to be transparent about the use of screen recorder software and to store and share any recordings in a responsible, considerate manner. Even though the researcher may subsequently de-identify or anonymise study participants in the interview transcripts and in the final research report, this form of anonymisation will always be relatively weak in nature as the researcher would not be able to store the original recordings in a safe manner in the first place.

Discussion

The sections above highlighted international best practice, the core research ethics principles, the functioning of South African research ethics committees and offered examples of how some visual communication researchers responded to the COVID-19 lockdown measures. Respect for persons, being a core research ethics principle, requires that researchers treat participants as autonomous and provide participant protection through anonymisation. This is of particular importance where a participant is vulnerable and exposed to risks. University research ethics committees usually require that a researcher informs participants that they will remain anonymous and that they have the right to withdraw from a study at any time (autonomy). Such a requirement is a prerequisite for obtaining ethical clearance.

Conflict arises when a researcher cannot guarantee anonymity, as illustrated in the above examples. It is at this point that we want to introduce the issue of autonomy by way of a question. If we treat persons as autonomous, should we not allow participants to choose to remain autonomous or not, or choose their level of anonymity? The answer is obvious when a study collects sensitive data, when there is the potential for reputational damage, and when data emanates from children and vulnerable participants. Scholarly articles written on artists,[7] however, do not anonymise the artists. It would be absurd to interview an artist and report on the artist's work while keeping their identity anonymous. In light hereof we further argue that it may sometimes be imperative to list participants' names and their credentials.

Allow us to illustrate with an example. The Department of Health reportedly contracted a communications company by the name of Digital Vibes to develop a mascot for the National Health Insurance (NHI). The mascot is an anthropomorphised Nguni cow (Dr Pelo) dressed as a medical doctor. This mascot raises research questions in terms of communication value and symbolism. One can collect the professional opinion of leading persons in the graphic design industry about its potential communication value, and the opinion of leading persons in culture studies about its symbolism. The credibility of such a study would depend on the professional standing and status of the participants. Knowing who said what, their position in the industry and their credentials and professional experience would provide the credibility that one seeks. A study that seeks to report on the 'professional' opinion of industry leaders must provide information about the persons who express these opinions. News reports concerning the above-mentioned mascot, however, mentioned controversy surrounding payments and the contract value of the project.[8] Therefore, it is understandable that some professionals would prefer to remain anonymous (in fear of not receiving a government contract), while others may deliberately choose to have their names listed in a project of such a nature. In a hypothetical case such as this, it would be desirable to respect a participant's autonomy and allow a participant to choose their level of anonymity.

Conclusion

The paper aimed to suggest ways of improving the ethical quality of visual communication research given the 'new normal' due to the COVID-19 pandemic. We conclude by arguing that non-anonymity could be an alternative ethics norm for visual communication research. Non-anonymity allows for greater participant autonomy, adds to reliability and validity, and provides credibility to the results. Giving participants a choice as regards their level of anonymity increases the autonomy of a participant.

We wish to conclude by pointing out that justice as a core principle still lacks in visual communication and fine art research. Scholars tend to interview and report on prominent cartoonists and artist such as Zapiro and Jan van der Merwe but seemingly ignore lesser persons, violating the principle of allowing equal participation. This area, as such, requires further debate and research and will lead still further to the strengthening of participant autonomy, fairness, and credibility in research ethics.

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[7] For examples, see articles about artists in the South African Journal of Art History (https://journals.co.za/journal/sajah).

[8] See https://www.dailymaverick.co.za/article/2021-06-16-digital-vibes-scandal-meet-dr-pelo-the-national-health-insurances-literal-r1-1-million-cash-cow/.

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Overcoming educational inequalities associated with online learning in light of a pandemic: A private higher education approach

Keshni Nana, *Villioti Fashion Institute*
Carla Roos, *Villioti Fashion Institute*

Abstract

The COVID-19 pandemic has been declared a global pandemic forcing many countries into a widespread lockdown. In South Africa, contact higher education institutions were forced to develop and introduce online learning and teaching platforms. Considering the fourth industrial revolution, patterns of digital access are unequal across South Africa whereby rural areas are likely to be most disadvantaged. Students who returned home during the national lockdown may not have been equipped for online learning due to a lack of resources.

Through the lens of a contact, private, Fashion, higher education institution's online learning management system, progress issues among Diploma of Fashion students were noted within the virtual classroom setting due to a possible lack of student social presence. To counter for this, an At-Risk Programme was developed, with reference to the Community of Inquiry model, to address government's pressure for students to have an equal opportunity to complete the 2020 academic year. For the purpose of this study, the social presence was considered as a possible reason for the disconnects found within the online learning environment, in terms of Diploma of Fashion students joining and participating in the virtual classroom.

A quantitative study grounded within the post-positivist paradigm was undertaken. A cross-sectional, exploratory design was implemented to address the study's aim: investigating the outcome of an At-Risk Programme on student progress, due to a possible lack of social presence among at-risk Diploma of Fashion students within an online learning environment, in order to ensure 'no student gets left behind'. The study population consisted of at-risk Diploma of Fashion students who had poor attendance and a low rate of assessment submission, for the duration of the online learning period, within a first-year practical course, Visual Studies 1. Non-probability, purposive sampling was used for identifying the at-risk students within this study, according to specific inclusion criteria.

Following the At-Risk Programme, data was collected from 14 participants who were registered for the Visual Studies 1 course in the Diploma of Fashion programme and attended the At-Risk Programme over a two-week period. The student portal was used to extract the data to determine an improvement or lack thereof, in the at-risk students' results. Findings indicated an overall success rate of student passes. As this study was explorative, the findings contribute to future research by informing the implementation of an At-Risk Programme to possibly assist, and offer a second chance to, at-risk students and suggestions for enhancing students' experience within an online learning environment.

Keywords: COVID-19, educational inequalities, private higher education, online learning

Introduction

The COVID-19 pandemic began in China, December 2019, and due to its widespread effect, the World Health Organization (WHO) declared it a global pandemic in March 2020 (Adnan & Anwar, 2020, pp. 45; Ojo, 2020, pp. 20-21). Globally, the spread of COVID-19 has led to profound changes in how we interact socially and within organisations, which means that higher education institutions (HEIs) have not been immune to its impact (Murphy, 2020, p. 492). Due to a lack of knowledge on the virus, many countries resorted to a lockdown in order to protect their citizens, resulting in negative implications for the global economy (Adnan & Anwar, 2020; Toquero, 2020). Numerous countries temporarily closed their schools and universities, bringing learning and teaching practices to a halt, as was the case in South Africa (SA).

The South African government's fear for the rate at which the pandemic has been spreading, motivated the declaration of this pandemic as a national state of disaster with regards to the Disaster Management Act (Mhlanga & Moloi, 2020, p. 3). The widespread effect of COVID-19, in addition to the disruption of everyday life, forced the South African government to enact a national lockdown, resulting in the closure of schools and universities (Mhlanga & Moloi, 2020; Motala & Menon, 2020). Upon announcement of the national lockdown, all private and public HEIs in SA were pressured to put in place alternate measures to continue with core practices, as well as the prioritisation of the academic year (Motala & Menon, 2020, p. 81).

Impact of COVID-19 on higher education institutions in South Africa

The majority of SA's contact HEIs received government pressure to ensure that students have equal opportunity to complete the academic year, with the Department of Higher Education, Science and Technology declaring that "no single student or institution will be left behind" (Mhlanga & Moloi, 2020; Ojo, 2020; Asma, 2020). With this announcement, several HEIs had to adapt and place learning and teaching online with faculty having no prior experience or training for online delivery (Hedding, Greve, Breetzke, Nel & Jansen Van Vuuren, 2020, p. 1). Contact HEIs were therefore forced to develop and introduce online learning and teaching platforms, for the delivery of both theoretical and practical courses and assessments (Hedding, et al., 2020, p. 1). In a brief span of time, academic staff had to familiarise and up-skill themselves with the pedagogy of online teaching and delivery (Hedding, et al., 2020. p. 1).

While focus has been on hosting learning and teaching online, the neglected 'elephant in the room' is that prior to the emergence of the COVID-19 pandemic. SA's higher education (HE) Sector was already dealing with an existing learning crisis as evidenced by a high risk of learning poverty (Mhlanga & Moloi, 2020, pp. 1).

Digital exclusion within demographically diverse South African higher education institutions

During the apartheid era, SA integrated ideas around race, social-class and political power (Leibowitz & Bozalek, 2014, pp. 94). These racial categories remain a significant identifier of social background, and decades after the end of apartheid, an indicator of social privilege (Leibowitz & Bozalek, 2014, p. 94). Scholars view post-apartheid SA as embedded in an enduring cycle of segregation and class struggle (Kronenberg, Kathard, Rudman & Ramugondo, 2015, p. 1).

As such, preparing students for an evolving society in the twenty-first century is challenging given the demands of a diversifying student demographic (Patel & Lynch, 2013, pp. 223). Scholars define diversification as a process by which an environment becomes more varied in its operations, positioning and student body regarding ethnic and cultural diversity (Varghese & Püttmann, 2011; Takwate, 2016). The diversification of student demographics in SA could be due to a broad influx of students from disadvantaged backgrounds into HE landscapes (Wingate, 2015; Tkachenko, Bratland & Johansen, 2016).

Amidst this transformation, one must consider the HE student demographic, who may have travelled home prior to the national lockdown. As per the objectives of government's White Paper 3, to ensure equity, redress, democracy, autonomy, and efficiency, the South African HE system has been under pressure for quality education delivery (Elliott, 2005; Vandeyar, 2010). In order to resolve equity issues and allow greater student diversity, HEIs have been admitting students from previously disadvantaged backgrounds (Smit, 2012, p. 367). However, patterns of digital access are discerned and unequal across South Africa whereby rural areas are likely to be most disadvantaged (Timmis & Muhuro, 2019, p. 4).

Information and communication technology (ICT) has infiltrated all aspects of our globalised society with a drastic growth in its adoption within the HE learning and teaching environment (Saifuddin & Lykkegaard, 2020, pp. 614-615). Information and communication technology may be in the form of online resources and virtual learning environments with many universities investing in a Learner Management System (LMS) and video conferencing to offer a virtual learning and teaching experience (Saifuddin & Lykkegaard, 2020, p. 615). That being said, all students have not benefited from ICT as certain individuals experience limitations when dealing with digital technologies; in a global context, this divide has been termed 'digital exclusion' (Saifuddin & Lykkegaard, 2020, p. 615).

Post-apartheid SA is still dealing with unequal distribution of income and educational resources, such as poor connectivity and a shortage of funds for data, resulting in a digital divide (Nyahodza & Higgs, 2017, p. 40). Known causes of the digital divide in South African HE includes inadequate ICT infrastructure and skills and low, expensive bandwidth, especially within certain communities (Nyahodza & Higgs, 2017, p. 40). Timmis and Muhuro (2019, p. 2) argue that HEIs are not equipped to support students from rural contexts given restrictions caused by technological infrastructure. As a result, students' home environments may not have been suited for online learning due to an existing lack of resources (Ojo, 2020, p. 21), as was found by a contact,[1] private, Fashion HEI situated within Johannesburg, Gauteng.

Investigating a lack of social presence within a private higher education Institution amidst COVID-19

The specific Fashion HEI went online using a LMS known as Moodle. Lessons were created combining a range of resources, such as electronic books, pre-recorded video content, and a virtual classroom setting that enabled lecturers and students to remotely communicate via audio, video and chat tools. Attendance issues were however, noticed among students within the virtual classroom component. Upon investigating students' online activity logs on the LMS, it was found that students were still accessing downloadable resources and had attempted submissions, but in their own time.

The research study thereby, employs an integrated model for online education as its theoretical framework, known as the Community of Inquiry (CoI) model. This model is conducive to online, active learning environments whereby lecturers and students share ideas, information, and opinions (Picciano, 2017, p. 173). The CoI model is based on three presences, namely a cognitive, social, and teaching presence (Garrison, Anderson & Archer 2000, pp. 88). For the purpose of this study, the social presence was investigated through online learning for a Fashion HEI, as a disconnect was found within the online learning environment, in terms of students joining and participating in the virtual classroom.

[1] A contact Institution is where learning and teaching takes place on-site and face-to-face.

The research problem involved the possible lack of a social presence among a group of at-risk, Diploma of Fashion students within an online learning environment, due to possible educational inequalities. The aim of this study is to investigate the outcome of an At-Risk Programme on student progress, due to a possible lack of social presence among at-risk Diploma of Fashion students within an online learning environment. The study's main objective was to develop an At-Risk Programme to counter for the learning missed due to possible educational inequalities and assess student results following the At-Risk Programme.

Theoretical underpinning

Garrison, Anderson, and Archer (1999) proposed the CoI model to foster critical thinking with a collaborative online learning experience (Junus, Suhartanto, R-Suradijono, Santoso & Sadita, 2019, p. 1). The CoI model suggests that critical thinking within online learning is most beneficial when it embodies three presences, namely 1) cognitive presence, 2) social presence and 3) teaching presence (Junus, Suhartanto, R-Suradijono, Santoso & Sadita, 2019, p. 1). The three critical aspects are illustrated in Figure 1.

Figure 1: Community of inquiry model (Garrison, et al., 2010, pp. 6)

The cognitive presence is vital to success in HE as it involves critical thinking (Garrison, et al., 2000, p. 89). The social presence involves participation and social interaction whereby personal characteristics from learners are presented (Garrison, et al., 2000, p. 89; Kreijns, Van Acker, Vermeulen & Van Buuren, 2014, p. 8). The social presence indirectly supports the critical thinking process in its effectiveness for collaboration and knowledge construction and may be a direct contributor to the success of the educational experience (Garrison, et al., 2000, pp. 89; Kreijns, et al., 2014, p 8). The final presence, teaching, is the responsibility of the lecturer who organises and delivers course content, along with developing learning activities and assessments and facilitating the programme, which as a result, supports and enhances the social and cognitive presence for the purpose of realising educational outcomes (Garrison, et al., 2000, p. 89).

Garrison, Anderson, and Archer (2010, p. 5) formulated the CoI model to support learning and teaching within an online learning environment with regards to 'human issues'. These authors emphasise that the value of the model lies within the specific context of online learning in HE as opposed to a traditional distance education perspective that assumes students work independently from one another (Garrison, et al., 2010, p. 6).

Research methods and design

Research design

A quantitative study grounded within the post-positivist paradigm was undertaken. An experimental, cross-sectional, exploratory design was implemented to address the study's aim: investigating the outcome of an At-Risk Programme on student progress due to a possible lack of social presence among at-risk students within an online learning environment, in order to ensure 'no student gets left behind'. As this study was explorative, the findings will contribute to future research by informing the implementation of an At-Risk Programme possibly to assist at-risk, Diploma of Fashion students, registered for the Visual Studies 1 course, and suggestions for enhancing students' experience within an online learning environment.

Research setting

The research setting of this study was an urban fashion HEI situated within Johannesburg, Gauteng. The focus of this study was on fashion students identified to be at-risk during the national lockdown. Data was collected from student results and attendance that were virtually captured via the online LMS, Moodle. This platform serves as the student portal that hosted virtual classrooms and lessons during the lockdown period.

Study population and sampling strategy

The study population consisted of at-risk, Diploma of Fashion students who had poor attendance and a low rate of formative assessment[2] submission in the Visual Studies 1 course, for the duration of the online learning period. The following inclusion criteria applied for students to be invited to attend the At-Risk Programme:

- Less than 80% attendance for the individual course;
- Two or more nil submissions for the individual course; and
- Active student logs (to verify students' attempts of trying to access the online lessons).

Non-probability, purposive sampling was used for identifying the at-risk, Diploma of Fashion students within this study according to the specific inclusion criteria.

Data collection

Visual Studies 1 is a first-year course in the Diploma of Fashion programme at the Fashion HEI, which provides students with the tools to express unique ideas and acquaint students with step-by-step techniques of fashion illustration. Fourteen students were identified as failing profiles in Visual Studies 1 due to not making their Formative Duly Performed mark. The private HEI had initially identified 18 at-risk students however, four students did not attend due to deregistration or non-payment of fees. For a student to achieve their Formative Duly Performed mark, it is a pre-requisite to achieve a 50% formative average in practical courses, such as Visual Studies 1. As a result, these students would have had to re-register and redo the course in the following year.

To counter for this, data that was initially extracted from the student portal, assisted in flagging the at-risk, Diploma of Fashion students, in order to develop an At-Risk Programme. The At-Risk Programme was designed to run on-site at the Fashion HEI, over a two-week period. Prior to the At-Risk Programme, a letter was sent to students and parents informing the opportunity being offered for students to improve their attendance and complete their Formative Assessments that were never submitted, in the presence of their lecturers and peers at the Fashion HEI. The Fashion HEI's COVID-

[2] Formative Assessment determines where students are in terms of the specific outcomes for each course to assist students and lecturers with determining which work will have to be revisited. Formative assessments are important for students to monitor their progress and their readiness to partake in Summative Assessments.

19 protocol was also sent to parents and students whereby students were requested to complete a health declaration upon attending the At-Risk Programme.

During the At-Risk Programme, the Registrar informally met with the 14 attending, at-risk participants individually, to inquire on the reasons for their lack of participation observed during online learning. This discussion supported the relevance of hosting the At-Risk Programme and input gained served as anecdotal evidence to the study. Students received the opportunity to complete their Formative Assessments within a social presence, which stems from the CoI model to support the social experience possibly lacking within a virtual classroom setting.

On completion of the two-weeks allocated for the At-Risk Programme, the Formative Assessments were graded by the lecturer and the marks allocated with feedback on the LMS, Moodle. The student portal was then used to extract data to determine an improvement or lack thereof, in the attending, at-risk participant results for Visual Studies 1.

Ethical considerations

Ethical standards were maintained during the informal meeting whereby students were met with privately by the Registrar of the private HEI; responses were noted with no misrepresentation or deception. All possible measures to ensure confidentiality of information were applied. Approval from the Fashion HEI was gained to make use of student data. The researchers, Registrar and the Administrator of the Fashion HEI were the only individuals who had access to the data, thereby minimising undue risks. Throughout the research, participant anonymity was maintained.

Data analysis

Data was analysed via the LMS's 'Record of Achievement', extracted via Microsoft Office Excel, to track student progress. Using Microsoft Office Excel's functions, student marks could be highlighted to indicate results. Prior to the At-Risk Programme, the Exam Committee had analysed the excel spreadsheets for Visual Studies 1 which included student attendance, all formative results (including classwork) and the students final Formative Duly Performed mark. Students with two or more nil submissions for Formative Assessments were flagged in addition to students not making the 50% Duly Performed mark required for the practical course. These identified students were extracted and discussed within the Exam Committee to create a separate risk assessment profile for each student.

Following the At-Risk Programme, the Exam Committee had extracted the same set of results for the identified at-risk students to determine if students had improved their Formative Duly Performed marks following the At-Risk Programme. The Exam Committee analysed results to determine the status of at-risk students within the course and communicated whether these students gained access into their Summative Assessment[3] or whether they would need to go into an Intensive Programme [4] to gain access to the Summative Assessment.

Findings and discussion

Upon reviewing input from the informal, private meetings held by the registrar, students attending the At-Risk Programme indicated that the following were hindrances to their progress in the Visual Studies 1 course: a lack of data, poor connectivity, and network coverage in their area, technical challenges, unplanned power outages, family responsibilities, and a shortage of equipment during the

[3] Summative Assessments are the evaluation of a culmination of learning in accordance with the level of the course in the form of a formal examination.

[4] An Intensive Programme is a specific programme created for each student in order for them to attain the competencies lacking in a specific course should they not make the 50% Formative Duly Performed mark.

course. These responses were self-reported by students and therefore served as anecdotal evidence. From the fashion HEI's point of view, this investigation was necessary to understand all contributing factors that negatively impacted students' presence online.

Following data analysis, students Formative Duly Performed marks had improved in some instances as illustrated in Table 1. Students 12 and 14 did not submit additional work on completion of the At-Risk Programme, and as such their Formative Duly Performed marks remained the same. The cohorts Formative Duly Performed average for Visual Studies 1 was 33% prior to the At-Risk Programme and 50% following the At-Risk Programme. As such, the At-Risk Programme allowed for a 17% increase in the Formative Duly Performed average for Visual Studies 1.

Table 1: Student Formative Duly Performed prior to and following the At-Risk Programme

At-risk students	**Initial formative duly performed mark**	**Updated formative duly performed mark**
Student 1	33%	58%
Student 2	10%	70%
Student 3	47%	63%
Student 4	43%	55%
Student 5	47%	67%
Student 6	22%	43%
Student 7	31%	41%
Student 8	37%	44%
Student 9	45%	47%
Student 10	38%	44%
Student 11	12%	42%
Student 12	31%	31%
Student 13	31%	61%
Student 14	36%	36%

As per the fashion HEI's Assessment and Moderation Policy, all courses are signed off for Summative Assessment access dependant on the student's Formative Duly Performed mark. Following the At-Risk Programme, five students achieved results that gained them access into the Visual Studies1 Summative Assessment. Following the Summative Assessment period, three out of the five students who wrote the Summative Assessment had passed the course.

Nine students had to complete an Intensive Programme to gain access into their Supplementary Summative Assessment as their Summative Duly Performed marks were below 50%. Following the Intensive Programme period, nine students made their Summative Duly Performed mark and gained access into the Supplementary Summative Assessment. Following this, eight out of the nine students passed the Supplementary Summative Assessment. The reason why one student did not pass was due to the student not attending the Supplementary sitting. The supplementary was done on-site at the Fashion HEI due to the hindrances previously experienced with online learning. In total, 11 out of the initial 14 students who attended the At-Risk Programme passed Visual Studies 1 as opposed to having to redo the course.

Stemming from the CoI model, the initial intent of the research considered the lack of a social presence within the virtual classroom setting. However, during the informal meetings held by the registrar with students, it was revealed that social presence was not the only factor contributing to a lack of participation in the virtual classroom. Additional factors from the findings included digital exclusion and social responsibilities. The findings in this paper further indicate the importance of each aspect within the CoI model as opposed to only 'social presence'. As evidenced by this study, an At-Risk Programme is a viable option to counter for failing profiles among students in an online learning environment. An At-Risk Programme would be best suited for students accustomed to contact learning who experience a lack of digital access thus hindering online participation.

Conclusion

In light of the pandemic and its impact on contact learning and teaching, the online experience was compromised as the priority for HEIs was to save the academic year. The initial premise of the study outlined the lack of a social presence possibly contributing to poor attendance and formative assessment submissions in the Visual Studies 1 course. However, the findings revealed technological and sociological inequalities to be the actual hindrances to online learning. Although the At-Risk Programme proved to be beneficial to students in terms of their results, the shift back to the classroom during the At-Risk Programme, where the focus was on interaction and individual support, may have been the main contributor to the improvement of student results.

Limitations

The students' lack of participation within the virtual classroom setting was not explored in-depth, thereby the lack of social presence could not be considered as the core reason for students' poor attendance and low formative assessment submission. Furthermore, students' lack of resources and home environments could not be evidenced as it was not within the scope of the study.

An additional limitation to the study involved the COVID-19 restrictions following the national lockdown. Students may not have felt safe to attend the At-Risk Programme as it was held on-site. However, all 14 students attended the At-Risk Programme with the exception of four students who deregistered or were suspended for non-payment of fees.

Recommendations for future developments

Further research may investigate a lack of student social presence in an online setting with consideration to technological and sociological deterrents that they may experience. Lecturers may investigate whether social presence in their online lesson is lacking due to technological attributes, such as the tools chosen to navigate the LMS, or the social groups using those tools. Furthermore, teaching factors, such as the pedagogical methods chosen and how these methods support social presence among students, could be investigated.

Suggestions for enhancing students' social presence within an online learning environment may include the revision of assessments to become group work, wherein discussions among the students and lecturer may take place on platforms such as the virtual classrooms 'breakout rooms'[5] or chat forums. In addition, allowing students a few minutes before a lesson to join the virtual classroom and communicate among themselves to bring in a social element to the virtual classroom. Gamification may be used in an online environment to create a healthy competition among students, to be able to track each other's progress and activity completions.

[5] 'Breakout rooms' is a setting within the virtual classroom where rooms are created to separate and create smaller groups of participants for the purpose of group work, workshops, individual meetings, among others.

The lack of students’ presence cannot only be attributed to a lack of social presence as other factors that came to light may be further investigated by government by better equipping communities with internet connection and affordable data rates to accommodate for digital exclusion. Further study is recommended on how conducive students home environment are for having online lessons remotely in terms of their physical surrounding and familial responsibilities.

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Towards 4IR and African scholarship: Exploring research capacity in the widening discipline of communication design

Ria (HM) van Zyl, *Independent Institute of Education (IIE), Vega School*
Lizette Carstens, *Independent Institute of Education (IIE), Vega School*

Abstract

Scholarship has many dimensions, such as the scholarship of research/discovery; the scholarship of integration, application, and teaching; and the scholarship of public and democratic engagement where knowledge is co-constructed. These broader notions of scholarship challenge the traditional understanding of a university and position scholars and researchers in a broader socio-economic, historical, and cultural context. Design as a field developed and widened as a result of new challenges and opportunities – for example the fourth industrial revolution – and changes in the discipline. In addition to these shifts, South African design researchers are challenged by the need and capacity that drive the different dimensions of scholarship in the pursuit of locally relevant, African knowledge. Modes 1 to 3 of the Knowledge Development Model is used as a broad theoretical framework.

The purpose of this study is to explore local research capacity in the communication design field in the context of 4IR, African Scholarship and shifts in the domain. The paper starts with a theoretical exploration of the multi-dimensional nature of scholarship, research, and research capacity. This is followed by an analysis of research activities in the widening field of communication design. Insights are based on desk research such as accredited research output and government research reports. The desk research comprised a discussion on purposively selected research projects on communication design and examples of collaborations and was supplemented by explanations from the research leads and participants.

The last part of the paper discusses the indicators, shortcomings, challenges, and opportunities, as identified during the research. The paper contributes to the discourse on the development of research capacity in the pursuit of African scholarship in design, which is relevant to the fourth industrial revolution.

Keywords: 4IR, African scholarship, communication design researchers, research capacity building

Introduction

The central theme of the 2021 DEFSA Conference is the fourth industrial revolution (4IR). The organisers therefore requested papers that considered the past, present and future of design education, seen through the lens of African scholarship. The fourth industrial revolution is viewed as a new chapter in human development, building on previous technologies and potentially presenting people with the opportunity to "enjoy more freedom, better health, higher levels of education" and security and economic certainty (Scwhab, 2018, p. 7, 11). Schwab (2018) describes four principles of 4IR. The first is that it is about *systems* and *not technology* (and integration); second, about *empowering*, not determining (giving people choices and control); third, by *design* and not *default*; and last, *values* are seen as a feature and not a bug. These four principles present design as a discipline and way of thinking with new possibilities and opportunities. Similarly, higher education in 4IR (HE 4.0) presents the opportunity of a new kind of university with a new and different way of teaching, research and service (Xing & Marwala, 2017).

The purpose of this paper is to explore local research capacity in the communication design field in the context of 4IR, African Scholarship, and shifts in the domain that aim to answer research questions on nature of research output by local scholars and to identify strengths, challenges, opportunities, and threats. Insights are based on desk research and an analysis of articles found on the WorldCat Database. A keyword search of a 10-year period was conducted and analysed according to the number of articles per year, place of publication and central theme. Higher Institutes of Education's websites and other conference sites were consulted to identify projects and other forms of research activity and participation, and purposively selected examples were discussed. Information was supplemented by primary e-mail communication where available data needed clarification or confirmation. Permission was obtained to quote respondents.

The Knowledge Production Modes 1–3 provide an underlying structure for the paper (Caryannis, Campbell & Rehman, 2016). Mode 1 knowledge is seen as scientific knowledge – basic research that is less concerned with application and quality controlled by disciplinary peers (Boehm, 2015). Mode 2 knowledge production centres around inter-, trans- and multi-disciplinarity, social accountability, civic engagement and reflexivity, with overlapping phases of discovery and application and with quality determined by the usefulness of solutions (Boehm, 2015; Nowotny, Scott & Gibbons, 2013). Mode 3 knowledge is a catch-all term for a multi-level, knowledge-systems perspective where Modes 1 and 2 can be integrated and combined and extended beyond the university and industry to include society and environment (Caryannis, et al., 2016).

Design from 1IR to 4IR

Schwab (2018: ix) describes the world at a crossroads – on the one hand, the failure of social and political systems, the destruction of the natural environment and widening inequality; and on the other hand, the disruptive potential of 4IR technologies and new ways of creating value for "organisations and citizens".

The first industrial revolution (1IR) in the mid-eighteenth century resulted from mechanised spinning and weaving, manufacturing, steam engines and railways (Schwab, 2018). Design focused on functionalism, and communication design was concerned with the marketing and advertising of consumer goods (Manzini, 2015; Roxburgh & Cox, 2015). The Second Industrial Revolution (2IR), during the period 1870 to 1930, is attributed to the power of electricity, the internal combustion engine and the availability of new materials (Schwab, 2018). This was also the time when design became a field of formal teaching and learning at academic institutions such as the Bauhaus and the Ulm Hochschule für Gestaltung (Ferrari, 2017). The differentiation of labour created different design fields, and design knowledge was driven by functional needs, the establishment of design principles and a focus on production (Ferrari, 2017).

The Third Industrial Revolution (3IR) lasted for the second half of the twentieth century and was brought about by information theory and digital technologies (Ferrari, 2017; Schwab, 2018). The possibilities changed the way designers worked and put the tools of production into the hands of the communication designer. The focus shifted away from how things should be designed and produced to what messages should be communicated – consequently shifting knowledge needs.

Communication design in a 4IR post-industrial world echoes the development away from consuming 'things' to experiences. It shifted to a design practice where multi-disciplinary teams work in the fields of service design, customer experience design, interaction design, experience design, and visual storytelling (Roxburgh & Cox, 2015). Accompanying this new chapter in development are changes in designers' roles, from form-givers to seeding the system and facilitation. Through co-design, they have become facilitators of others' creativity (Calabretta & Kleinsmann, 2017; Sanders, 2017).

The ubiquity of design and the interplay between design and the social context requires a critical evaluation of the role of 4IR technologies in our humanity, as well as the ethical considerations that should guide how we use them to create a more humane, liveable world for everyone (Escobar, 2018; Mann-Kler, 2019). Rapid development in 4IR technologies and the global interconnectedness of people impose a new set of rules for design, based on interactivity and user participation. Design has become a critical co-creative practice embedded in the local context, where technology supports local culture (Escobar, 2018; Manzini, 2015). Accordingly, any effective 4IR education should include a critical consideration of the cultural, socio-economic, and -political effects of new technologies on humanity in a way that fosters deep intercultural understanding and abiding respect for freedom and human rights (Penprase, 2018).

A new culture and practice raise questions that demand new design knowledge (Bonsiepe, 2012) and requires an integration of design practice, design research and design education to explore a new landscape for innovation and growth (Sanders, 2017).

4IR, African scholarship, and design research

The fourth industrial revolution heralds a new chapter in human development where innovation is based on combinations of fast-developing technologies such as artificial intelligence, digital fabrication, and nanotechnology, which cause a global disruption of social, economic, and environmental systems and power structures (Schwab, 2018). These disruptions can potentially bring about gains in productivity, efficiency, safety, longevity, and general quality of life but can also widen social and economic inequality and perpetuate social injustice (Schwab, 2018). These shifts also challenge the traditional understanding of a university and position scholars and researchers in a broader context that includes not only technological changes, but also socio-economic, historical, and cultural contexts.

The characteristics of 4IR scholarship are therefore driven by the needs of social and environmental good, the integration and democratisation of technologies and knowledge systems (and inclusion), and collaboration among people across all disciplines and all socio-economic levels (Escobar, 2018; Penprase, 2018). Knowledge needs in 4IR design are now directed at three major clusters. The first is knowledge of new technologies – such as digital fabrication with new materials and 3D printing, which provides experiences such as augmented and virtual reality – and interacting through technologically mediated user interfaces (Meyer & Norman, 2020). The second cluster relates to new design practices and processes, and leadership in complex socio-technical systems such as interdisciplinary and intercultural collaborative and participatory design practices, with negotiation being a part of design skills (Escobar, 2018; Meyer & Norman, 2020; Sanders, 2017). The last cluster relates to the need for sustainability, and the impact of design on humanity, including racial and gender equality and social justice (Escobar, 2018; Meyer & Norman, 2020). It must be noted that these new knowledge needs do not replace, but build on previous knowledge needs in communications design – for example, strategic purpose, form and function.

Locally, a critical reflection of how local knowledge is constituted and developed, to what purpose this is done, on what assumptions and choices it is based, and about whose knowledge is or is not included is becoming ever more urgent and part of the decolonising debate (Motala, 2015). The #Decolonise! theme of the 14th DEFSA Conference (2017) is an example of such critical engagement. Scholars at this conference highlighted the need for different forms of knowledge, comprising multiple perspectives, origins and cultures instead of a purely Eurocentric understanding of knowledge (Botes & Giloi, 2014). Historically, universities in South Africa have mimicked European institutions, resulting in a form of cognitive colonialism where Eurocentric knowledge is regarded as “the way of knowing” rather than “one way of knowing” (Du Preez, Ramrathan & Le Grange, 2018, p.6; Mapaya, 2016; Soudien, 2015). Cognitive colonialism has permeated even locally produced knowledge as South African scholars rose through an education system that was built on a Eurocentric epistemology (Soudien, 2015). Globalisation has further perpetuated cognitive colonialism through processes of research and publications, which are governed by a publishing system that regulates what is published (Du Preez, et al., 2018).

The challenges of decoloniality re-engage with knowledge from the context of one’s society or environment (Oparinde & Govender, 2019). The possibilities afforded by a need for local knowledge, rapidly developing technologies and 4IR-aligned teaching and scholarship puts communication design as a young discipline in South Africa at a crossroads. This is somewhere between the opportunity to develop new forms of scholarship and fighting for a place in the modes of traditional scholarship.

Communication design research capacity – where are we now?

In South Africa, scholarly capacity is aligned with Mode 1-type Western measures of peer-reviewed research output and impact factors. The following types of research output are recognised and rewarded: peer-reviewed articles published in journals approved by the Department of Higher Education and Training (DHET) (one unit), scholarly chapters and books (units based on page numbers), peer-reviewed conference proceedings (half units) and creative output (one to three units) (Government Gazette, 2015). Furthermore, DHET provides information on the research output per capita and weighted output where research master’s and doctoral production is incorporated.

Mode 1: Traditional output in the communication design sector

The DHET reports annually on research output, using the Classification of Educational Subject Matter (CESM) as fields of study (Department of Education [DOE], 2008; DHET, 2021). Communication design falls into CESM 03: Visual and Performing Arts.[1] DHET reports only on main CESMs, making discipline-specific analysis difficult. Many of the new fields in design are also absent in the current classification. The lack of more detailed data makes it impossible to determine the output per capita for the field of communication design. The latest 2019 output indicates that CESM 03 reported 174.09 units – less than 1% of the total number of units[2] (DHET, 2019).

Table 1: Research outputs recognised by the Department of Higher Education and Training

Mode 1 - type of research capacity - DHET Model					
Type	Journal Articles	Chapters and scholarly books	Peer reviewed conference papers	Creative ourput / innovations	Masters and doctoral students graduated

Journal articles and scholarly books

To get a sense of how many articles are produced by local communication design researchers seemed to be a daunting task in the absence of discipline-specific publication data. A search using the WorldCat

[1] CESM 03: VISUAL AND PERFORMING ARTS comprises 0301 Dance; 0302 Design and Applied Arts; 0303 Drama/Theatre Arts; 0304 Film/Video and Photographic Arts; 0305 Fine and Studio Art; 0306 Music; 0399 Visual and Performing Arts, Other

[2] Only two CESMs (CESM 10: Family Ecology and Consumer Sciences; and CESM 16: Military Sciences) reported lower output (DHET, 2021)

database was conducted for a 10-year period (2011–2020).[3] Searches were filtered and further analysed to determine patterns (Table 2).

Table 2: Snapshot of journal articles in a 10-year period in the field of communication design in South Africa

Filtered article search: keywords (2011 - 2020) = n 89					
Graphic Design + SA	Communication Design + SA	Co-Design + SA	Illustration + Visual Narrative + SA	Visual Culture + Design + SA	
51	13	5	1	29	
Journal Patterns					
International	Image & Text	De Arte	SA Journal of Art History	Educational (all combined)	Other < 5 articles per journal
10	17	10	7	20	25

South Africa has one recognised journal that is dedicated to the visual culture and related fields: *Image & Text*. This journal stands out as the number one place of publication (Table 2). The journal was accredited by DHET in 1996 (Lange, 2012; SciELO, n.d.). It is now published yearly and, although starting out with a focus on design, has since 2011 evolved to include interdisciplinary topics such as visual and design culture (Lange, 2012). *Image & Text* was indexed by SciELO SA in 2018; data on impact factors and citations are still developing. There is currently not a dedicated design-specific research journal in South Africa.

Thematically, articles on design for humanity, design culture, and education tend to dominate, with a smaller focus on industry or technology. This confirms the observation that in the Global South, more of a Mode 2, civic-oriented value system for research prevails (Boehm, 2015). One such example is the 2018 publication of the first scholarly book on design by South African scholars, titled *Educating citizen designers in South Africa* (Costandius & Botes, 2018). This book is, according to Pretorius (SUNScholar, n.d.), the first of its kind that focuses on critical citizenship education that is driven by an overall aim for the need for social change. The book comprises case studies and examples of projects in the disciplines of architecture, graphic design, and product design.

Peer-reviewed conferences

One way to build scholarly capacity is through the development of an academic community of practice, with conferences a dominant platform and often the first opportunity for young academics to participate in research. South Africa is fortunate to have DEFSA, which, as a non-profit, hosts a biennial conference and publishes selected papers. It provides design scholars with experience in the formal processes of the peer review of abstracts and papers, strengthening the community. Opportunities for developing papers and posters also provide a space for young academics to participate.

The conference themes frame the development of local knowledge such as the 2000 Reshaping South Africa by Design, the 2001 Mapping New Territories in Design Education and the 2014 Redesigning Design Education. Peer-reviewed papers are indexed and freely available on the website

[3] The lists were saved and further filtered down to articles that were deemed relevant. This may not be the most accurate method, but is sufficient in providing an idea of patterns and number of articles

(defsa.org.za). An analysis shows that website pages received 48 114 page views during 2020, with 3 299 downloads during that period (Volek, Google Analytics, pers. comm., 30 Oct, 2021). The 2014 #Decolonise! Conference is still a favourite, with papers regularly accessed.

Postgraduate numbers

The DHET uses master's and doctoral numbers as a further indicator of research capacity. The Higher Education Management Information System (HEMIS) reports data on graduates in the public sector. Communication Design falls under the second CESM level: 0302,[4] which includes Communication Design, Industrial Design, Photography, and Fashion Design. The NQF 10 graduates in CESM0302 show a small rise, with 16 PhDs in the last five years compared to 11 in the previous five-year cycle. There may still be Communication Design graduates with PhDs in other CESMs, but even if these were included, the numbers are very small. Honours-level (NQF 8) numbers seem to be projecting a slight upwards curve after a worrying drop (Figure 1).

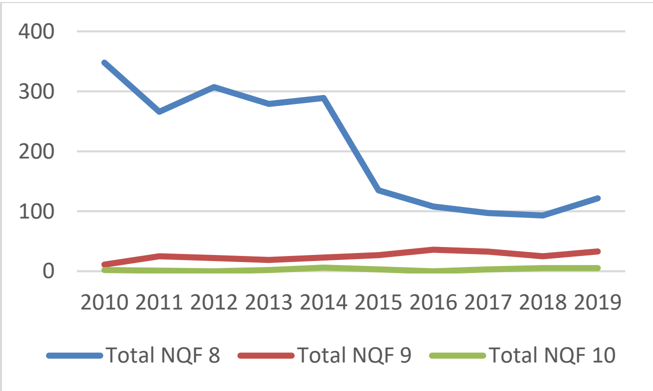

Figure 1: Ten-year comparison at public institutes of higher education (based on available HEMIS data – CESM 030200)

The top five institutions in the master's and doctoral space in CESM 030200 are CPUT, UJ, DUT, TUT and UP. Van Zyl (2014) found that the communication design industry saw little value in the research produced at universities and found access to research journals challenging; the universities' postgraduate qualifications did not seem to offer any career advantages, apart from teaching. Sauthoff (Lange, 2012, p. 6) echoes this and points out that design is dominated "by intuitive practitioners who are more likely to consult a trade magazine instead of a scholarly publication". However, Sauthoff adds that there are invisible networks of people with specialist knowledge in design. The question should therefore be asked about whether other forms or modes of critical scholarship, such as the ones mentioned by Motala (2015), exist and if these could bridge the gap between industry and academia to take design research in a different direction.

[4] 0302 Design and Applied Arts: 030201 Design and Visual Communications, General; 030202 Commercial and Advertising Art; 030203 Industrial Design; 030204 Commercial Photography; 030205 Fashion/Apparel Design; 030206 Interior Design; 030207 Graphic Design; 030208 Illustration; 030299 Design and Applied Arts, Other

Creative output

The DHET also recognises and subsidises research outputs from the creative and artistic disciplines[5] (DHET, 2021). Design is a subfield among fine and visual arts, music, theatre, performance and dance, film and television, and literary arts. An older system of evaluation was replaced with a new peer-review system (DHET, 2021). Unfortunately, out of the 100 approved outputs, not one communication design project was awarded research credits and no communication design submissions were made. A high rejection rate of 80% in the design subsector was noted. The critique in the design field related to the lack of creation of new knowledge, poor-quality images, a lack of articulation of process, and a shortage of reviewers (DHET, 2021).

Shifting modes towards Modes 2 and 3 knowledge production

The examples presented in the previous section reported on Mode 1-recognised research output that conforms to the local and international rules of knowledge production, mostly aimed at peer audiences. The next section briefly discusses purposively selected examples where the boundaries of knowledge generation modes are blurred and extended to Modes 2 and 3 (Figure 3).

Table 3: Examples of Mode 3 knowledge production

Mode 3-type of research: Extending research capacity and creating new opportunities			
Type	Integrating design and knowledge production	Working conferences	Virtual communities of knowledge and practice
Nature	Participatory and Integrative	Collaborative, transdisciplinary and virtual	Collaborative and Inclusive
Participants	Industry, community, more than one institute	local and global	Industry, scholars and general public, fast-paced, open and accessible
Type of knowledge production	Unique to design, situated in the design problem e.g. local or society, solution is part of the project, visual language	Intra- and transdisciplinary possibilities for young researchers, verbal, local languages	Networked, accessible, local language
Review and judging	Combinations of modes 1 and 2, seed projects that are shared across accredited and other platforms	Combinations of modes 1 and 2, shared in conference space, could lead back to mode 1 peer reviewed papers	Community of practice determine the value. If not perceied as relevant, they disengage.

Integrating design activity and knowledge production

The first example selected here, the Mandela Poster Project, was not initiated as a research project but is an example of a social entrepreneurship design project that also led to knowledge production. The design-led project was initiated in 2013 by South African designers Mohammed Jogie and ico-D's former president Jacques Lange, comprising 95 posters that visually narrated the life of icon Nelson Rolihlahla Mandela (1918–2013). These posters were selected from designers' contributions from all over the world. The proceeds of the project contributed to the Nelson Mandela Children's Hospital

[5] As guided by the Policy on the Evaluation of Creative Outputs and Innovations Produced by South African Public Higher Education Institutions (2017) in the Government Gazette No. 395

(Hanekom, 2015). The collection was to date shown in 12 countries. This project, in addition to the original intention of a social entrepreneurship project, created the opportunity for reflection. Lange (pers. comm., 1 July, 2021) calls this a "research seeding project" that has so far resulted in several critical articles aimed at the general design community, a peer-reviewed article in an academic journal and a master's dissertation (Du Plessis, 2018; Du Preez, 2013; Hanekom, 2015). The scholarly value of such a project is found in the collaboration between the local and global design community and academia, with a truly South African theme.

Another such participatory research project was a collaboration between US and UJ. Stories were collected from communities, then documented and illustrated. Corporate and NRF funding contributed to the project, and 16 wordless picture books were created (Haese & Costandius, 2021). The processes and outcomes resulted in a book chapter, a journal article, three conference papers, workshops, and further postgraduate studies, all focusing on creating solutions *with* communities that face challenges in terms of conventional reading skills (Haese, pers. comm., 5 July 2021).

The value of both these 'seed projects' are found in the collaboration between institutions, industry, community and scholars, grounded in the practice of design with benefits that extend to both the scientific community and society.

Alternative working conferences

Digital technologies are making international conferencing more accessible and have extended possibilities for collaborations (Bottas & Junginger, 2021). The 2021 Design as Common Good Conference process started with a double-blind abstract review, followed by authors' development of their own papers (Design as Common Good, 2021). Subsequently, authors from diverse design fields were assigned to working groups (Bottas & Junginger, 2021). The diversity of such an approach is resulted in a presentation that integrated a South African scholar's photo-ethnographic work about the Khoisan, with work by Italian, Portuguese and Australian scholars in diverse field such as form and quantum thinking; eco-friendly plastic in furniture design; and design as a catalyst for sustainable oceans (McKenzie, pers. comm., 1 Jul, 2021).

The 2020 Participatory Design Conference explored forms and understandings of participation, collaboration, intervention, design and technology; and traditional social and cultural systems as sources of learning and a means to contest essentialist views on participatory design (PDC, 2020). South Africa participated in a workshop on "Decolonising participatory design practices: Towards participations otherwise". This workshop explored how participatory designers in diverse global contexts are working together and adapting modes, methodologies and concepts of participatory design into decolonising practices (Del Gaudio, et al., 2020). Following a co-design session, participants debated the ideas and critiqued the participatory methods and processes employed (Carstens, pers. comm., 18 June 2020).

These examples extend beyond Mode 1 scholarship as the participatory processes resulted in an additional layer of knowledge production that is transdisciplinary and collaborative.

Virtual communities of knowledge and practice

Other platforms that contribute to knowledge generation are networked communities of practice. Examples of these are the South African User Experience Design Forum, a public group consisting of UX practitioners and scholars, Speculative Design South Africa and Think Design, platforms for design practitioners and scholars to engage in dialogue and exchange knowledge (Jooste, 2017; Meyers, 2020; SA UX, 2021). These platforms bring together designers, academics, and futurists for the purposes of knowledge sharing. Another example is the 2021 DxZA Conference, organised by a community of UX practitioners. Their aim is to connect industry, students, and scholars to share knowledge and engage in dialogue about technology, practices, and disciplinary intersections (DxZA, 2021). Another well-known example is TEDx's local, self-organised events that bring people together to spark grassroots discussions (TEDx Johannesburg, 2021).

Although these examples do not strictly fit the Mode 1 or Mode 2 criteria for scholarship, the existence of these platforms and the active participation of design practitioners and scholars may suggest the emergence of an intellectual activism as suggested by Motala (2015).

Conclusion

The paper set out with a seemingly impossible task – to explore research capacity aligned with 4IR and African scholarship, in the context of the widening domain of communication design. Research capacity was contextualised in the traditional Mode 1 production and extended to Modes 2 and 3 where potential was aligned with 4IR and the need for African scholarship. The paper contributes a starting point supported by evidence on research output and capacity specific to the communication design field.

It is clear when looking at the insights gained in this study that communication design consists of a small community of scholars that produces Mode 1 scholarly research. The small number of postgraduate students remains a challenge, however, a slight increase provides hope. The DEFSA conference is a strength in the design research space and plays a major role to provide a space for not only directing themes and sharing knowledge but also developing young researchers. New opportunities are presented when looking at Modes 2 and 3 of knowledge production that are collaborative and interdisciplinary. However, only a few such research projects, that also include design activity, could be identified. This area, if grown, may increase output capacity. Participation by local researchers in the newer online and working style-conferences presents fresh opportunities for networking that may also contribute to the strengthening of local capacity.

Further research is needed better to understand the challenges experienced by design scholars and to identify and develop strategies to improve research capacity and output. The opportunities for collaborative projects, alternative conference styles, and integration with industry need further exploration. The absence of a dedicated journal for design remains a challenge and the possibility of a journal needs to be investigated. The potential of 4IR in the design and design scholarship space was also only touched on in the paper and needs more research and exploration.

The widening domain of the discipline of communication design provides an opportunity for scholars to embrace the transdisciplinary shifts and combine strengths with others. As a final remark, design research provides the opportunity to embrace the challenges that our local society and industry faces and develop the knowledge and solutions that can make a difference.

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SESSION 2: Jewellery design education and practice in the digital space

DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Determining jewellery students' CAD competencies as a means to incorporate a student-led teaching strategy: A case study

Tracey Jane Lőtter, *Tshwane University of Technology*

Nina Newman, *Tshwane University of Technology*

Abstract

The COVID-19 pandemic has forced many changes to educators' teaching approaches. The pandemic has also highlighted the role that technology and the fourth industrial revolution play in the future of tertiary education. Many educators have to adapt to these changes and adopt strategies to benefit the students' prospective positions in various industries. Computer-aided design (CAD) has revolutionised the jewellery industry, mainly through decreasing production timelines, increasing the accuracy of the pieces, and creating production-ready designs. Initially, the industry was slow to integrate the technology, but it is now widely used in jewellery manufacturing.

CAD has been implemented in a South African university of technology's jewellery programme as part of the jewellery design module. Between 2018 and 2020, there was an apparent and significant change with each intake of first-year students' ability to adapt to the CAD software. Students quickly comprehend the commands and easily gather know-how about the technology. The students' computer skills and increased understanding of technology mean that educators must adapt and adjust teaching strategies so that the students can benefit in their future employment.

This research aimed to ascertain why each cohort of students adapts to CAD more readily and what factors play a role in the process. The methodology included a literature review and a questionnaire. The questionnaire was completed by the current first, second, and third-year jewellery students, gauged their interest in technology, and sought information about their exposure to technology before enrolling in first year and compared this to their CAD competencies during first year. Students were asked how they experienced the CAD learning process. The questionnaire's findings created solutions to CAD-specific problems the students face and assisted with the CAD teaching approach.

The research results include the data from the completed questionnaires of the students and are discussed in this paper. The research ascertains how the CAD teaching strategy should be altered to enhance the students' teaching and learning experience while remaining relevant to their competency level.

Keywords: Computer-aided design, jewellery design, student-led teaching strategy

Introduction

CAD was first introduced to the jewellery industry during the 1990s and was only fully embraced by jewellery designers from the early 2000s (Dalrymple, 2010, p. 6; Bernabei, et al., 2016, p. 2). Although initially slow to be accepted and integrated by the South African jewellery industry, CAD is currently used by most local jewellery designers and seen as an integral part of the manufacturing process.

As opposed to the traditional method of handwork, the advantages of using CAD in the jewellery sector are that CAD will help achieve better product quality, as accuracy will improve; will help increase efficiency, as existing designs or components are re-used or edited; and will help reduce the manufacturing time (Wannarumon, 2011, p. 41; Bernabei, et al., 2016, pp. 2-3). Most importantly, the CAD design file can be exported directly to the production process, namely computer-aided manufacturing (CAM), which usually involves the milling or printing of the CAD design in wax. The wax model is then cast in the desired precious metal, and the casting is finished by hand to create the final jewellery item.

The CAD training will equip students to design and create accurate jewellery items without yet having the experience or technical skill to produce such a model in metal by hand fabrication. This ability to use CAD will position the student well in the industry for a potential job application. Master goldsmith Lewton-Brain (1996) notes the importance of educating students in CAD systems and providing training in practical jewellery skills and jewellery design to give them the best possible options for the future. Bernabei, et al. (2016, p. 6) confirmed this by noting that according to CAD teachers, “students who have acquired skills in CAD/CAM have a better chance of succeeding in the jewellery business”.

CAD training in jewellery institutions

CAD training is already implemented in various institutions. Matejovska and Achten (2011, p. 58) conducted a study in the Czech Republic on using CAD in the architecture field. The researchers observed increased students’ computer use and skills before they engaged in their tertiary studies. This was mainly due to computer ownership, where over 97% of the interviewed students owned computers before registering for their tertiary studies. This computer ownership resulted in increased use of CAD in practice and a faster application of the technology by the students (Matejovska & Achten, 2011, pp. 58, 62).

Consequently, the teaching of CAD evolves according to the competencies of the students due to their exposure to various technologies. Garcia-Ibanez and Vergara (2016, pp. 1,2) confirm that the CAD curricula should be developed in line with the level of the CAD learners and that various methodologies are required to teach CAD-related abilities, such as special abilities and visualisation skills. Furthermore, the authors agree that educators should conduct action research to improve students’ learning and contribute to the discourse of the profession (Garcia-Ibanez & Vergara, 2016, p. 2). In a study conducted with engineering drawing students, it was found that the students improved their skills through web-based interactive learning compared to the traditional learning tools (Cerra, et al., 2014, p. 398). This finding established that the learning capabilities of the students could be increased, specifically in CAD, through self-learning methodologies such as web-based interactive learning. However, Cerra, et al. (2014, p. 400) note that access to online platforms and physical resources, and adapting to students’ needs are crucial to successful web-based learning.

Using the Rhino3d software programme, CAD was taught from 2013 onwards to the second and third-year students in the university of technology institution studied. Rhino3d is reasonably priced and widely used in the South African jewellery industry. From 2017, first-year students were given introductory lessons during the second semester. The CAD lecturer noticed a significant change in each intake between 2018 and 2020 in the first-year students’ ability to adapt to the CAD software. Examples of the students’ CAD designs can be seen in Figures 1 and 2.

Figure 1: CAD ring design by Tebogo Mokoka, third-year student, 2020

Figure 2: CAD pendant design by Bongani Sakasa, third-year student, 2020

At the university of technology, students are taught in a dedicated CAD computer laboratory, where the lecturer's interface of the Rhinocerous software is projected. As the lecturer explains on the interface (an example of this interface is shown in Figure 3), the students follow the instructions on a desktop computer. Further exercises are given where the students must complete the task independently.

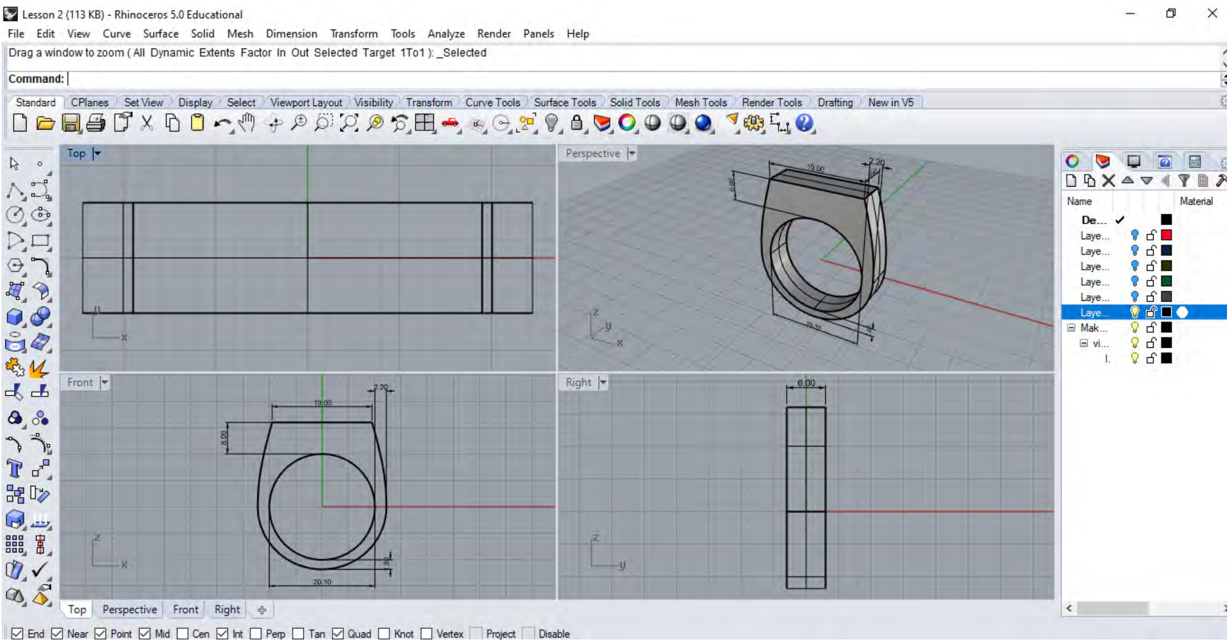

Figure 3: Example of the Rhinocerous CAD software interface

With students comprehending the commands quicker and easier, it was apparent that the teaching strategy had to be adapted to the students' competencies and would ultimately benefit their future employment in the industry. This benefit is confirmed by Lin, Ulah, and Harib (2006, pp. 331,338), who note that a solid foundation in CAD/CAM at the undergraduate level is vital for generating economic growth. The CAD course offered in a programme should equip the students for life-long learning. Hence, the importance of developing and adapting the CAD curricula and teaching strategy according to students' competencies is vital in any training institution for improving the students' CAD-related abilities.

The adaption and assessment of the students' CAD-related capabilities will help develop a more student-led teaching strategy. In this strategy, the students are placed in the centre of the learning experience, giving them greater responsibility for their learning (Marvell, et al., 2013, p. 548). Rowley, Fook, and Glazzard (2018, p. 37) explain that student-led learning empowers students to take ownership of their learning. This strategy is essential to implement in tertiary education as it prepares students for the working environment through autonomy and self-expression. However, Rowley, Fook, and Glazzard (2018, p. 37) caution that a student-led teaching strategy should be a collaborative effort with the lecturer. The more experienced lecturer should act as a facilitator in the teaching process.

Research objective

The primary objective of this research is to investigatethe reasons for the increased application of the jewellery students' computer skills and understanding of technology, specifically in CAD, through a case study. If these reasons can be clarified, the educators can adapt and adjust teaching strategies so that the students can benefit in their future employment. The following strategies were used to reach the primary objective:

- Investigate the 'base-state' of students regarding their exposure to technology. This base-state indicated how the students were exposed to various technologies before their tertiary studies;
- Gauged the students' opinions about their current competencies in CAD and views about the CAD teaching strategy;
- Gained information from students regarding problems that they encounter in the current CAD teaching; and
- Explored possible solutions to CAD-specific problems the students encounter in terms of resources and teaching strategy. The students were asked their opinions about their future in the jewellery industry and the fourth industrial revolution.

Research methodology and design

The research followed a mixed method approach that consisted of a literature review and an online questionnaire. Data collected from the online questionnaire included the students' opinions, challenges, and knowledge about CAD.

The questionnaire was structured into four sections: the first section questioned the students' exposure to various technologies; the second section gauged the students' opinion on their current CAD competencies; in the third section the students were questioned about CAD problems they encountered; and the fourth section explored possible solutions to CAD problems faced and their thoughts about their future and future technologies.

Although the data obtained from the students' online questionnaire was mostly quantitative, qualitative data was obtained through open-ended questions that gave the students an opportunity to remark on their own opinions and experiences. The addition of these qualitative questions created a more in-depth response from the students, which could assist us in drawing better conclusions based on all the students' answers.

The questions in the questionnaire were formulated by adopting the recommendations of similar studies conducted about CAD teaching, whether the studies focused on student or lecturer participation. A study by Matejovska and Achten (2011) presented findings about CAD students before they registered for their studies and their opinions about their CAD practice. We used and adapted the questions from Matejovska and Achten (2011) for the first two sections of the questionnaire.

Sections 1 and 2 of the questionnaire are also based upon research by Garcia, et al. (2005) and Bernabei, et al. (2016). Garcia, et al. (2005) developed a questionnaire sent to CAD teachers at various Spanish universities to gauge various aspects of the present state of CAD teaching, including class duration and student capacity. Another study by Bernabei, et al. (2016) investigated themethods to incorporate into CAD in jewellery-design-based tertiary education institutions. In this study, a questionnaire sent to the CAD teaching staff of five institutions investigated teaching methods, perceived advantages and disadvantages, and possible problems faced by the CAD lecturer.

Sections 3 and 4 of the questionnaire included COVID-19-related questions and gauged the impact of the pandemic on CAD teaching and learning. Autoethnographic and phenomenological questions based on the CAD lecturer's observations and teaching experience were added in Sections 3 and 4 of the questionnaire.

Population

The participants for this project consisted of the entire student cohort of the tertiary institution's jewellery programme. Due to the small number of students registered in the first-year jewellery programme, all the jewellery students were invited to participate in this research. The participants included the first-year jewellery students (25 registered students), second-year jewellery students (20 registered students), and third-year jewellery students (29 students) of the 2020 academic year.

Results and discussion

Exposure

The first section of the questionnaire sought to understand what, if any, the student's previous exposure to or use of technology was before starting at a tertiary institution. The questionnaire presented various current technologies related to the fourth industrial revolution and asked what the students' level of exposure was to these technologies. The questionnaire also investigated for what the students used these technologies.

At least 80% of the students stated they had used or were still using smartphones, laptops, social media (Facebook, Instagram, and Twitter) and streaming platforms such as YouTube, Netflix, and Spotify. The students noted that they used these technologies for various purposes such as entertainment, connecting with friends, online learning, conducting research, learning about interests, and keeping up with current events.

Over 60% of the students used or still use gaming platforms such as PlayStation and Xbox for entertainment and to connect with friends, and 69% of the students used smart assistants and online learning platforms to assist them with research and learning.

While few of the students had used any of the other technologies listed – software programming, CGI/animation, robotics, and artificial intelligence– most had knowledge of these technologies.

When asked whether the students had previous knowledge or had used 3D software programmes before their tertiary studies, 31% of the students had heard of (14%) or seen someone (17%) using a 3D software programme, and 28% had used programmes such as Blender (an open-source 3D modelling programme and architectural and industrial design 3D modelling programmes before starting their studies in the jewellery programme (Figure 4). The remaining 41% knew little or nothing of 3D software before entering the tertiary institution.

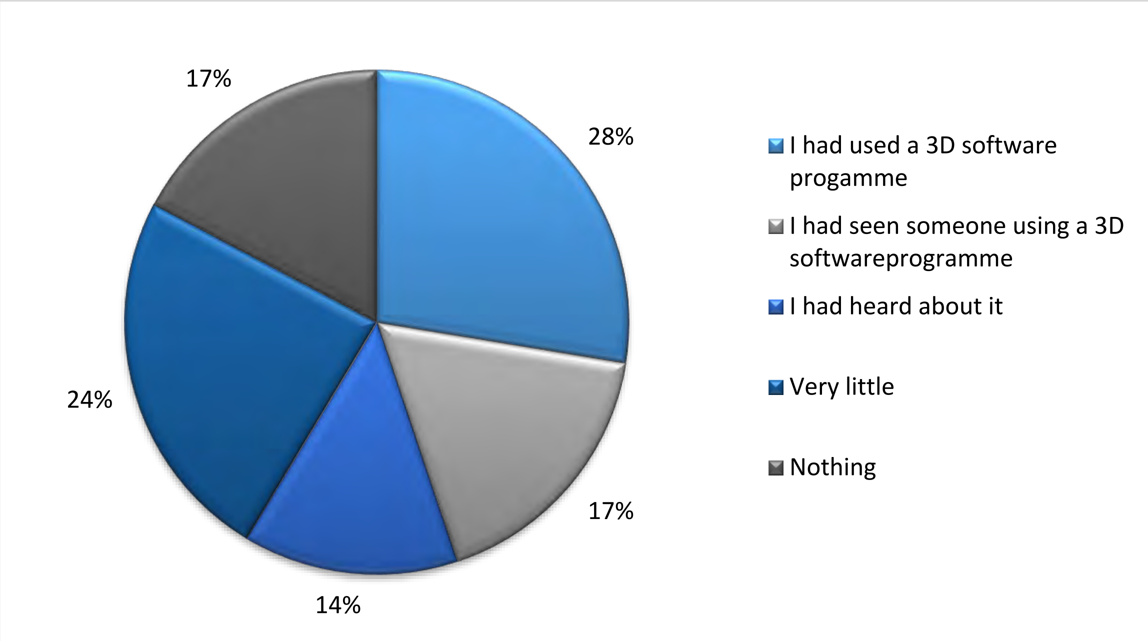

Figure 4: Students' awareness of 3D software before tertiary studies

With so many of the students showing an aptitude for the 3D software in their CAD class, it could mean that just the exposure to various technologies provides ease and confidence with using the newly introduced technology. Another possibility could be that the knowledge of 3D software provides them with aspirations of using these technologies. It can also be postulated that the students are further influenced by their newfound peers at the tertiary institution who have had previous exposure to these technologies.

If the students already engage and are familiar with several technologies, then these technologies can be explored for online teaching methods, for example, employing platforms such as YouTube or social media platforms for live streaming, instructional videos and forums, as well as using gaming disciplines as teaching methods.

Current competency

The next section of the questionnaire sought to understand how the students feel about their progress and what they think their competency is in CAD.

As seen in Figure 5, most students (93%) found the introductory CAD class exciting (62%) and informative (31%). The introduction demonstrates to the students where their skills will be useful and how learning the CAD software will assist them in the jewellery industry.

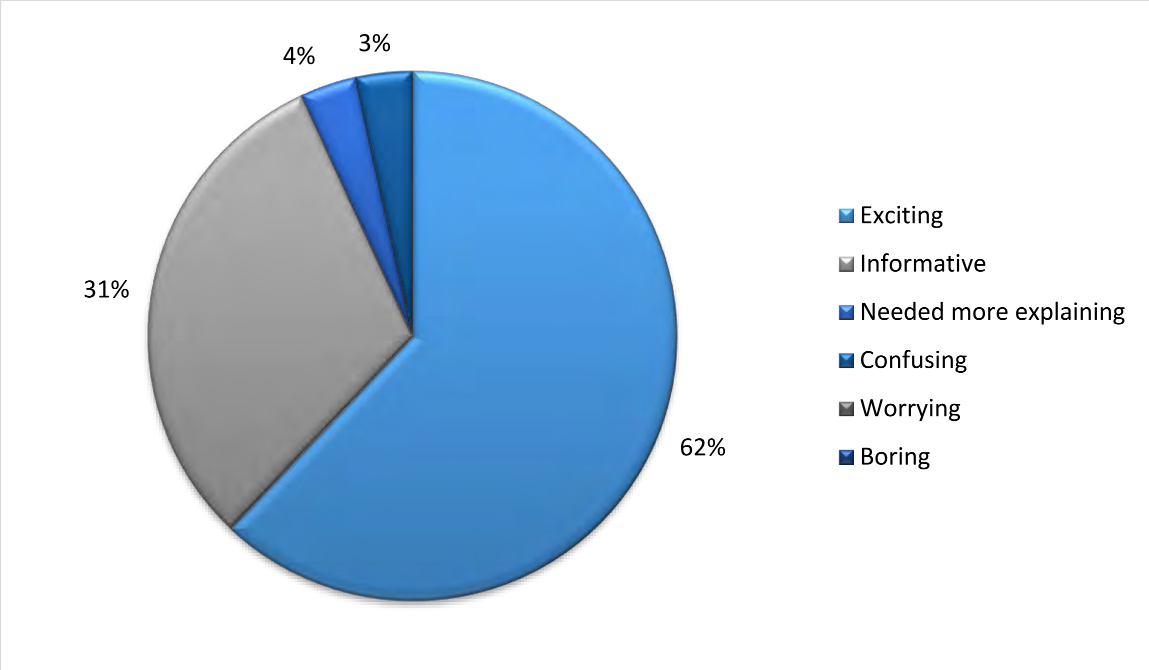

Figure 5: Students' experience of the CAD introduction class

Figure 6 shows that 69% of the students grasped CAD tools once the tools were explained by the lecturer. This clear grasp of CAD tools implies that the lecturer-led teaching remains important and can be implemented for online learning through online tutorials explaining and showing the various software tools in instructional and step-by-step videos. Figure 6 further indicates that it took a few lessons for some students to understand all the software tools (28%), and only one student took a few months to comprehend the tools fully.

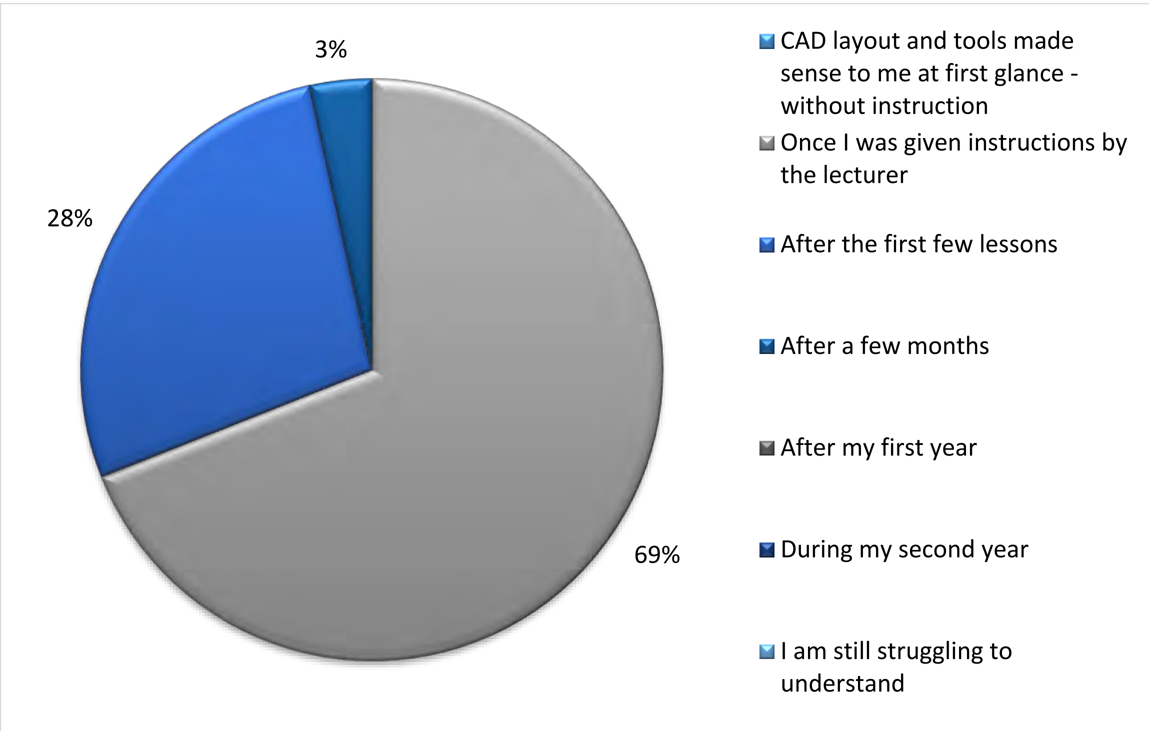

Figure 6: When students comprehended CAD layout and tools

When asked how the students felt about their overall CAD experience, the response was positive. One student responded, *"I heard [a bit] about CAD before I came to university. When I arrived at university, I got a chance to work on CAD and through the lessons I [received] and practice I got the basic ideas of how the software works and now I am able to create a printable piece and I can be creative on the software"*.

When exposed to CAD, another student was astounded by the capabilities of 3D modelling and how it helps them design. The student noted: *"I was shaken by the idea of dimensional transitions, how you can build anything from nothing. To take a 2D structure to [an] 3D form from a push of a button at the comfort of your seat. Very exciting".* Several students said that they came to see the advantages of CAD over time, and to understand how the software could help them with design. A student who initially struggled with CAD enjoyed it once they understood it better: *"I just started liking CAD now as I have a way better understanding how and why things are done the way they are"*. Several students mentioned that they would like to have more classes, access to laptops, and the CAD software to improve their CAD skills.

When asked whether they can see themselves using CAD in the future, 90% said yes, and the rest of the students said maybe. Half of this 10% group responded that they would use it for jewellery-specific and related design work, and the other half responded that they would use it for any design-related work.

Problems faced

The questionnaire then examined obstacles the students faced both before and during the COVID-19 pandemic.

When asked whether once a week (before COVID-19) was enough time spent on CAD, 59% of the students answered no (Figure 7), and when given the option to suggest more hours, 72% suggested more days and/or hours a week. Around half the students (48%) suggested two classes, and a fifth (17%) suggested three or more classes. The remaining 7% suggested more hours per class. One student commented: "Technically two classes per week, but realistically one class per week will be enough considering that students have other subjects to focus on, so more classes might be a bit overwhelming even though it can be beneficial".

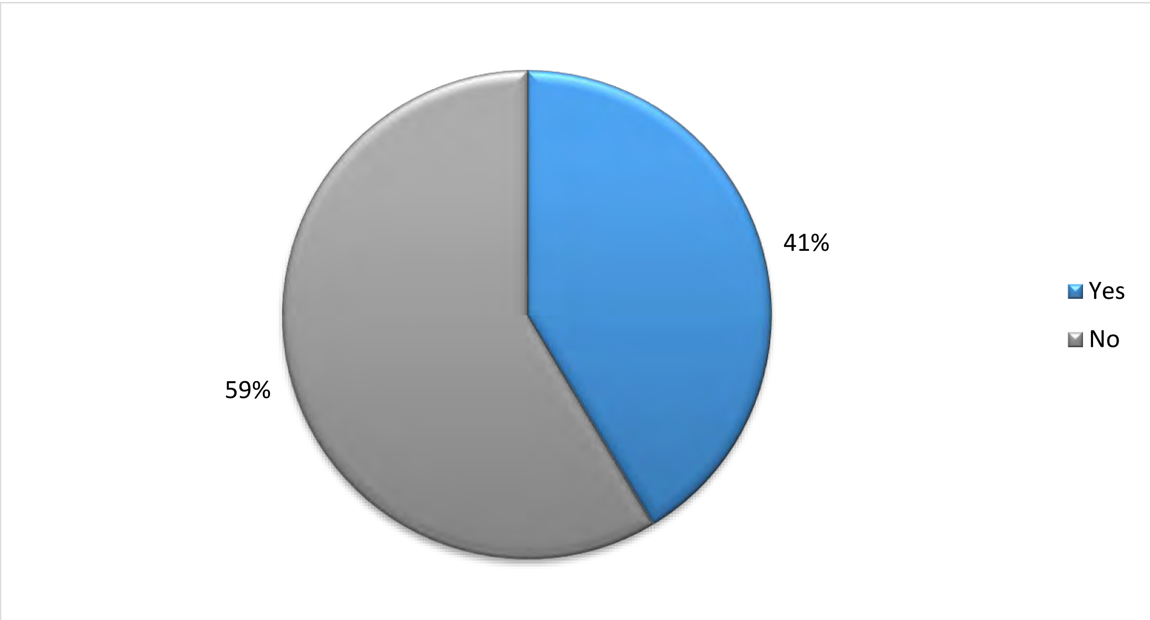

Figure 7: Students' opinion regarding whether there are enough CAD teaching hours per week

During COVID-19, classes were halved due to social-distancing requirements. When asked if the students would be interested in online classes to supplement their missed class due to the COVID-19 protocols, 59% of the students replied yes. We asked the students if they had access to a computer. Of the students who answered yes, 65% have their own computer, 25% have access to a family computer, and 10% said they could use a computer at the community centre (Figure 8). Conversely, Figure 9 shows the breakdown of reasons students cannot attend online classes, with 24% not having access to a computer or laptop, 14% not having the right specifications to run the software, and 48% not having access to the software programme. Some students (9%) cited a lack of data as a problem, and 5% have network coverage challenges. When asked whether the students would do homework if they had access to a computer with the right specifications and the software, 100% responded that they would revise between classes to further their CAD skills (Figure 10).

This information about resources clearly highlights the importance that access plays in online teaching and for the students to revise for improving their CAD skills.

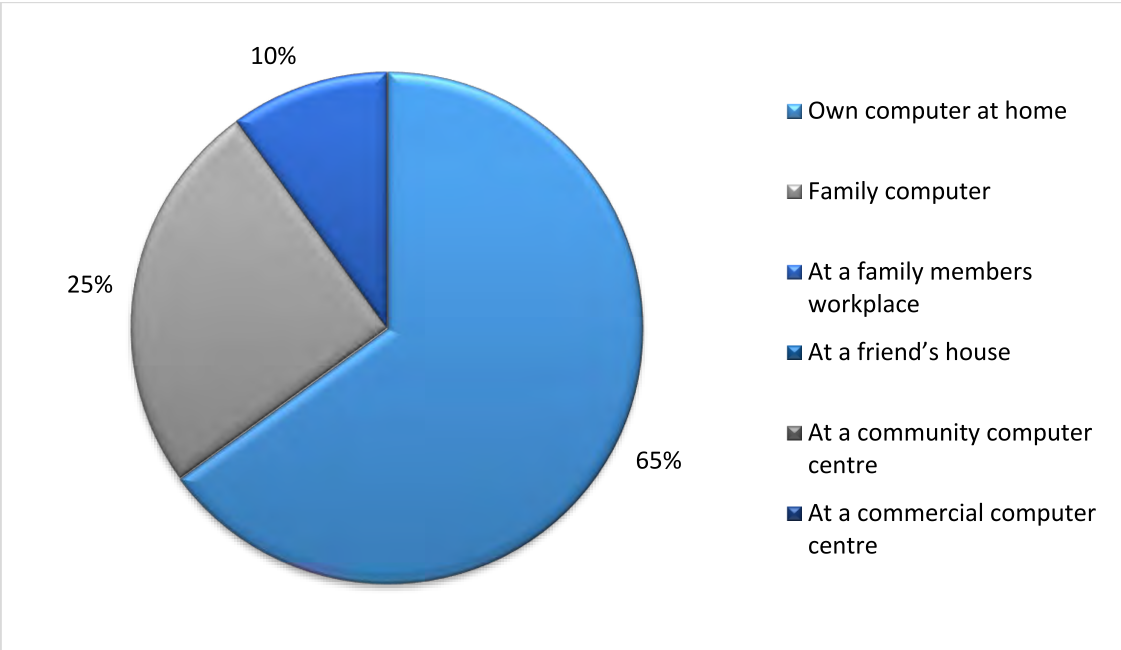

Figure 8: Students' after-hours access to a computer or laptop

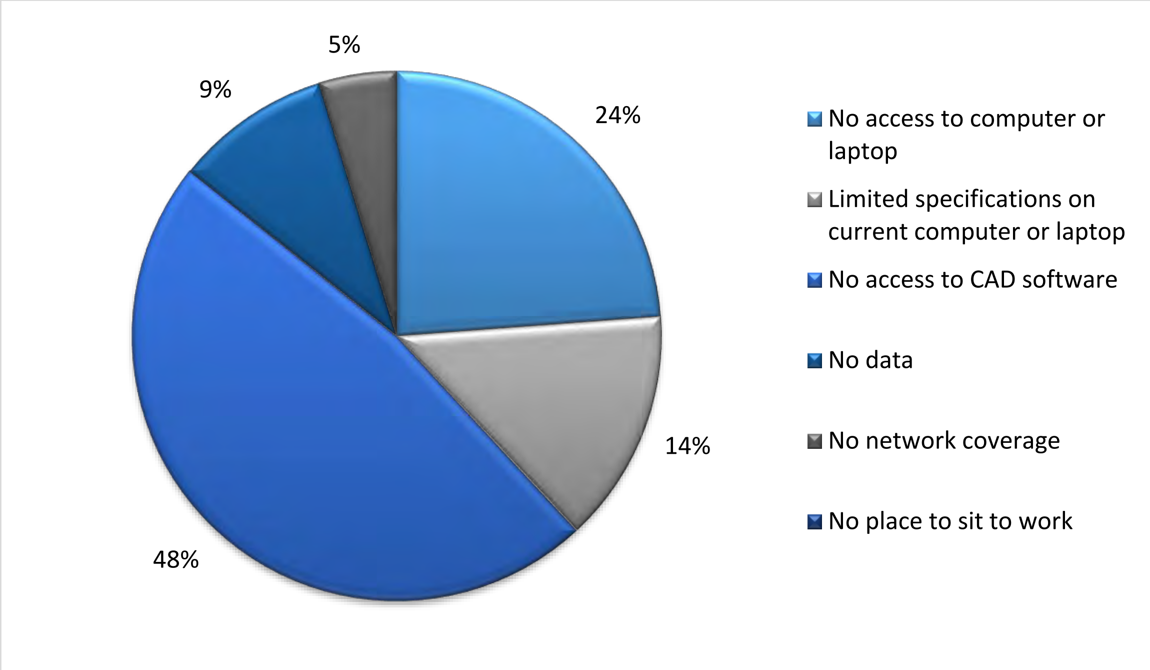

Figure 9: Students' reasons for not learning or revising online

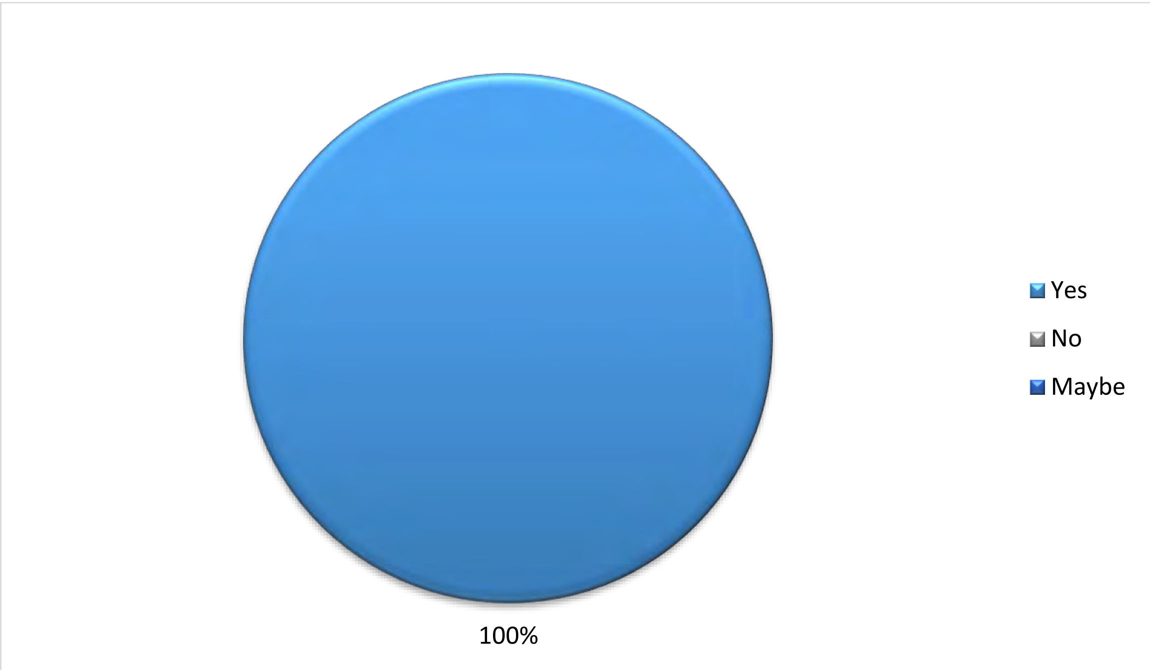

Figure 10: Students who would revise if they had access to a computer with the software

Solutions

The last section of the questionnaire gauged the students' opinions regarding possible solutions and concerns they have. The students were also asked their opinions about the fourth industrial revolution and what role they think the fourth industrial revolution will play in their futures.

We asked the students if they could complete online classes at their places of residence if they were given a computer and the CAD software. Figure 11 indicates that 83% of the students said they could complete online learning at their residence. Of the students that could not do online classes at their place of residence, 40% of them said they have no data (30%) or network coverage (10%) where they live, 20% have safety concerns when carrying around a laptop, 30% said their environment was not conducive to learning, and 20% said that they prefer one-on-one classes.

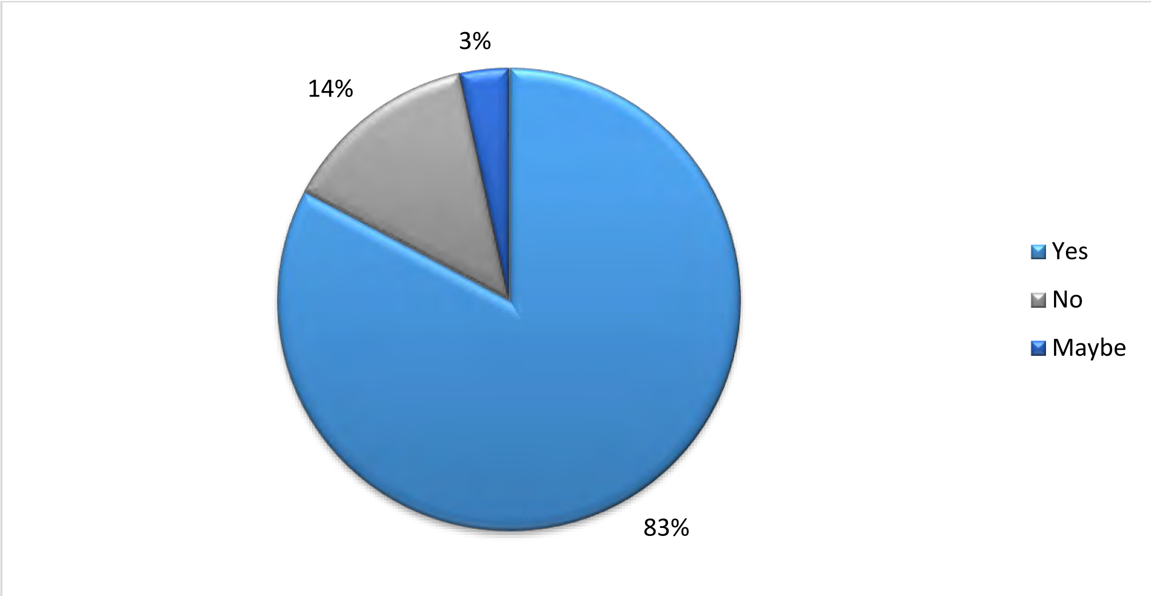

Figure 11: Students' accommodation's conduciveness for working online

When asked which platforms the students would prefer for online classes, the highest-rated choice at 58.6% was the institution's online learning platform. A close second was YouTube with 44.8%, online meeting platforms such as Zoom and Skype at around 30%, and WhatsApp at 24.1%. The ideal online teaching method for the students thus would be to integrate the platforms (such as YouTube and Zoom) within the institution's own online learning platform.

We also wanted to know which teaching methods would best meet the students' needs regarding online learning. Figure 12 shows that 72% of the students said they prefer online videos, with step-by-step videos are done by the lecturer (52%) being the most popular option. A small number (10%) of the students cited a combination of two or more of the options, and only one student responded that they prefer in-person classes.

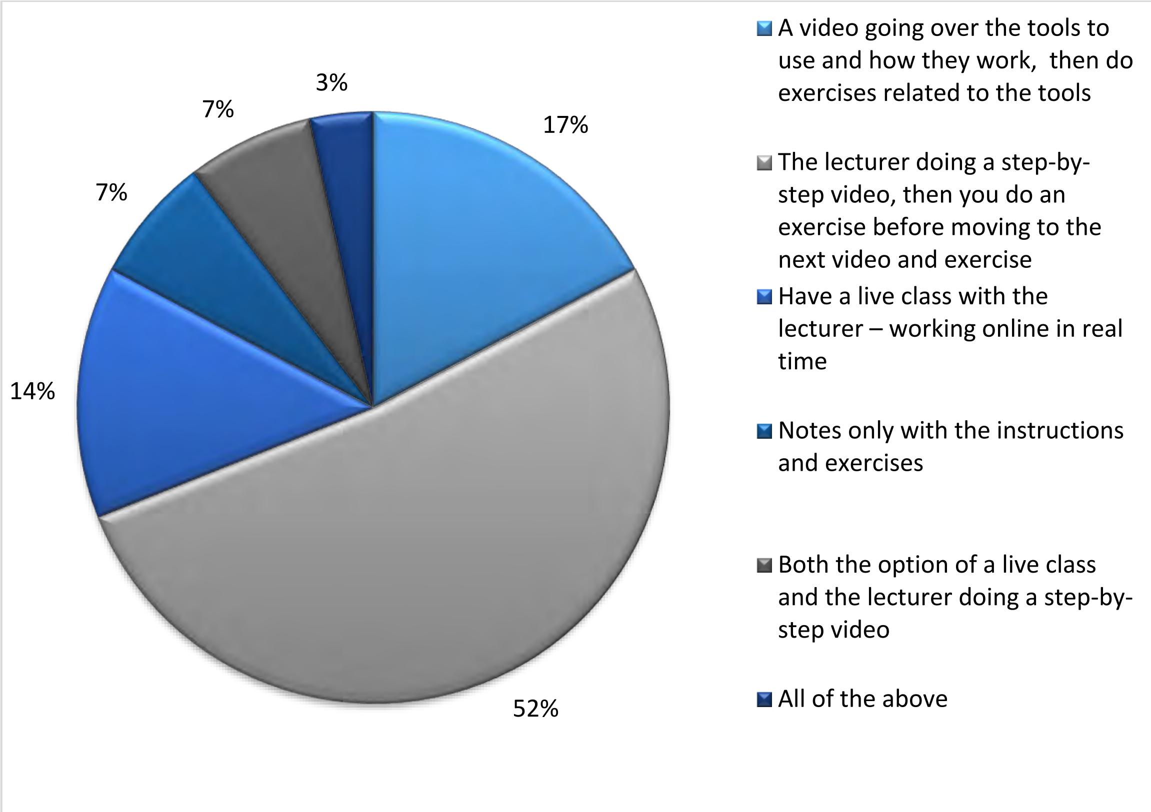

Figure 12: Students' choices regarding suitable methods for online learning

The students were forthcoming with their suggestions regarding online learning. Several students mentioned instructional videos as a possible solution: *"Video instructions are better because one can play back where they missed a step".* Another student suggested that *"The [instruction] videos should be online to be downloaded and viewed anytime".*

One student proposed the following: *"Come up with fun-learning activities related to the programme. Most art students are virtual learners with photographic [memory]. And our brains tend to capture what we do with our bodies more than what we do sitting down".*

When we asked the students what their interest would be in learning CAD in a gaming format, most of the students (79%) said yes, indicating that using gaming incentives could be incorporated as an option in the teaching method (Figure 13). Gaming could be implemented in various ways, such as various levels of learning or new tools that can be unlocked once having successfully completed a previous exercise, or using a 'reward' system for learning more 3D modelling skills.

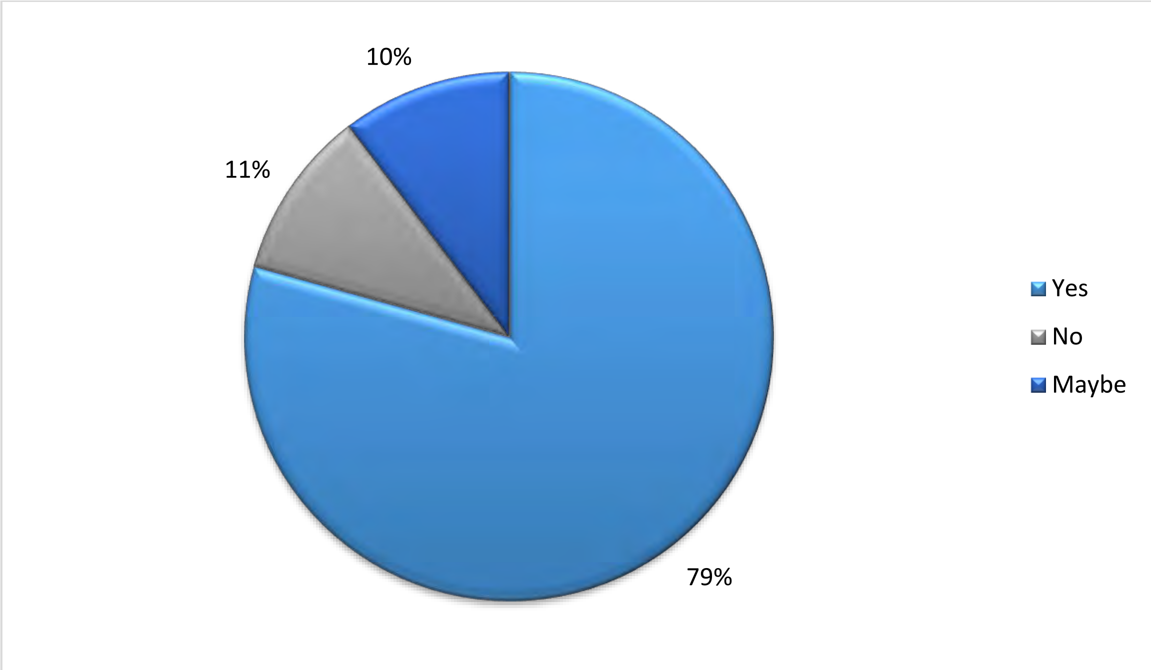

Figure 13: Students' interest in learning CAD using a gaming format

Most of the responses confirmed the importance of the lecturer facilitating any online teaching and that the students would like access to lecturers for guidance. One student suggested that *"If the lecturer [cannot] be a part of the live meeting, then having a diligent student who understands the programme well or an online tutor for the students while going over the lesson to assist them. TeamViewer could also be a handy application to show individual students on their programme what the problem is and how to fix it".* In this instance, an online forum could be a feasible solution where the students can raise their questions and respond to each other with the lecturer answering at allocated times.

Again, a few students reiterated the importance of having access to the software and hardware for successful online CAD learning. One student commented: *"Yes, if we can get laptops that have the right specifications to run the Rhino software. We will engage more on online learning via Zoom or live classes, making it easier for us as students to learn the programme swiftly".*

In our final questions, we specifically asked about the fourth industrial revolution and how the students felt about it. Overall, most students indicated that hearing the term 'fourth industrial revolution' made them curious and excited, while others were wary and nervous.

The students were asked what they knew about the fourth industrial revolution. Figure 14 shows that 34.5% had some knowledge, 28% had a reasonable amount of knowledge, 14% knew nothing, 21% very little, and only one student replied that they knew a lot.

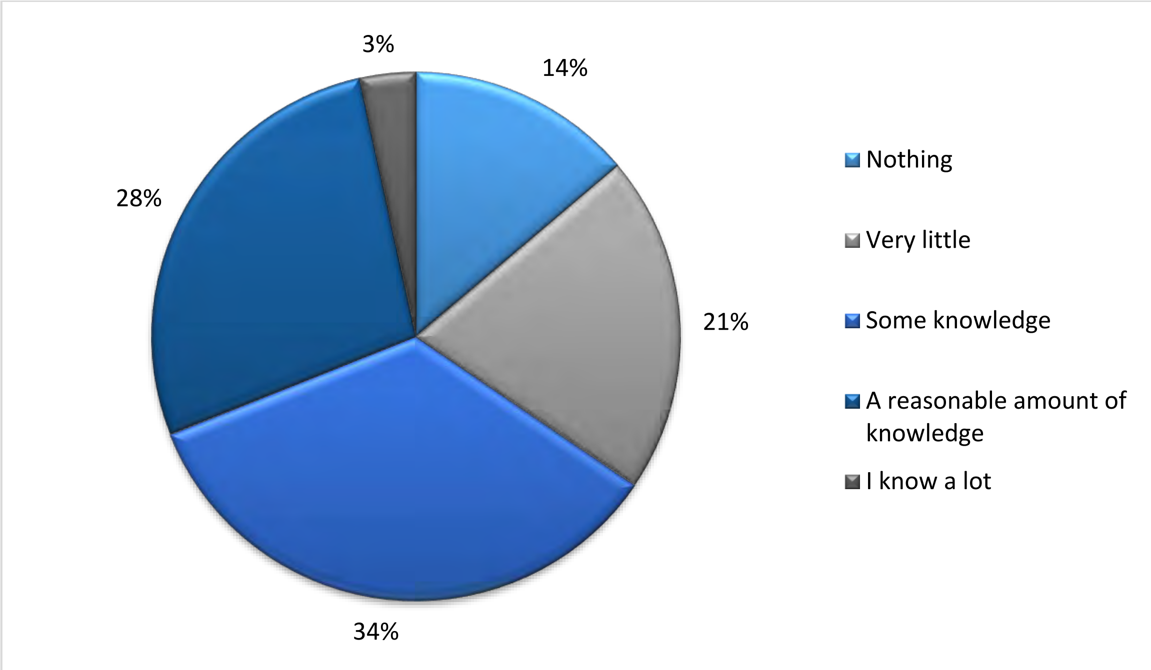

Figure 14: Students' knowledge about the fourth industrial revolution

The questionnaire then asked students in an open-ended question to mention their outlook about the future regarding the fourth industrial revolution. The answers ranged from overwhelming concerns about South Africa's socio-economic issues to concerns about an inability to keep up due to a lack of resources. Some students were worried about the new technology furthering inequality in the country, with one student cautioning, *"Increased unemployment may drive economic inequality in society".* A student also mentioned that the fourth industrial revolution could drive unemployment: *"I feel it will/is replacing the workforce on the production industries, thus means more [people] are [losing] their jobs through it's fast and efficient"*. Another student voiced this concern: *"it will make my job obsolete and that all working-class people will be out of a job".*

The lack of basic amenities in some of the poorer communities in South Africa was also mentioned with a student stating: *"Our continent isn't ready for that. We still have people that don't have access to running water and toilets. We can't really be talking about the prospect of 4IR".*

These students are concerned with their own development and also how their development will affect the rest of the country, and was very aptly put by the following comment: *"Not everyone has access to laptops/computers, quality education, and even the internet. How on earth will they catch up while the rest of the world is living in a digital era. This only means one thing for them, they will simply be left out, and that's not the world I want to live in".*

Conclusion

This paper aimed to gauge the students' CAD competencies so that CAD teaching can be improved in the jewellery programme. There is currently limited research available on CAD teaching for jewellery design and implementation. The study data was gathered through a questionnaire that was sent to all the registered jewellery programme students. The information gained in this research will be implemented in CAD teaching to improve the students' employability and address possible CAD-specific problems faced by the students.

The first section of the questionnaire showed that most students were exposed to technology before studying at a tertiary institution. This exposure is ultimately beneficial for the students, as it helps familiarise them with the CAD software and tools.

Most students viewed themselves as competent in CAD and as understanding the CAD tools. Although most students found the experience positive, they mentioned that they only understood better once explained by the lecturer.

One of the prevailing problems that the students mentioned was the lack of resources required to complete online classes and revise. Other problems mentioned by the students include access to data and network problems.

The students are optimistic about using CAD in the future. However, concerns and apprehensions about the possible negative effect of these new technologies were raised. The students mentioned socio-economic problems such as unemployment and inequality as potential negative consequences of the fourth industrial revolution.

The students' overall positive responses and suggestions to this questionnaire provide a good online learning foundation on how to proceed with and adopt their suggested teaching strategies. Although a student-led teaching approach can be incorporated as a teaching method, the students mentioned that they still prefer lecturer input and teaching and are comfortable making suggestions about various teaching methods. Consequently, the students will become part of the CAD teaching methodology. Through student-teacher teaching collaboration, the students will become active role-players in their own learning experience.

This type of research is vital to address the unique challenges faced by South African students. How educators can improve the CAD teaching methodology in South Africa, specifically in jewellery design, should be considered an evolving process that is aligned to and influenced by student abilities and technologies.

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DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Lost connection: Reflections on online jewellery design teaching

Shashi Cullinan Cook, *University of Johannesburg*

Thato Radebe, *University of Johannesburg*

Khanya Mthethwa, *University of Johannesburg*

Cailin Ernst, *University of Johannesburg*

Abstract

In this paper, four educators teaching undergraduate jewellery design and manufacture recount our adaptations to online learning during the COVID19 lockdown, and how this impacted our ideas about lecture content and delivery. We look at the possibilities for online study in jewellery design in relation to the developments of the fourth industrial revolution, such as blended learning, simulations and computer-aided design and manufacture. We share adaptations that may serve educators in distance or blended learning scenarios. However, the lockdown created difficult learning circumstances in South Africa in which we often 'lost connection' due to high data costs and inequalities in students' living conditions. We discuss problems of student access, staff and student resilience and wellbeing, and how coloniality and technocracy are bound together in 4IR.

Keywords: 4IR, blended learning, inequality, jewellery design, online teaching, resilience

Introduction

A national lockdown in South Africa began in March 2020 in response to the rise in COVID-19 infections and increasing burdens on the health system. At the University of Johannesburg (UJ), the final week of the first term was cancelled and students went home, 'returning' (virtually) in the second term to the 'new normal' of online teaching. In this paper, four educators teaching undergraduate jewellery design and manufacture recount our experiences and adaptations for online learning to identify what we can learn from this emergency and apply these lessons in future.

The authors Thato Radebe, Khanya Mthethwa and Cailin Ernst are the first, second- and third-year coordinators at UJ's Department of Jewellery Design and Manufacture, while Shashi Cullinan Cook coordinates the Contextual Studies module. The department is headed by Farieda Nazier, who led the process of setting up meetings during lockdown and gathering information to design the curriculum around our students (and offered critique on this paper). Our department is small in comparison with others in our faculty. It employs two permanent staff members, ten contract staff, and has a capacity for 70 students. Student numbers are consistent, with around 23 first-year students, 18 second-year students, 17 third-year students, and eight honours, advanced diploma and master's students. Demographically, student cohorts trained in the department over the last five years have been predominantly people of colour, with equal gender representation.

The experience of online learning alerted us to the potential for the greater integration of technologies of the fourth industrial revolution (4IR) in our teaching. Compared to the other revolutions humankind has experienced, the 4IR is different in scale and complexity. It is described as "the blurring of boundaries between the physical, digital, and biological worlds" and "a fusion of advances in artificial intelligence (AI), robotics, the internet of things (IoT), 3D printing, genetic engineering, quantum computing, and other technologies" (McGinnis, 2020). These advances challenge ideas about what it means to be human and are developing at a rate that affects all aspects of life – economic, industrial, governmental and personal (Schwab, 2016, p. 7). We discuss this and share how online learning shifted our ideas about lecture content and delivery, noting some adaptations that help with blended learning.

However, our paper's title, 'Lost Connection', alludes to the realities of online teaching in which connection was often intermittent and disrupted, and to the social disconnection and opportunities missed due to context-specific issues of inequality and access. This must be considered in relation to the 4IR as it suggests a lingering relationship between coloniality and technocracy.

Methodology and method

This paper is interpretive-constructivist, drawing mainly on reflections by lecturers on their teaching practice, and characterised by "openness to learning and change" and "willingness to revise thinking in light of experience" (Schwartz-Shea & Yanow, 2011, p. 74). Context is essential in interpretive research to "understand how specific human beings in particular times and locales make sense of their worlds" (Schwartz-Shea & Yanow, 2011, pp. 11-12). Interpretive research often begins with abductive thinking. In this case, we noted the lessons of the lockdown and puzzled over their significance for our field.

Throughout lockdown, during online staff meetings and group chats, colleagues shared challenges such as high anxiety, home environments unconducive to work, and the relative usefulness of online teaching platforms such as Blackboard and WhatsApp. As events unfolded, we pondered the significance of this, and the impact of COVID-19, on the future of jewellery design and manufacture education in South Africa. Noting that we had major concerns around the realities of online learning, we delved into this in the form of this reflective research paper – based on our field and working notes, and on "researcher memory, and embodied experience" which are important in interpretive research as these "provide the material for researcher sense-making" (Schwartz-Shea & Yanow, 2011, p. 89). We pooled our reflective accounts and drew from these the themes presented in this paper – concerning the lessons and possibilities of online teaching; staff and student wellbeing and resilience; and coloniality and technocracy. The reflective and retrospective nature of this paper is necessary because the work done during lockdown was not a planned research intervention.

Our conclusions about the practice and implications of online teaching and learning are intended to guide jewellery and design educators in future decision-making.

Innovation under pressure: can jewellery design and manufacture be taught online?

Lockdown showed us that learning online from home presents myriad issues for the ordinary student in South Africa that impacts their wellbeing and performance. However, as educators in a country that embraces technology and intends to keep up with global advances, we must develop and learn more about technologies that work in our context. This begs the question: what are the possibilities for online teaching in jewellery design and manufacture, and what is needed to advance this?

In a paper questioning whether design can be taught online, Katja Fleischmann (2019, p. 3, citing Kumar, et al.) explains that "Comparatively few fully online design courses exist while other academic disciplines are experiencing rapid growth in offering fully online subjects". Fleischmann acknowledges that while media design lends itself well to exploring fully online design teaching, smaller studio-based classes form the bedrock of learning in many design contexts, focusing on "supporting interaction, active learning" and "social engagement" (Crowther; STP cited in Fleischmann, 2019, p. 1). This is true of our jewellery department as many of the modules are practical – held in studios and workshops.

Jewellery practice, particularly techniques, involves learning manufacturing hand skills and working with precious and semi-precious materials, workshop and bench equipment, tools and chemicals. Hands-on, studio-based teaching is core to teaching 'qualified jewellers', for example, first-year lecturer Thato Radebe literally holds a student's hand to train them to solder.

Metal preparation involves the use of gas and oxygen systems installed and maintained by qualified professionals. This equipment is expensive, specialised, and potentially dangerous (Figure 1). The need for safety and resources makes it impossible for students to work unsupervised outside of the department, and therefore, for lecturers to teach the required techniques. To study these online, students would need a home workshop; constant internet access; and a technician or safety monitor as the substances and processes can be dangerous, and the department could be held legally liable for accidents.

Figure 1. Mmeshi Nkadimeng (photographer), jewellery design and manufacture student working on smelting/metal preparation at the melting bay, 2021

Our challenge during lockdown was to adapt this heavily practical qualification to suit an online learning environment and keep students engaged. Initially we focused on teaching theory, but with no end in sight to the lockdown, the need to awaken practical muscle memory grew pressing. We reintroduced creative practice online using simulations, video demonstrations and time-lapse presentations, YouTube tutorials and model making. Staff and students pushed the limits of their creativity using recycled materials, found objects, and even clay-making skills.

Simulation

To help students keep their manufacturing knowledge on the burner until studios opened, lecturers tasked students with producing videos where they imagined themselves in a workshop environment and recorded themselves doing step-by-step simulations of the manufacturing process. This encouraged tacit learning because students were using similar motions and thought processes as in a physical studio space. However, students had different levels of access to support materials, and therefore model-making and manufacturing simulations had to be open to interpretation. Morale improved considerably when students were allowed to return to the studio in a partial lockdown schedule, and we rushed to teach and learn as many jewellery techniques as possible in a limited time.

We propose that, in future, design educators could explore using simulations in online learning. If students have access to virtual reality (VR) technology anywhere in the country, it would close the current gap between manufacturing in the real and VR worlds. It is already possible to work on a model with VR, and 3D-print it at home (Atwell, 2017; Nigro, 2020), but the price of such tools is prohibitive. Soon, however, these methods might be normalised and more affordable, and we look toward that possibility, beginning with identifying more accessible computer-aided design and manufacturing (CAD/CAM) programmes.

CAD

The biggest 4IR advancement in jewellery design is in CAD/CAM and 3D printing, or additive manufacturing, which involves using software, hardware, and materials to create physical objects by depositing materials in layers based on a digital model (Autodesk, 2020).

Figure 2. Formlabs 2 3D printer, 2019 model (Formlabs 2021)

This is advantageous because it allows manufacturing businesses to print their own parts, with less tooling, at a lower cost, faster than via traditional processes, with designs customised to ensure a perfect fit. Designing jewellery using desktop 3D printers (Figures 2-4) combines the precision of CAD with the tactility of a prototype to produce consistent, symmetrical pieces without the tediousness and variability of wax carving (Formlabs, 2021).

Figure 4. Thato Radebe (designer; photographer), resin ring stand, 2019, photopolymer resin, 2019, 53 x 75mm

However, during lockdown, CAD classes were postponed until students could return to the studio because Rhino 7, the software used to teach the module, is licenced to the departmental computers. It costs around R14,000 to buy it for individual use – far beyond what most of our students can afford.

Radebe investigated the use of open-source CAD programmes because the technology is freely downloadable and the plug-ins in most of the programmes are compatible. It is theoretically possible to run an open-source CAD programme called Blender on a smartphone (Coriolis, 2015), but Radebe tested this and found it impractical in the current circumstances. The data needed to download the software was costly, the installation process was complex, and most students' devices lacked the memory to run them. If this were adopted for online learning, a high-spec device would need to become another 'tool of the trade' in addition to manufacturing tools – increasing the overall study costs. Theft is also a factor in a South African context that results in associated costs for insurance and losses.

We need time and resources, such as suitable applications and hardware, to develop these options. Using Blender to teach CAD online might be viable for distance learning in future, as long as technical support is available to students.

Blended learning in jewellery design and manufacture

Fleischmann (2019, pp. 34) suggests that blended learning is currently a better option for exploration in design education than fully online teaching. In our case, some modules were teachable online on days when students worked from home to avoid crowding in studios. These modules included design and drawing units (supervised drawing and creative tutorials focusing on visualisation); Gemmology (study of the properties of precious stones); Technology 1 (theory behind the jewellery tools and techniques); Contextual Studies (critical thinking and writing about jewellery design history and theory); and Design Management (entrepreneurial skills and business practice). These are our provisional findings, drawn from our reflections on teaching these modules online:

Educational platforms and tools

1. <u>We used mainly WhatsApp and Blackboard as our teaching platforms.</u> Blackboard recording functions and WhatsApp threads and transcripts made it easy for students to access and repeat a lecture. Third-year coordinator Cailin Ernst found that creating PowerPoint lectures with voiceover and posting these on Blackboard worked well for theoretical subjects, followed by discussion boards and Q&A sessions. Some lecturers also used WhatsApp for this purpose with Blackboard serving more as a repository for learning material and a submission portal. Group chat transcripts from WhatsApp and other platforms can be edited and loaded on Blackboard as class notes, making class discussion an integral part of the learning experience and notes.
2. <u>Lecture methods:</u> students looked at lecture content on <u>PowerPoint slides</u> and responded with questions in a flipped-classroom style, or lecture content was created dialogically (through the sharing of texts, voice notes, images and videos).
3. In cases where students struggled to understand the required visual end-products, lecturers tasked them with sketches and gave feedback on problematic areas, providing <u>Googled images</u> as visual references.
4. <u>Video demonstrations and YouTube tutorials</u> are powerful aids in sharing practical tips, and students could watch them repeatedly.

Communication, lecture content and delivery style

Lessons ran as if we were physically in class, greeting students at the beginning of the day/lecture, and noting replies on the register. Not replying equated to not participating, although replies could be asynchronous when real-time communication was impossible.

1. <u>Lecture content had to be self-explanatory</u> to maximise opportunities for students to be independent and self-motivated. This strengthened the quality of the learning materials supplied.
2. Lecturers and students had to be concise and conservative in their wording without oversimplifying. The increased use of writing and reading boosted these proficiencies during lockdown and <u>honed professionalism in written communication</u>.

A 'human touch'

1. Spontaneity and a 'human touch' were conveyed on WhatsApp through <u>voice notes</u> – a low mb/cost option – and by <u>emojis, GIFs and memes</u>. Emojis are integral in online learning, digitally conveying facial expressions and body language.

2. Video and voice notes with enthusiastic tones work best (Brame in Fleischmann 2019, pp. 5), with the voice being a way to connect and convey warmth and interest. Voice notes also help when too much text gets overwhelming or confusing.
3. Online practice and simulating 'real time' effects in online teaching: During timetabled contact time, Radebe explained, "I wanted to ensure that I could give feedback on the work presented as seamlessly as I would have if we were in the design room, from a physical time point of view. … I always had to have my phone in my hand and the ring tone set on loud so that I could jump onto the phone as soon as a WhatsApp message came in". This coheres with findings that "the successful implementation of online collaboration in design depends on high student participation rates and quick instructor feedback" by Bender and Vredevoogd (Fleischmann, 2019, p. 4).
4. Flexibility and spontaneity in online teaching may be reduced if lectures become overly prescribed and transmission-focused, so maintaining dialogical communication creates a responsive learning environment, helping to build trust and ensure affective learning.

Some advantages and lessons of online education:

1. There is an interesting spatial difference in online environments. Physical lecture venues place students 'facing forward' at the lecturer but an online group is more of a web or network of teachers and learners.
2. While there is still a hierarchy and power dynamic in online lectures in which lecturers set topics for discussion, the constant feedback required from students (signalling participation) dilutes the 'sage on the stage' tendencies of some lecturers.
3. While students were slow to formulate and type questions and answers, some seemed more confident to speak up in text than in person. Comments were often more well considered than those voiced in physical classes. More students asked questions than in a physical class situation, and different students posted queries (rather than those who tended to dominate physical lectures). It also seemed that students paid more attention to one another's responses than in physical classes.
4. The 'chatty' quality of WhatsApp communications can be an asset: Online environments in WhatsApp, Zoom or Teams may see multiple conversations coinciding – between lecturers and students, and among students. It does not matter if messages 'interject' in a dialogue. This burble of voices is a vibrant aspect of online communication, provided one can handle distractions.
5. Advantages of online 'studio crits': Studio crits are central to art and design feedback (Fleischmann, 2019). Although intended to be interactive and inclusive, with students and lecturers gathered to give input, there are often practical problems with the physical crit. COVID19 concerns aside, it is difficult for 20 people to gather around a piece and see it equally well. As physical crits wear on, some students become disinvested and hang back, not taking an interest in their peers' work. Lecturers' voices may become dominant, and students may follow lecturers around without offering peers much feedback.

However, greater visibility is afforded when sharing drawings and photographs of progress on WhatsApp groups. Using a messaging component in physical studio crits may spark more (or more audible) peer feedback and encouragement.

These lessons are applicable both in future emergency online teaching scenarios and under usual circumstances, however, some realities of online learning need urgent attention.

Coloniality and technocracy

Conducting our curriculum digitally, while our physical beings were scattered around the country, made us appreciate how the 4IR blurs boundaries between the physical and digital worlds, and we must engage with this in our teaching. However, the issue of lack of student access made the exercise somewhat unsuccessful even though the possibilities are inspiring, so the difficulties of online learning in a South African context must be addressed. There is a tendency to ignore questions of access in the quest to appear globally competitive. This 'survival of the fittest' narrative perpetuates and entrenches historical inequality.

The writers of this paper all witnessed #feesmustfall – the student-led protests over increases in higher education fees – and we acknowledge high fee costs and financial inequalities between students. Economic contraction is also a generally worrying factor in the jewellery industry (Mamaila, 2020), and we had worked hard before COVID-19 to streamline and improve the course at all levels – technical, business, theory, design, studios and equipment. Having got through the annually challenging hurdle of getting students registered (and perennial funding delays), we were forcibly reminded when students went home during lockdown that their levels of privilege and access differ. Considering these stark inequalities, we took care to keep track of each student, however, this was affected by students' differing access to, and familiarity with, digital resources.

A student registering for an online qualification does so knowing that they require access to a suitable device, stable internet connectivity, and the necessary space, furniture, materials and tools. None of our students signed up for this and many were ill-equipped to participate in this capacity. During early lockdown, it was unnerving to find how many students were completely dependent on the campus Wi-Fi to do online submissions and communicate via electronic media and, initially, there were some students who simply could not attend online, plunging them into the role of being 'digital strangers' – a phrase describing students "without direct access off campus" who may own a mobile/cell phone but do not necessarily have internet or network access, according to Czerniewicz and Brown (Timmis & Muhuro, 2019, pp 3). Many students could not afford the initial increase in mobile data fees (before the free 1GB bundle allocation), and some had extremely poor network coverage – in both rural and urban areas.

Internet access in rural areas is more limited than in metropolitan and urban areas, increasing the difficulties for students applying to and engaging in higher education (Chothia, 2017). Prior to lockdown, Statistics South Africa found that while 61.8% of South African households had at least one member with internet access either at home, work, place of study or internet cafés, only 10% of South African households have internet access at home – and, in the predominantly rural regions of Limpopo, Eastern Cape, and North West – this was less than one per cent (Stats SA, 2018). We were also reminded of the inequalities stemming from South Africa's apartheid history, as it seemed that white students were more likely to have steady access to Wi-Fi at home.

Not all students had devices suitable for sustained online work, due to poor battery life or other faults (for example, some student wrote 1000-word essays on small, cracked smartphones). Theory lecturer Shashi Cullinan Cook initially accepted hand-written submissions, but found that this did not afford students sufficient opportunities to practise using the word-processing tools needed in professional contexts. To level the playing fields, teaching staff applied to the National Student Funding Aid Scheme (NSFAS) for devices for students, and used the support systems UJ provided to assist qualifying students with loan devices. In cases of consistently poor network, students were granted the chance to submit work when their network access improved.

Along with data and network disruption, 'load-shedding' was instituted by South Africa's national electricity provider, Eskom. These scheduled power-cuts (two to four hours a day) impacted how and when students submitted daily tasks. To mitigate this problem, students purchased power banks and charged these and their phones overnight – giving them half a day's battery life to submit daily tasks and maintain participation. This demonstrates the hurdles jumped to approximate 'business as usual', and it does not seem comparable to situations in the 'Global North'.

In his review of Klaus Schwab's book on the fourth industrial revolution, Jake Okechukwu Effoduh (2016, pp. 78) explains that "imagining the possibilities of having billions of people connected by smart devices, with extraordinary processing power and access to data" is exciting, "not to mention that there are already algorithms used to foretell cultural interests or even software to discover new medications". However, Effoduh (2016, pp. 78) admits to feeling a "sense of despair and pessimism as I became aware of the gap that the 4IR" entrenches between resourced and unresourced contexts in

> *… almost every area of human development and agency. For example, in the West, genetic sequencing is now unbelievably cheap, and humans and machines are augmenting and assisting each other with knowledge and skills. Meanwhile, there are four billion people in the 'Third World' who tend to lack reliable internet access. For Africa, the second industrial revolution is yet to be fully experienced as nearly 1.3 billion people lack access to electricity. The problem rests not with the 'failure' of the 'Third World' to 'catch up' to the 4IR, but it is how the 4IR raises concerns around issues of power asymmetry, security, and the resulting threats of inequality, disempowerment, and exploitation.*

Students' familiarity and comfort with digital resources was also a factor in our context. Researchers from Melbourne, Australia, describe their students as "digitally native – that is, they have been exposed to digital technology from a very young age – and so are expecting their educational institutions to incorporate the latest technologies in their teaching and learning approaches and environments" (Davey, Elliot & Bora, 2019, p. 1). In South Africa, this may be applicable to students who are financially more privileged, but it is not the case for most of our students. In our context, simple, low-data teaching and learning platforms are likely to remain preferable until suitable devices are available to all students, and mobile networks reduce the cost of data.

As institutions of higher education galvanise towards 4IR, issues with network connection, electricity provision, data costs and device availability must be addressed. We need to be clear about what will be available to students going forward, and what we need, if we are to integrate online innovation with real-world realities. Policy makers in all industries must recognise that 4IR compatibility in Africa will promote entrepreneurial experimentation within an appropriate entrepreneurial ecosystem (Naude, 2017, p. 2).

The problem with lauding student 'resilience'

Living in residence helps some students to cope with and escape the harsh realities of their home situations. When students had to leave university residences, many expressed difficulties around their home environments being unconducive to learning, negatively impacting their productivity. Some students experienced overpopulation in their household settings and (sometimes violent) family dynamics that infringed on their focus. In addition, many are the first generation in their family to attend university, which means there may be lower levels of academic support at home. To juggle house chores and course work, some students had to show their parents their timetables and explain what was required of them while working from home. For 'first generation' students, this was an additional stress as they risked being perceived as being uncooperative in their home environment.

Students were remarkable throughout this period, overleaping issues with admirable bravery. Those who missed weeks of lectures showed incredible fortitude in catching up, and we praised their 'resilience'. Resilience is the ability of an individual to overcome, resist, and endure any negative factors they experience within their lived context (Rutter; Walsh cited in Mosavel, et al., 2015, p. 2).

However, Adrian van Breda (2019, p. 10) argues that the definition of resilience for the Global South must consider the long-term effects and life-long traumas of colonisation, poverty and gender-based violence. The 'global South' is "traditionally conceived of as including countries in Africa, Asia and Latin America" but "is not conceived of solely in geographic terms" (SOTL in the South, 2021). The term encompasses “power differentials, technological and financial resourcing, and the recognition of indigenous knowledges”, as well as “income inequality, fractured identities, and contestation about knowledges” in ‘postcolonial’ contexts (SOTL in the South, 2021). Van Breda (2019) argues that the definition of resilience gives the impression that adversity can be overcome, but in the Global South, there is no end to adversity. This ‘resilience narrative’ breeds a culture of acceptance of difficulty as a normalised response to an unsupportive environment (Van Breda, 2019, p. 8) – which occurred in our context when marginalised students had to adapt to online learning at home.

Expecting students to accept circumstances, and adapt to changes that do not consider their lived experiences, may manifest as a form of silencing that has negative implications on adolescents' development (Van Breda, 2019, p. 7). In the classroom, lecturers may encounter ‘resilient’ students who do not vocalise their difficulties because they are so accustomed to trying to overcome adversity. This is true for staff as well, as we teach and complete research in tricky circumstances which are often heavy on administration and understaffed by permanent staff members.

From lecturer to ‘reassurer’: boundaries and wellbeing

Setting clear boundaries between lecturers and students means respecting one another’s family time and wellbeing by avoiding messaging on WhatsApp after office hours or on weekends, but this was upended during lockdown. Staff gave out their personal mobile phone numbers, and worked after hours to accommodate load-shedding and network issues, and students messaged at all hours of the night to save data.

Second-year coordinator Khanya Mthethwa related that students were panicky “about missing out on practicals and could not foresee how they would pass the year without doing what they knew was required for them to pass”. Mthethwa’s solution to this was “Communication, communication and communication … to assure students that the university was aware of the problem and a resolution would be found” to prepare them adequately for the following year. Mthethwa assured students that she was willing to put in extra and weekend hours to assist them when the time came to return to the studio. This exemplifies how lecturers went above and beyond in responding to the emergency – offering their time with no expectation of increased compensation.

Radebe recounted that he had to change from lecturer-coordinator to ‘reassurer’, because the first-year students, many of whom are ‘first generation’, were only just getting settled into a new environment before we shifted online. Later, once boundaries had been reworked, we had to be mindful not to appear tone deaf to students’ reasons for not adhering to rules of communication because, with online learning, boundary-setting can become a form of exclusion for some students if not handled carefully.

Conveying a sense of security and stability with students was imperative, but in many cases staff did not really know if things would be ‘okay’. In the context of constant changes, lecturers’ dedication, optimism and hope stood in for certainty. Treating lockdown education conditions as evidence or motivation for online ‘business as usual’ is therefore unethical because students and staff had to act like superheroes to achieve passable results.

Conclusion

After researching ways that jewellery design and manufacture might be fully facilitated online, we concluded that the resources and costs required, and the health and safety implications, are presently prohibitive. Our research could be advanced by exploring the use of open-access CAD programmes and VR-simulated learning and manufacturing, and further exploring the listed benefits of blended learning, such as adding group messaging components to create blended school crits.

However, this should only be instituted if students are aware that they are registering for a partially online qualification, which should only be offered with a sense of how to address digital inequality. Until digital access is available to all students, online and blended learning may be more a case of 'survival of the richest' than of the fittest. To make the most of 4IR innovations without reinforcing inequality and avoid 'lost connections', government and institutional bodies must continue to negotiate ways to mitigate problems such as high data and Wi-Fi costs off campus, varying network coverage, electricity outages, and unsuitable devices and workspaces. In the COVID-19 lockdown, as in other scenarios, lecturers and students stepped into the breach between ideal working circumstances and realities, but student 'resilience' and staff dedication should not consistently bridge systemic gaps. Tackling these inequalities with a united front would help everyone to better manage contextual challenges beyond the COVID-19 lockdowns.

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Studio jewellery processes for the post-cyber designer

Caru Smuts, *Cape Peninsula University of Technology*
Monica Di Ruvo, *Cape Peninsula University of Technology*

Abstract

The cyber revolution has emphasised the dialogue regarding perceptions of value between the mechanically produced and the handmade jewellery piece. The application of modern digital design technology with traditional methods of working by hand in the studio jewellers' practice raises questions of authorship, authenticity, and artisanship.

Literature reveals that in the digital age, technology is developing at a rapid pace, and that in the future manual jewellery design and manufacturing processes could be eliminated completely. To date however, there is no jewellery making process that excludes manual labour entirely. The rapid development of technology could impact the future sustainability of the studio jeweller in their ability to remain viable in terms of price, time, material consumption, variety and complexity of design afforded by digital processes. In turn, this has direct bearing on the design curriculum at higher education institutions preparing graduates with the necessary skills to enter the workplace.

In this research, the authors aim to explore the incorporation of digital design technology into the studio jewellery design and manufacture process of bespoke jewellery. The research aimed to develop a basic framework to find the balance between technological advancement, mass production, the continuity of tradition and the function of the studio jeweller in the jewellery industry.

The study was conducted in the greater Cape Town area using a participatory action research method based on an iterative reflective cycle. Participatory action research allows for the parties most affected by changes in the industry to participate in finding a proposed solution. The findings of the first cycle are presented in this paper and a conceptual framework is proposed which will inform future research and jewellery design curriculum development. Such an updated framework will assist studio jewellers to consider a wider range of technologies while retaining the authenticity of traditional bespoke jewellery in a post-cyber society.

Keywords: Digital jewellery design, jewellery design education, jewellery design processes, studio jeweller processes

Introduction

Jewellery design has been defined as a discipline where specialist knowledge and practice are applied to the conceptualising and making of jewellery products (Newman, 2015). The essence of the studio jeweller's craft is the design and manufacture of bespoke pieces of jewellery underpinned by the individual design aesthetic of the designer and the personalised requirements of the consumer. Jewellery design and production is a craft learned through tacit knowledge and practice, traditionally through a system of passing down knowledge, gained through experience of generations (Orlandi & Erkan, 2015, p. 1).

The cyber revolution and the associated rapid advancement of technology have profoundly influenced the jewellery industry in both manufacturing and design processes. Digital production techniques including but not limited to three-dimensional printing have highlighted the conflict about the perceptions of value between the mechanically produced and the handmade jewellery piece (Fuchs, Schreier, & Osselaer, 2015, p. 98). The combined application of modern digital design technology with traditional methods of working by hand in the traditional studio jewellers' practice raises questions of authorship, authenticity, and craftsmanship. The problem is the synthesis of these opposing aspects and components in the post-cyber studio jewellery industry.

The studio jeweller primarily designs bespoke pieces of jewellery for consumers that attach a perceived higher value to handmade jewellery pieces. The conventional design process framework is based on the principle of design for manufacture. This principle considers manufacturing limitations and constraints of a product at the start of the design process (Cooper, 2015 p. 240) but with today's available technology designers can create virtually any geometry without the constraints of traditional manufacturing methods (Cooper, 2015, p. 240).

In Cape Town, studio jewellers have made some integration of digital technology, while others have shunned the integration completely. For this research, we analyse how the boundaries of the handmade have evolved in studios in Cape Town, South Africa. Does the jewellery community embrace the advances made in the tools available to the industry, or do they choose to remain within the traditional scope of the process? The researchers aim to explore the conditions for mechanical and digital design technology to be incorporated into the design and manufacture process of authentic jewellery.

Literature

A literature review was initiated by a search for published academic articles, books and dissertations that investigate the challenges faced by studio jewellers. An initial online search was done using Google Scholar, Mendeley, Researchgate and Acedemia.edu using keywords "jewellery design", "digital craft", "jewellery processes", and "jewellery education". The search was then expanded using available online databases, including IEEE Xplore Digital Library, Bloomsbury Design Library, EBSCOhost, JStore, Scopus, Springer link and Klimt02: International Art and Jewellery online. The review revealed limited academic literature on jewellery processes in the current post-cyber age. The literature focuses on individual techniques rather than complete processes that include both the design and manufacture of the finished product. The list of titles that met the search criteria was inserted onto a spreadsheet to be evaluated for inclusion in the review. Based on their relevance to the post-cyber jewellery industry, 26 articles were selected for inclusion.

The table below illustrates how the articles selected for inclusion relate to the themes that emerged. These themes are then discussed in the following paragraphs.

EMERGED TOPICS	AUTHORS	TITLES	CONCEPTS
History of processes	Untracht, 2011	Jewellery concepts and technology.	The role of the studio jeweller within the larger industry.
	Orlandi & Erken, 2015	Value creation in jewellery fabrication today: Exploring the interrelations of crafts and innovation through the case of the grand bazaar of Istanbul.	Jewellery process learnt by means of tacit knowledge. Evolution of the industry within the space of the grand bazaar. Processes development.
	Gregorietti, 1970	The history of jewellery design.	Traditional techniques as we know it today were established by the 15th Century. Progress and development of tools have enhanced the processes.
	Adamson,2013	The invention of craft.	Craftsman not superseded by machine -Rather plays a vital role in its success.
	Harrison, 2010	Gold science and application	Development of tools enhances the quality and capability of making the field of jewellery design
	Prins, 2009	Gems and Jewellery. The South African Handbook.	The Industrial Revolution gave rise to modern tools and techniques which enabled the advancement of jewellery processes.
	Batista, 2017	A Contribution for Jewelry teaching.	Batista (2012) developed a framework to assist jewellery design students to work in a structured and methodical manner.
	Brepohl, 2001	The theory and practice of goldsmithing.	Young craftsman is in a position to evaluate the choice of tools and their position in the workplace. Advanced worker should be equally motivated to take advantage of the latest developments.
	Rajili, Olander & Warell, 2015	Characteristics of Jewellery Design : An Initial Review	Jewellery practice may also be characterised as positioned between craft and design-based approaches. What are the principles for jewellery design?
	Supsomboon, 2019	Simulation for jewelry production process improvement using line balancing: A case study	Simulation modeling is one of the powerful tools which could be used to analyze problems and study the behavior of production system. The research explores simulations to improve production in jewellery design.

Blurred lines Handmade vs machine	Corti, 2003	Technology is irrelevant to Jewellery Design — or is it ?	We think of jewellery design solely in terms of artistic design, and CAD systems used for jewellery design work from this artistic approach. The growing use of CAD illustrates that technology could facilitate artistic design and speed up the process.
	Fuchs, Schreier & Osselear, 2015	The handmade effect: What's love got to do with it?	No production process involves no machines, but the idea of handmade hold value with consumers.
	White, 2004	Hybrid Practice- Challenging Traditional Craft Boundaries: Authenticity: Anxiety: Autonomy.	CAD enables a new dialogue within practise. On the one hand there are more possibilities.
	Pettersson, 2019	Craft in the age of digital reproduction- a research into digital reproduction and its aesthetics.	Digital fabrication tools augment the hand of the maker.
	Bernabei, 2015	CAD/CAM and jewellery design education	CAD/CAM requires a similar knowledge base and practise of skill to accomplish.
	Manavis, Nazlidou, Spahiu & Kyratsis, 2020	Jewellery design and wearable applications: a design thinking approach	The potentials for reimagining the jewellery products in relation to the Design Thinking Process and CAD-based tools at the same time.
Importance of handmade to the studio jeweller	Fuchs, Schreier, & Osselear 2015	The handmade effect: What's love got to do with it?	Handmade-effect: Handcrafted is considered more valuable than industrially made.
	Lico, 2014	Applying 3D modelling technology to traditional craftwork: Rapid prototyping in artisanal Jewellery making and its impact on the perceived value of Jewellery.	Value increases sentimentally as the piece is worn on the body.
	Woolley & Niedderer, 2016	Real or unreal?-Crafting authenticity in the digital age.	Relevance of Authenticity in the digital age. CAD production raises questions in established understandings of making and of craft in terms of the hand-made and its individuality.
	Simptani & Barrett, 2020	Investigating the use of digital technology in Jewellery Design: A thematic analysis	Consumer perceptions must be steered toward creating the link between the concepts and aesthetics created by the jewellers.
	Sennett, 2008	The craftsman	Authenticity of the handmade process is evident in the uniqueness of the imperfection that the hand augments. The hand is the window on to the mind.
	Norton, 2014	Exploring the Negotiations over subculture Ideology of authenticity within the Etsy community.	Authenticity is understood as the inherent quality of an object and because it inherent it is not negotiable nor achievable.

Designomics	Hague, 2006	Unlocking the design potential of rapid manufacturing.	The use of rapid manufacturing could delink the relationship between complexity and cost.
	Hill, 2018	The jewellery industry's design dilemma.	If all the products in the market are essentially the same, then the only thing any customer will care about is price. Once customers only care about price, the market starts bleeding value.
	Hashim, 2018	Design economic evolution in the jewellery industry.	The value of a particular design is determined by the theories of economy in this influence.
	Cooper, 2015	Sintering and additive manufacturing: The new paradigm for the Jewellery Manufacturer.	Costs can be reduced with the inclusion of digital manufacturing processes
	Dauriz, Remy & Tochtermann, 2019	A multifaceted future: The jewelry industry in 2020	Fine jewelry has so far been immune to the effects of fast fashion, but not the fashion-jewelry market. Studio jewelers to enhance supply chain pace to stay competitive.
Autonomy	Cooper, 2015	Sintering and additive manufacturing: The new paradigm for the Jewellery Manufacturer.	Design for manufacture principle. Venture beyond boundaries of geometry of conventional jewellery making.
	White, 2004	Hybrid Practice- Challenging Traditional Craft Boundaries: Authenticity: Anxiety: Autonomy.	Investigates whether 2D image manipulation software, by 3D modelling hardware is informed by knowledge of production techniques in jewellery. CAD production has raised questions of authenticity and of control.
	Newman, 2015	An illustrated dictionary of jewellery	Jewellery design defined as a discipline where specialist knowledge and practice is applied to the conceptualising and making of jewellery products
	Hague, 2006	Unlocking the design potential of rapid manufacturing.	Expand the possibilities of geometry that is viable for production via the inclusion of rapid prototyping and digital production.
	Pettersson, 2019	Craft in the age of digital reproduction- a research into digital reproduction and its aesthetics.	The jewellery industry is a subtle balance between the originality of the author and the needs of the market.
	Scarpitti, 2019	Singular Multiples: Contemporary Jewellery Beyond The Digital	What the hand tells the Brain: Tool Use, Creativity and Embodied Cognition'. Jewellery making, constraints imposed by the materials used, the tools, the design brief, the aesthetic considerations or historical considerations.

Figure 1: Literature table (Authors, 2021)

The importance of the handmade for the studio jeweller

The jewellery industry consists of various subsectors. Larger operations rely on mass-production processes to meet their supply chain demands, but the studio jeweller (small to medium-based operations) mostly rely on traditional hand manufacturing processes to produce individual or collections of artisanal pieces (Pattersson, 2019, p. 3).

Despite the rise in popularity of high-quality machine-made products, the presence and popularity of handmade products have remained across most product categories. Jewellery design is also affected by the “hand-made effect” (Fuchs, Schreier, & Osselaer, 2015, p. 107) a phenomenon where handcrafted items are viewed as more valuable or desirable than mechanically made products. Handmade became a descriptor for unique jewellery items of a high quality (Orlandi & Erkan, 2015 p. 6; Lico, 2014, p. 32). The manufacturing of handmade jewellery is typically done individually that makes it improbable to create an object identical to another.

Uniqueness and rarity contribute to the appeal of handmade jewellery. This can be evident in small imperfections or slight differences in shape or form, from one piece to the next (Sennett, 2008:149). Lico (2014, pp. 32) also identifies the sentimental value of jewellery increases with time as it is worn on the body.

The term handmade is also often synonymous with authenticity. Norton (2014, p. 18) states that authenticity is understood as an inherent quality of an object and because it is inherent it is neither negotiable nor achievable. Authenticity in craft lies within the process and practice of the crafter. The process itself becomes authentic through the designer’s unique approach and combination of tools and techniques (Woolley & Niedderer, 2016, p. 160).

The blurred lines between handmade and machine-made

There are almost no production processes that do not involve machines or technology. A maker of handmade jewellery will use a machine to polish and finish a piece. Most mechanical production processes require some form of human involvement. The overlapping interactions of the hand and the machine make it difficult to objectively categorise a product as completely handmade or completely machine-made. This creates an opportunity to present a product as handmade and justify it as such (Fuchs, Schreier, & Osselaer, 2015, p. 107). The studio jeweller has always relied on traditional mechanical processes driven by expert craftsmanship and practice. Just like the hammer, digital fabrication tools augment the hand of the maker while simultaneously introducing specific tool-based limitations (Pettersson, 2019, p. 5).

The production of work, using computer-aided design (CAD) has raised questions of authenticity and control. When using digital processes, the technology does not function autonomously, it requires the skill and knowledge of the operator (White, 2004, p. 3). The jeweller will apply their aesthetic to the design through the machine. The hand of the designer draws the control points of every line in a CAD programme that requires the same knowledge base and practice of skills to accomplish as any other traditional hand process (Bernabei, 2014, p. 18). Digital technology has therefore allowed the line between the hand and the machine to blur.

Designomics

Designomics is the collective term for design and economics (Hashim, 2018, p. 24). It describes the economic considerations of a design. The production of a tangible product happens through the design process where the combination of theme, concept, and ideation are incorporated. Connection and interaction between these conceptual values result in the final product. These values interact according to the parameters set by the client or the market for which the product was intended.

The design process before achieving satisfying jewellery will depend on a designer's understanding of need, science, technical knowledge, creativity, time frame, and costing (Hashim, 2018, p. 24). The cost of labour in conventional processes is directly linked to the intricacy and complexity of the design, these costs can be reduced with the inclusion of digital manufacturing processes (Cooper, 2015, p.

234). Jewellery products in certain markets have similarities. One example is the engagement ring market, where designomics plays a large role. A similar design can be produced with various methods both traditional and digital in various qualities, the principle of designomics is to determine the best method of producing a design at the market-related price-point with exceptional quality (Hill, 2018, p. 25).

Autonomy

The application of digital design and manufacturing tools in the design process can allow the designer to create virtually any conceivable geometry without the restrictive capabilities of conventional manufacturing processes. Including digital design and manufacturing makes the complexity of a design and the cost of production independent from one another (Hague, 2006, p. 10).

Prevalent design methods and processes employed today are fundamentally based on the 'design for manufacture' principle. This principle considers the manufacturing of the product as a first step, whereas artistic value is usually the first step in the design process (Cooper, 2015, p. 236). By combining the ability of handmade techniques with innovative digital design technologies the studio jeweller could potentially access autonomous capabilities that will inspire design innovation and still hold the appeal of the handmade-effect the consumer prefers (Fuchs, Schreier, & Osselaer, 2015, p. 100).

The studio jeweller's design process

Batista (2012) developed a framework to assist jewellery design students to work in a structured and methodical manner. Jewellery design can be described as an activity that involves the researching, creating, and planning of production. These activities focus on aesthetics, ergonomics, durability and designomics. The designer completes a complex arrangement of interrelated tasks before producing a finished piece, starting with the customer requirements, and ending with the specification of the manufacturing process. In South Africa, not all jewellery design graduates end up employed only as designers, some become designer-makers or studio jewellers. Technology is also evolving rapidly and therefore the jewellery design curriculum in South Africa needs to take these factors into account. Batista's (2012) framework included below is used a starting point for this research on jewellery design and manufacturing processes for studio jewellers in a post-cyber context.

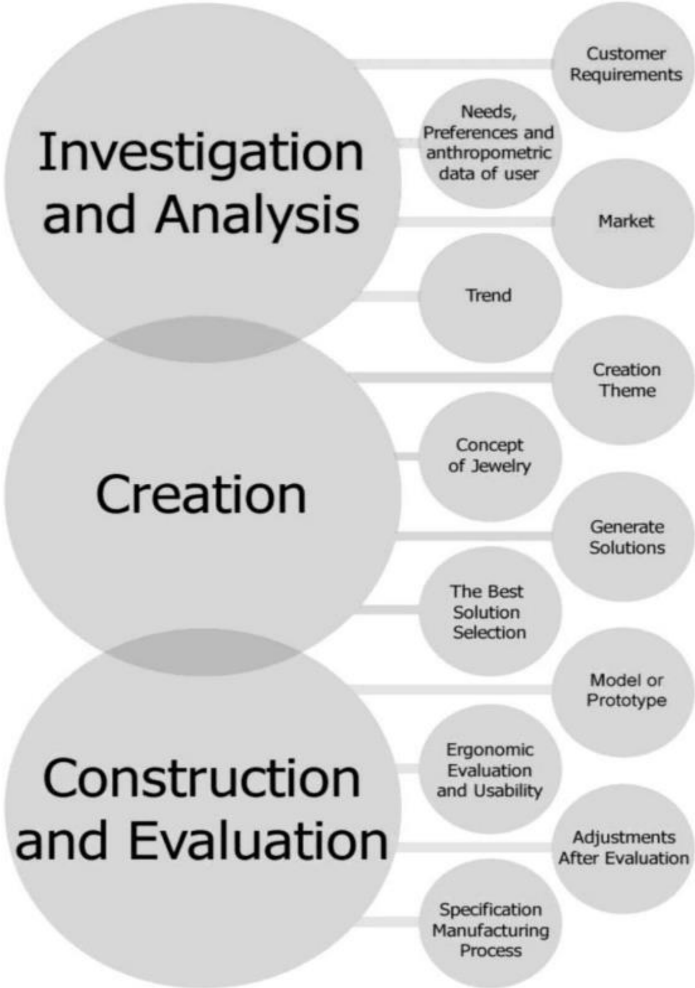

Figure 2: Jewellery design process (Batista, 2012)

The studio jeweller takes this process further to include production of the finished article. With experience, the designer-maker learns to predict results through empirical experimentation. No two designer-maker products are the same; there are constants in manufacturing determined by experiential knowledge and not strict formula. The combination of digital design technology processes with experiential knowledge when applied to new scenarios, allow the maker to venture beyond boundaries. White (2004 p. 11) characterises this as 'technological opportunism'.

Authors indicate that the tools available to the studio jeweller should be assessed and evaluated according to the principles of historic value, handmade allure, designomics and autonomy (Hashim, 2018, p. 24; Fuchs, Schreier, & Osselaer, 2015, p. 100; Adamson, 2007, p. 21; White 2004 p. 10).

In the digital age, technology is developing exponentially, and in future, manual jewellery design and manufacturing processes could possibly be eliminated completely. In Cape Town, there are no studio jeweller's processes that exclude manual labour in its entirety. In this research the authors explore a framework to guide processes that combine the handmade, mechanical and digital processes for the highest quality and intrinsic value.

Method

The research design is based on the iterative reflective cycle by Coghlan (2019, p. 11). Every cycle consists of four stages that include Identify, plan, act and evaluate as illustrated in Figure 3 included.

In this paper we present the findings from the contextual enquiry, the first of three envisaged cycles of enquiry. The results presented here will inform the next cycle of research, which according to Coghlan (2019), consists of the co-design workshop.

The concept of reflective practice was introduced by Schön (1983) and provides an appropriate theoretical approach for research in jewellery design and practice. Schön states that professionals solve problems through tacit knowledge linked to activities, such as jewellery production and that they develop individual repertoires of solutions gained through experience. In this instance the jeweller learns to re-frame problems into manageable situations. Schön refers to the process as reflection, which can take place during and after a task for continuous professional improvement. The notion of lifelong learning is recognised as an important skill in fast-changing contexts.

Using Schon's theory of reflective practice as a lens, the authors aim to explore the incorporation of digital design technology into the studio jeweller's repertoire.

Reflective practice is the ability to reflect on one's actions to engage in a process of continuous learning. By asking jewellers to reflect on their practice, the authors attempt to answer the following research questions.

- To what degree are digital technologies incorporated in the practice of studio jeweller's; and
- And how could this inform the jewellery design curriculum?

The research seeks to analyse the process of design to articulate it as a translatable framework (Stewart, 2014, p. 4). The research is based on participatory action research that involves an action researcher and community or organisation who aim to solve a problem (MacDonald, 2012, p. 36). In this instance, the community is the jewellery practitioners. Participatory action research was selected because it allows the subject of the research to participate and collaborate with the researcher throughout the process (MacDonald, 2012, p. 38). Participatory action research is defined as the stage where most input is collected from stakeholders in an engaging manner with a focus on locally defined priorities and local perspectives (Cornwall & Jewkes, 1995, p. 1667).

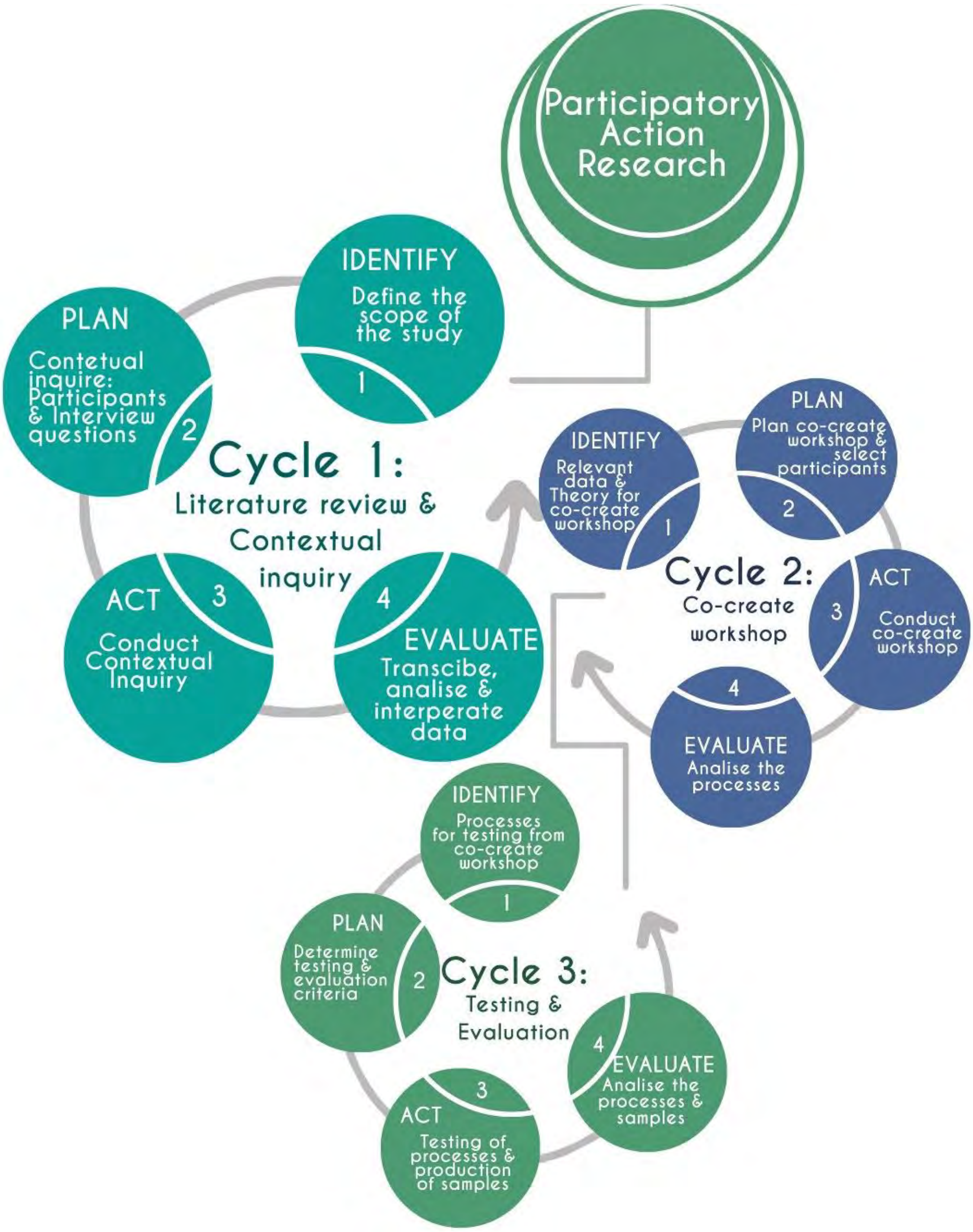

Figure 3: Research design and method (Authors, 2020)

Participatory action research cycle one

Identify

The first cycle aims to identify the processes that are currently used to create authentic handmade jewellery and establish to what degree they involve digital processes. The scope of the research was defined by conducting a literature review. Thereafter participants were identified to take part in the contextual inquiry into new possible technologies and processes that can be adopted by studio jewellers in the greater Cape Town area.

Plan

Five jewellers in the Cape Town area were initially identified from a closed Facebook group of which one of the authors is a member and contacted via email to enquire whether they would be willing to take part in this research. A spreadsheet was drawn up to track who was contacts and respondents. From the first five initially contacted, the snowball technique was used (Parker, Scott & Geddes, 2019, p. 1) whereby those jewellers referred the researcher to further possible participants. In total, twenty-five jewellers were contacted, the restrictions imposed by COVID-19 made it difficult to engage with some participants and nine jewellers eventually participated. An informed consent form was discussed and signed by all participants on the understanding that their identity would be kept anonymous and that they could withdraw their consent at any time during the research.

Act

Nine jewellers were interviewed during the contextual inquiry phase of the research, including three manufacturing jewellers, five studio jewellers and one technology based specialised manufacturer. Participants included high-end commission-based jewellers, specialist service providers to industry, art-jewellers who aim to bridge the gap between art and design and jewellers that serve a tourist market. Participants were purposefully targeted from different sections of the jewellery industry to obtain a broader range of perspectives to address the validity of the data. The interview guidelines were predetermined and conducted in a semi-structured manner (Hollway & Jefferson, 2011, p. 9). The conversational approach and the location of these interviews gave the researchers insight into the interviewee's perspectives and practices. The interviews were recorded and transcribed, before using Atlas-Ti to thematically code and analyse the data (Maguire & Delahunt, 2017).

Discussion

Evaluate

In this section we conclude the first cycle of the participatory action research by interpreting the data collected in the contextual inquiry. The data was coded thematically is presented under the following themes.

The Importance of handmade in current practice

The importance of the term handmade was discussed in the context of each jeweller's practice. It was interesting to note the extreme points of view. Interviewee 4 explain that her business is 'exclusively handmade'. From the design sketches to packaging production every step is done by hand.

Two jewellers interviewed have moved away from hand making completely as that title has had some associations to poorly made items. These jeweller's opinion were that the branding of how it was made is not important. The service providers reiterated that the method is not important, but rather the quality of how it was made and the final aesthetic.

In contrast to these opinions four jewellers emphasise the importance of handmade to their practice. They describe the practice of making as a journey they embark on with every piece, as there is something spiritual about handmade jewellery as it engages with the human body.

Another jeweller mentioned that the allure lies in the exclusivity of the handmade and another opinion was that the handmade process provides the jeweller with control over every step, which adds an additional layer of authenticity. They reiterated that machines may be able to do things humans cannot, but the touch or the 'mark made by the human hand is where the magic lies' (Interviewee 5). That unique mark left on each piece is what makes handmade valuable and exclusive.

Application of digital tools in current practice

The digital tools used by the scope of jewellers interviewed were similar, but the application of the tools and why they were selected, were varied throughout the design process in each practice.

Digital design software is used for illustration purposes by most jewellers interviewed. There is the application of complex three-dimensional computer aided design (CAD) software like Rhinoceros, as well as the application of simple software like quick-sketch on a tablet device and Photoshop to create a realistic effect. Jewellers who intend to produce the finished piece employing computer aided manufacturing (CAM) will apply three-dimensional software and render the design with plugin applications or Photoshop to present the design as a realistic illustration.

Digital design drawing tools have also been incorporated into the handmade process of push-engraving. It was interesting to note that the hand engraver would apply a digital method to transfer a design to the piece that needs to be engraved. They explain how they would transfer the design by means of light laser engraving, in this instance opposing technologies work in sync to create better economic value and increase the quality of the finished product.

Digital tools used in the making of sections of the process included microscopes for improved precision. The jewellers who applied CAD and CAM in their making process had different approaches to how these technologies should be applied in an authentic manner. Some jewellers outsource the CAD section of their process as they are not versed in the software, but still employ the technology. The CAM process is usually outsourced as it is rare for studio practice jewellers to own the required equipment. Other technologies noted in the making section of the process were the laser-based options such as micro-welding, laser welding, laser engraving and laser-cutting. These technologies are usually employed on an outsource basis to solve design-based problems.

Digital tools for the future

The jewellers were asked if there were any tools that they would like to incorporate into their practice. These could be any tools or process that could aid the jeweller in their studio. Jewellers noted that even though there are many options for illustrating designs, that most of them are time consuming to apply to three-dimensional renderings. There is a need for design software for fast and realistic renderings to illustrate ideas to customers.

A large selection of the interviewed jewellers felt that there is technology available to them, they simply chose not to apply it in their practice, because they prefer to work by hand only.

Direct metal printing is a technology noted by some jewellers that needs to be explored. The technology already exists, but the application to the jewellery industry could be explored. Metal printing was noted as an option for the manufacturing of titanium rings, specifically as it is a difficult metal to work with by hand.

The current processes of studio jewellers

Each participant was asked to describe their process from conceptualisation to production. This question was included to gain a better understanding of the workshop practice of the jewellers. It was interesting to note how personal this process is for most of the jewellers. It is described as a journey.

Jewellers follow a process of investigating, conceptualizing and making. These processes were mapped against Batista's (2012) model as illustrated in Figure 4. This basic process is adapted by the designers with their own unique steps taken and a variety of tools applied with each stage of their process. The first phase of the process is documented as organic according to the business structure of each studio jeweller. The suggested tool that could be incorporated in this phase is a web-based user interface with the client.

The creation phase of the process is where the idea will be conceived and presented to the client. Traditionally this would occur through hand sketches. Jewellers alluded that they have started to incorporate digital drawing software at this stage. There are multiple options available for lithographic drawing and full three-dimensional drawing. It was found that this is time consuming and there is still a need for a software that will allow for the rendering of three-dimensional sketches at a faster pace without a high level of skill.

Construction and evaluation have the most potential for the inclusion of digital technology. Models could be produced in wax as a realistic example or as a working model. Three-dimensional printing can be used as a starting point for a complex design, or a design can be printed in full detail ready to cast. These decisions will be determined by the economic implications and the complexity of the designs. The possibility to explore what other purposes this technology could be used for and where in the design process it could have the greatest positive effect.

Direct metal printing is a new technique that the jewellers interviewed viewed as something worth exploring to mitigate the difficulties of working in non-precious metals like titanium. These techniques could broaden the possibilities of design as the material and production could be more cost-effective. Laser welding and micro soldering is used for specialised intricate designs. These technologies broaden the boundaries within in which jewellers used to design.

The employment of outsource-based manufacturing was discussed. Digital tools are expensive, and it makes economic sense to outsource the application of these tools rather than carry the cost of running and maintaining these tools. It is considered common practice in the jewellery industry in Cape Town to outsource the casting of pieces to specialist companies. Outsourcing was also found to apply to CAD designs. The jewellers interviewed, those making use of technology and those that don't, do not have the skills for engaging with CAD software, and employ an independent contractor to complete these tasks.

Handmade jewellery with digital processes

To determine what the parameters of the digital/handmade process could be, the jewellers were asked to what extent they think digital technology can be incorporated into the handmade process. It was interesting to note that the opinions were varied from no digital application in the process at all, to some jewellers saying that a mixture of processes will allow for the handmade title to stand in place. Authenticity of feel is also a comment made by some, meaning that if the piece attains the feeling of being handmade, irrespective of process, it is still considered to be handmade. Interviewee 3 noted that 'the piece should evoke a feeling for you, and if you connect to it, then you are connecting with the designer and maker'.

A selected group thought that CAD and CAM could be included in the handmade process, but with conditions. Interviewee 3 noted that 'whether it was designed completely on an interface, there is still a human involved'. CAD tools can be incorporated for presentation and manufacturing purposes. CAD has multiple applications for the jeweller like illustration and creating files for the printing of 3D models for CAM. It is also applied for precise mapping of stone layouts or engraving details and to create symmetrical angles in traditional manufacturing. Parameters and limitations for the use of CAD for CAM in the handmade process noted by the jewellers during the contextual inquiry were the following:

- Design should be sculpted with the mouse and not use preset pieces;
- No preset stones in the wax;
- Pavé and micro setting should only be mapped and drilled; and
- Complex pieces should be drawn in separate pieces to ensure proper polishing and finishing in the final product.

Digital laser tools and processes like engraving, welding and cutting were still considered handmade. The jewellers stated that these processes involve the human hand throughout and can be considered handmade as it is a step in the creation of a piece and not the entire process. Digital tools that are aids to the manual process that were mentioned during the interviews were pneumatic engravers and microscopes, which assist with the manual process. “Nothing is simply handmade or machine made. Everything is a complex mix of different things and I think if we can embrace that complexity, we can really do some creative and exciting things” (Interviewee 5, 2020).

All parts of the process were noted and mapped between Batista’s (2012) framework for jewellery design students on the one hand and the appropriate digital tools on the other. By positioning the findings in between what currently informs the design curriculum and the digital processes available to industry practitioners, the authors aim to explore processes that can inform the studio jewellers practice and in turn the jewellery design curriculum to prepare graduates to enter the industry. The resulting conceptual framework is included in Figure 4.

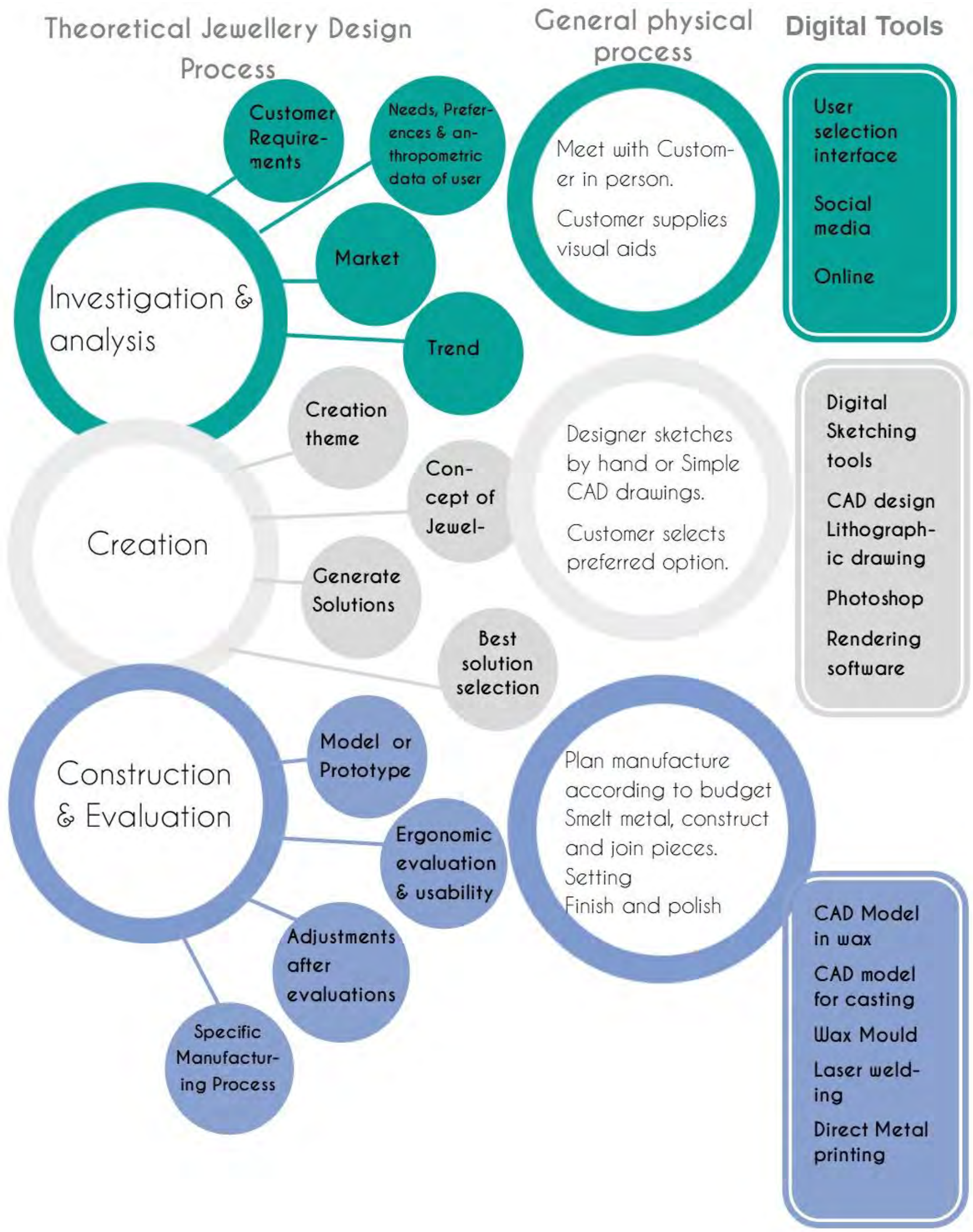

Figure 4: Towards a designomic framework for the post-cyber studio jeweller (Authors, 2021)

Conclusion and recommendations

The contextual inquiry provided insight into what the current process of studio jewellers is, what the requirements or needs are and it informed possibilities of new processes and the inclusion of new technologies. The information gained from the contextual inquiry forms the basis of a proposed new framework which can be used for further research. The new process should aim to mitigate some of the problems or challenges that arose from the literature and the contextual inquiry.

No definitive consensus emerged but the participants all believed to some degree that digital tools require expertise and skill similar to the manual process. “Nothing is simply handmade or machine made. Everything is a complex mix of different things and I think if we can embrace that complexity, we can really do some creative and exciting things” (Interviewee, 2021). The opinion of another jeweller was that the tools applied are not what is important, but rather the maker's mark should be evident in the final product for the wearer.

A piece of jewellery could be considered handmade with the use of digital tools if the following considerations are included within the proposed new framework:

- The design should be authentic:
  - The mouse, not pre-set design algorithms, should be used to sculpt;
  - Digital design and manufacturing should be applied as scaffolding and not to create the finished product;
  - Setting should be done manually; and
  - Final finishing should be done by hand.
- Control over the process should remain in the hand of the designer:
  - Quality control inspection should be done.

The findings of this enquiry could assist the studio jeweller to remain relevant and competitive by employing a designomic approach, while retaining the authenticity of the “handmade” in a post-cyber society. The proposed framework will inform design education in the field of jewellery design in that digital processes can be included in the curriculum. Graduates need to be able to confidently toggle between methods and adapt to processes by embracing the efficacy of combining the handmade, mechanical, and digital processes for the highest quality and intrinsic value. There is also a need for flexible higher education programmes that can respond to the gap identified among studio jewellers for continued professional learning. Recommendations for further research include a co-design workshop to develop and test the proposed framework using participatory action research.

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SESSION 3: Disrupted spaces – the Afrikan [online] University

Preparing the future workforce in African universities of technology: A case of new media art as a mutating discipline in the 4IR

Mashaole Jacob Makwela, *Vaal University of Technology*
Folasayo Enoch Olalere, *Durban University of Technology*

Abstract

The industrial revolution, a steady process of change that started in the eighteenth century, has been characterised as presenting different phases. The fourth phase (4IR), which signals an unprecedented convergence of physical, digital and biological spheres into technological forces, is transforming jobs faster than employees can adapt, and setting the base for a different kind of skill. Hence, everyone, including arts and design educators, are asking similar questions about its potential challenges and opportunities in their fields, particularly in the African universities of technology that place emphasis on career-directed courses. One of the questions revolves around the issue of how 4IR will affect the visual arts ecosystem in general and specific to types of skills required, production processes, theory, epistemological curiosity, intellectual tools, authorship, commodification, representation, distribution, among others. Furthermore, it is thought provoking to realise, through literature search that not much is written about the potential challenges and opportunities in the context of visual arts at universities of technology in Africa. Against this backdrop, this paper explores the changing landscape of the supply and demand of skills and how arts and design education can respond to this inevitable change. Using new media art as a case study, the exploratory case study employed post-phenomenology to interrogate the mediating effects of the technological revolution in shaping the new media art discipline. This was achieved through a content analysis of secondary data. In response to these mediating effects, the study proposed a framework that could help create access to new skills sets that would equip students to face the new markets and opportunities.

Keywords: Arts and design education, African university of technology, fourth industrial revolution (4IR), new media art, post-phenomenology

Introduction

Higher education has gone through different phases (elite, mass, and post-massification) as a result of its connection with the socio-economic structures, and its constant role creating prepared minds that contribute to scientific, technological, economic and social development. With the advent of the fourth industrial revolution (4IR), higher education is facing a world where technology is creating different opportunities and challenges for formal education systems, and post-work is defining the present period (Xing & Marwala, 2017). Even though the 4IR is similar to the first three revolutions, in that it is characterised by advances in technology, 4IR differs from the first three in two major ways. First, 4IR not only advances technology it also augments technology with web connectivity, which allows automated visualisation and decision making. The second difference is that the technologies in the 4IR are capable of cognitive processes similar to humans (Masinde & Roux, 2020). As a result, institutions are constantly reimagining their central role by introducing technology-centred curricula that focus on developing new mindsets needed for current and future jobs.

Against this backdrop, this paper investigates, from a post-phenomenological viewpoint, the mediating role of technology in visual arts and design education at the African universities of technology, with a primary focus on the universities of technology in South Africa. The study begins by examining the role of African universities of technology as career-oriented institutions. The study delves deeper into the subject matter by exploring the impacts of 4IR on visual arts and design disciplines, and with a specific focus on new media art, highlights the mutating nature of disciplines in visual arts and design in response to technological developments. Based on these understandings, the study then proposes a framework of skillsets needed to face new markets and opportunities in the 4IR.

Methodology

This study uses new media art as a case study to explore how arts and design education can respond to the changing landscape of the supply and demand of skills amidst the 4IR. Post-phenomenology theory was employed to understand the mediating effects of the technological revolution in shaping the visual arts and design disciplines in general and the new media art discipline in specific, and to develop a framework that respond to the effects. These effects were viewed from the four dimensions of post-phenomenology: 1) the existential nature of technological systems; 2) the epistemological dimension, which promotes experiential knowledge; 3) the practical dimension, which emphasises the importance of interaction; and lastly; 4) the ethical dimension that emphasis the two-sidedness of technological mediation. The desktop study takes the form of an exploratory case study using content analysis of secondary data such as analysis of policies and reports, institutional websites, qualifications (CEMS), published empirical studies, among others.

African universities of technology as career-directed institutions

According to Thathiah (2005), the focus on the concept of universities of technology should not only be limited to an institutional type but also the concepts of a University or of Technology. His argument questions the “lack of clarity [that] extends beyond the question of what a University of Technology is or, for that matter, what technology is, to the question of what the human condition is” (Thathiah, 2005, p. 187). In South Africa, there are views that universities of technology are or should be distinguished as career-directed institutions because of their historical association in comparison to their counterparts (traditional universities) (Du Pré, 2010). However, in relation to curriculum development in disciplines of arts and design, Thathiah (2013) expresses concerns that universities of technology do not possess the skills and knowledge base to take on challenges. More recently, Garraway and Winberg (2019) also add to the argument that there are fundamental contradictions between current practices and the desirable vision in terms of the future identity of the University of Technology, especially when it comes to training for Industry 4.0 (Garraway & Winberg, 2019).

The establishment of universities of technology from Technikons in 2004 to this date (and future reference on 4IR) still presents challenges of conceptualisation and the meaning of such higher institutions in terms of identity, role/positioning, curriculum development, among others. One of these challenges can be related to the nature and variances between universities. Lategan (2005) argues that irrespective of the three types of university, namely classical universities, comprehensive universities and universities of technology, they all have three similar core mandates of teaching and learning, research and service. Thathiah (2013) suggests that the development of modules in the Theory of Technology could be a starting point to interrogate, differentiate, and question the essence of universities of technology. Programmes at universities of technology should focus on the application of scientific principles in practice, and only use basic scientific principles in those cases where such knowledge is deemed to be essential to the successful application of the scientific principle concerned (Du Pré, 2010, pp. 10-11). This speaks to one of the five pillars of the University of technology, "Excellence in teaching and learning" under the heading career-oriented programmes, where programmes are generally acknowledged and guided by industry and respond to the needs of industry, business and society (Van Staden, 2010).

Above the issue of the nature of the University of Technology, the question of what African universities of technology look like in comparison to universities of technology also adds another dimension to the challenges. This can be seen in the vision and mission statement of the universities of technology in South Africa. What is also nebulous in this context is that out of the six universities of technology in South Africa, three have included the word Africa or African in their institutional visions. For example, the vision of the Vaal University of Technology (VUT) states that "An African University that leads in quality teaching and learning, informed by research and driven by innovation and technology" (VUT, n.d.). While Central University of Technology's (CUT) Vision is to be "a leading African University of Technology, shaping the future through innovation" (CUT, n.d.). Lastly, Walter Sisulu University of Technology (WSU) "An impactful, technology-infused African University" (WSU, n.d.). In this view, what makes an African university of technology an African university of technology? Should it be defined by its vision, students/staffing demographics, geographical, language, Intellectual independence, curriculum, research niche areas, architecture, technology and community upliftment? The meaning of the word Africa or African is complex, and it is always contested on many levels, especially when it comes to knowledge politics. As highlighted by Horsthemke (2009), the answer to 'what is the essence of Africa, western culture, the African culture and who or what is African? might be seen to turn on three aspects: ethnic and racial identity, orientation/commitment, and geographic location and identity. For the purpose of this paper, African universities of technology are referred to as higher education institutions in Africa with a fundamental goal to provide African solutions to African problems through the development and application of technology and research.

Industrial revolutions and their impacts on visual arts and design disciplines

Through the ages, the development of technology has always presented challenges and opportunities for the creative art industry, in general and specific to the use of tools from prehistoric use of stones to computer technology. Adopting Don Ihde's framework of concepts and perspective on post-phenomenology,[1] we intend to highlight general impacts on visual arts and design disciplines in relation to disruptions that have incurred in the case of first three industrial revolutions and possible predictions on the fourth industrial revolution. According to Rosenberger and Verbeek (2015, p. 1) one of the questions a post-phenomenologist study engages with includes how do technologies inform our politics, ethics, and our understandings of the basic features of our everyday experience? And secondly "As 'empirical philosophy', post-phenomenology does not base itself on the philosophical tradition and on conceptual analysis only, but also on the study of actual technological practices and artifacts" (Rosenberger & Verbeek, 2015, p. 30). In this view post-phenomenology studies can be characterised by four elements and for the purpose of this study, the focus is primarily on the fourth element that emphasises "conceptual analysis of the implications of technologies for one or more specific dimensions of human-world relations – which can be epistemological, political, aesthetic, ethical, metaphysical, among others" (Rosenberger & Verbeek, 2015, p. 31).

Taking into consideration Ihde's framework, the impact of industrial revolutions on visual arts and design disciplines can be seen in many ways at different levels from types of skills required, production

[1] https://sts.au.dk/fileadmin/sts/publications/working_papers/Ihde_-_Postphenomenology_Again.pdf

processes, theory, epistemological curiosity, intellectual tools, authorship, commodification, representation/aesthetics to distribution. Generally, the bone of contention in this is mainly centred (and still will be) on the establishment of new order versus the survival of the established disciplines. To put this in context, first we need to have a basic understanding of philosophy of art, secondly the technological historical development in relation to the industrial revolution 1.0, 2.0, 3.0, and 4.0. Philosophy of art engages the meaning and the interpretation of “the purpose of art, the nature of beauty, the effects of art on individuals and society and how the various arts are to be classified” (Harrison-Barbet 1990, pp. 286). There are generally three theories of art that offer a different understanding of the purpose of art, i.e. imitation (images of physical things), expression (human feeling) and form (aesthetic value) (Harrison-Barbet, 1990, p. 286). There are merits in each of the three theoretical perspectives in which help us to understand the visual arts ecosystem or visual culture/studies.

The impact of the development of technology during industrial revolution 1.0 in visual arts can be related to the photographic process. One of the early challenges faced by the medium of photography was gaining acceptance as a legitimate art form. It was also seen as serving the purpose to reference material for the artists for their paintings. However, in the later years when photography gained the reputation as an art form and this led Paul Delaroche to declare that “from today painting is dead”. In order for the artist to remain relevant, concepts such as art for art’s sake were introduced. According to Honour and Fleming (1999, p. 675), such concepts “develops when artists feel a hopeless contradiction between their aims and the aims of the society to which they belong”. Muybridge’s photographic study commenced in 1872 to complete 1885 also played an important role to bring to realisation the moving picture.

Industrial revolution 3.0 also affected the production, representation and distribution of artistic images in many ways. According to Marley (2000) “most of the early artistic images were produced by scientist or mathematicians, who had access to computer technology which was not commercially available” (Marley 2000, p. 19). Most methods of production also demanded collaboration and merging of techniques and skills. As a result, this also improved the aesthetic values, for example Lister, et al. (2009, pp. 140) identify the spectacular effects of verisimilitude, photorealism and hyperrealism as other elements that affected cinema as a result of computer technology. In animation, while the genre enjoys growing, traditional hand-drawn techniques were discontinued or downsized in favour of 3D computer animation by animation production studios (Beck, 2004, p. 336).

Labarre (2016) wrote about 18 new predicted design jobs (UX designers) by designers from big tech companies such as Google, Microsoft, Autodesk, among others. These jobs include augmented reality designer, avatar programmer, chief creative officer, chief drone experience designer, conductor, cybernetic director, director of concierge services, embodied interactions designer, fusionist, human organ designer, intelligent system designer, interventionist, machine learning designer, programme director, real-time 3D designer, sim designer, nanotech designer. In Ferrari’s view, these predictions and connections, such as software revolution, will speed up the changes in design processes as well (Labarre, 2017, p. 2631)

The changing landscape in the fourth industrial revolution: A case study on New Media Art

Several disciplines in visual arts and design have always been associated with socio-technological forces in the different phases of the industrial revolution. One of these disciplines is new media art, which is a merge of new media and technology within the field of contemporary art. The defining feature that differentiates it from conventional visual art is the emphasis on medium. The discipline is entirely tied to technological development, and its beginning can be traced back to the invention of moving images during the first two phases of the industrial revolution, from the late nineteenth century to the early twentieth century. The third industrial revolution that took place in the second half of the twentieth century progressively integrated technology into all fields of human activity, including visual arts and design. This relationship between art and technology ushered in a new dimension of new media art; where, rather than just an art piece, new media art acts as a platform for communication and interaction. The predominance of electronics and information technologies during this phase brought about the various forms of new media art such as digital art, computer graphics, video games, computer animation, and sound art. However, the 4IR, which is characterised by the fusion of technologies (Schwab, 2016), is creating the space for new forms of new media art, which include virtual art, internet art, interactive art technologies, computer robotics and cyborg art.

It is inevitable that technology forces will shape the future, and therefore, important to understand the extent to which these forces will impact our way of life and future jobs so as to stay relevant and prepared. In Kevin Kelly's book, "The inevitable", he proposed twelve overlapping technological forces that will shape the intangible digital realm of the 4IR; which are Becoming, Cornifying, Flowing, Screening, Accessing, Sharing, Filtering, Remixing, Interacting, Tracking, Questioning and Beginning (Kelly, 2016). According to Kelly (2016) as cited in Ferrari (2017), "*in the intangible digital realm, nothing is static or fixed. Everything is becoming".* From the post-phenomenology school of thought, the mediating effects of technology as a driving force in the process of *becoming* can be viewed from four dimensions (existential, epistemology, practical and ethical); 1) The process of becoming aligns with the existential nature of technological systems, which is chiefly maintenance (continual upgrades); 2) the epistemological dimension promotes experiential knowledge while; 3) the practical dimension emphasises the importance of interaction in the process of *becoming*, which according to Olalere (2018), improves applicative knowledge. Lastly, the fourth dimension (ethical) raises awareness about the two-sidedness of technological mediation, in which technology can both support and deplete efforts and good intentions.

Hence, from the post-phenomenology perspective, the '*new*' in new media art can be seen as an indicator of that process of *becoming*, which is driven by technology and multidisciplinary interactions. In this case, technology is not replacing the discipline-specific skills. It is acting as the medium in the process*,* where new techniques, interactions, innovations, jobs and skillsets emerge. Technological mediation is shifting the focus from a culture of the object (art object) to a culture oriented toward systems (Bessette, 2018), which Burnham (1968) called *systems art*. According to Burnham (1968), systems art focuses on the process of developing a relationship between art and technology within the larger culture (disciplines or fields). Multidisciplinary collaboration is key in this process and the driving force is technology; thus, expanding the new media art from just creating works of art to the creation of *lifestyle* (Bessette, 2018), which is dynamic and as a result '*becoming*'.

Besides technology acting as a medium, Smith and Leymarie (2017) opines that technology also acts as a creator/co-creator, and authors support their claim with relevant literature that bears ample witness of the emergence of technology as creator or co-creator. Some examples are 1) the algorithmic studio assistant that embellishes computer-mediated graphic or sculptural works of art (Rees, 1997; Lambert, Latham & Leymarie, 2013); 2) autonomous painting robot that creates striking abstract works (Doepner & Jurman, 2016); 3) AI systems that predict the author of existing works of graphic art (Johnson, et al., 2008); and 4) anthropomorphic robot that creates imaginative portraits of their human subjects (Figure 2) (Berio, Calinon & Leymarie, 2016). With this unprecedented development of technologies, 4IR presents a gradual release of the labour force from physical activity and mental efforts in favour of more striking creativity (Prisecaru, 2016). Thus, disciplines, such as new media art, that is not locked to the idea of form-giving (art object) has a bright future (Ferrari, 2017).

Figure 2: Baxter writing its name as a graffiti tag (Berio, Calinon & Leymarie, 2016)

Interestingly, the recently released technical report by the Department of Home Affairs listed only new media art (digital artist and multimedia designer) under the critical skills list in South Africa, with other specialisations within the visual arts and design excluded (Department of Home Affairs, 2021). This evidently shows that new media art is one of the jobs of the future. Unfortunately, most of the universities of technology in South Africa do not offer new media art (or multimedia) as a stand-alone programme. A few of the universities of technology only offer new media art (or multimedia) as a module within a programme. Although, some traditional and comprehensive universities, as well as private higher education institutions, have already recognised the potential in this domain in South Africa. Therefore, UoTs should stand up to the challenge and re-invent their programmes to prepare a workforce for this scarce skill in South Africa.

Framework of skillsets needed to face new markets and opportunities in 4IR

The changes and developments in 4IR indeed will affect the visual arts ecosystem in many ways and specific to the types of skills required from African universities of technology. In order to conceptualise a framework of skillsets needed to face new markets and opportunities in 4IR, it is important to find ways to adapt to those new technologies. According to Schwab & Samans (2016, p. 31), "technological trends such as the 4IR will create many new cross-functional roles for which employees will need both technical and social and analytical skills. Most existing education systems at all levels provide highly siloed training and that is hindering progress on today's talent and labour market issues". In South African universities of technology, most of the courses offered under CESM's art and culture are still focused on siloed training. Therefore, we argue that in order to adapt to the technological drivers of change in 4IR, a multidisciplinary approach in developing skills sets for future jobs in new media art is one way to address this challenge of siloed training.

As illustrated in Figure 3, the multidisciplinary approach requires an integration of technological skills as a driving force rather than a replacement of discipline-specific skills. We believe that discipline-specific skills will still play pivotal roles in future jobs but will require technological skills to function effectively in the changing landscape. Such skills that will cater for technological advancement, namely artificial intelligence (AI), augmented reality (AR), virtual reality (VR), programming or coding, internet of things (IoT), three-dimensional (3D CAD) modelling and simulation, and additive manufacturing (3D printing). Even though the relevance of the technological skills will vary across different specialisations, the dynamic nature of the technological applications will require keeping up-to-date with the technological development in order to stay aware of what is obtainable. The multidisciplinary approach also requires exposure to both management and entrepreneurial skills to drive multi and transdisciplinary collaborations and interactions. The management skills include the ability to plan or organise with set guidelines, good communication skills (interpersonal skills), great decision-making and problem-solving skills. The entrepreneurial skills include strategic and critical thinking ability, financial skills, analytical and organisational skills.

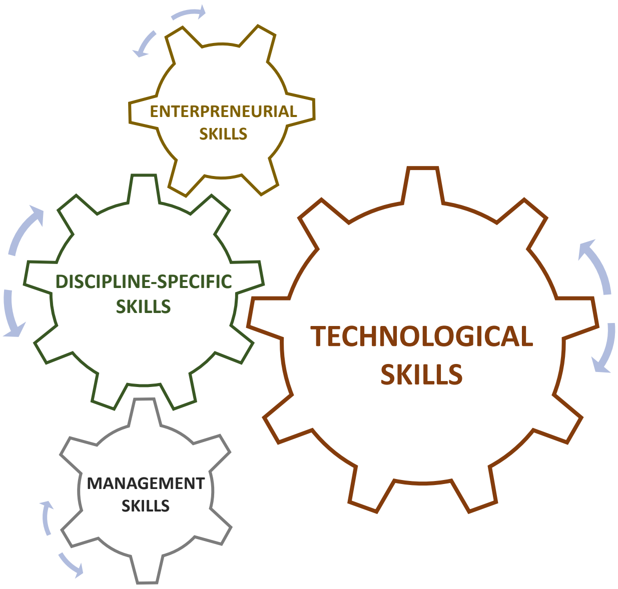

Figure 3: Multidisciplinary approach in developing skills sets for future jobs

The fusion of technologies is creating the space for new forms of new media art such as virtual art, internet art, interactive art technologies, computer robotics and cyborg art, which demand a multidisciplinary approach that drives disciplines and ensures interaction with other disciplines. Schwab & Samans (2016, pp. 31–33) suggest that across all industries, a higher level of technology literacy will be at the core of the 4IR. Above technological skills, the demand for a wide range of skills or skill set combinations for different industries will also become a basic requirement for most industries. So now, in the case of an undergraduate programme, for example, three years diploma with 360 credit or bachelor's degree (first degree) with 360 credit, how can the mediating effects of technology and the concept of *becoming* assist to identify the skill sets needed to face the new markets and opportunities in 4IR at the African University of Technology.

The illustrative diagram (Figure 4) suggests possible skills required to meet the continual changing landscape. According to Schwab & Samans (2016, p. 20), there are three categories of skill sets that cut across all the industries, namely, abilities (cognitive skills, physical skills), Basic skills (content skills and process skills), and cross-functional skills (social skills, resource management, system skills, complex problem-solving skills and technical skills). As shown in Figure 4, New Media Art provides a bridge to linking the changing landscape of future jobs. To function effectively as a New Media Artist in this changing landscape, one requires the core skills or in other words, discipline-specific skills (such as creativity, design thinking, basic skills, artistic and aesthetic skills). In addition to the core skills, the technical skills are needed to engage effectively with the emerging 4IR technologies. The technical skills include programming and coding, 3D CAD modelling and simulation, data science and visualisation, critical and analytical thinking, digital literacy and ethics. However, to drive an effective multidisciplinary interaction and aid the technological drivers of change, some soft skills (such as complex problem solving, system thinking, cross-functional skills, among others) are needed. In Europe, this multidisciplinary interaction is already happening. An example is organ designer, which is a collaboration between bioengineering and design to develop prototypes of human organs through 3D printing (Amsen, 2019). There are, however, limitations at the African University of Technology and the developing countries. Three years of education might not be enough to prepare students to be industry-ready; hence, the training should start from a basic education level.

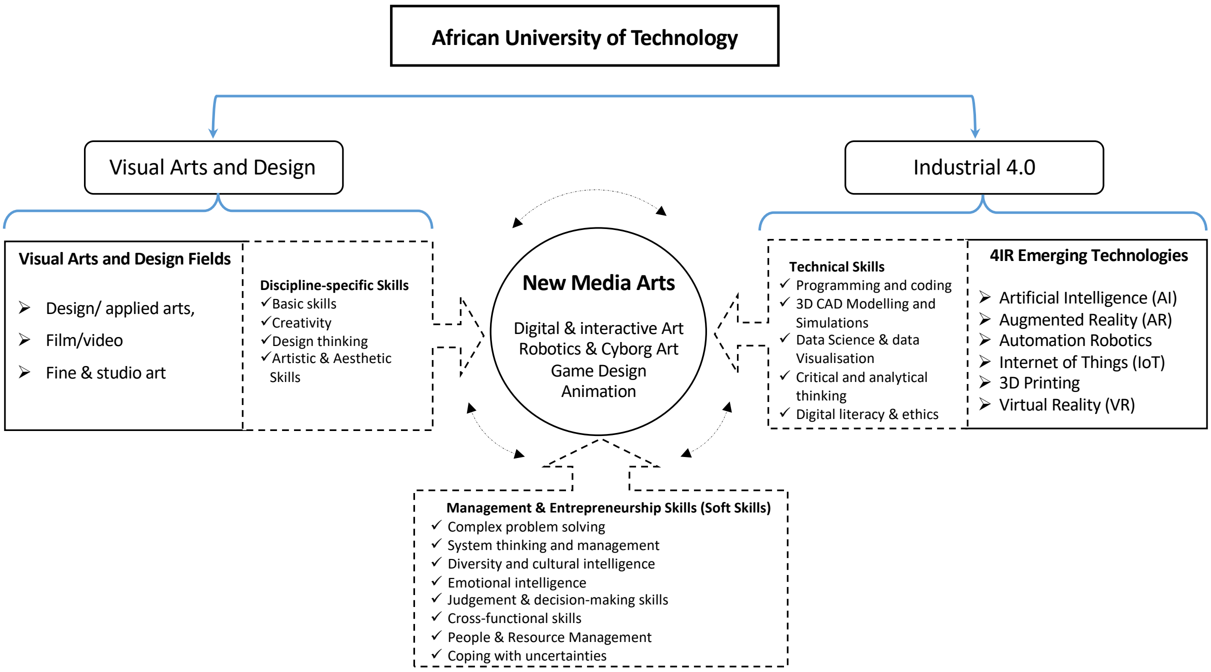

Figure 4: Framework of skillsets needed to face new markets and opportunities in 4IR

Conclusion and recommendation

It is evident that in South Africa, African universities of technology are regarded as career-directed institutions with historical ties with Technikons in which are primarily industry oriented. This type of institution has its own challenges and opportunities to contribute to the socio-economic and technological developments, especially the historically disadvantaged universities of technology. These challenges and opportunities also affect the underrated and so-called expensive visual arts and design departments and their programmes to achieve its potentiality in socio-economic and technological developments. The impact of all three industrial revolutions (IR 1.0; IR 2.0 and IR 3.0) on visual arts and design disciplines can be seen in the tension between at least the established disciplines and the emerging new disciplines, automated and hand-crafted, analogue and digital, among others. During IR 3.0 we also experienced the convergence of these established disciplines and the emerging new disciplines into one through computer technology. IR 4.0 is at its initial stages or is imminent to disrupt future jobs, skills, and industries at a higher pace compared to IR 3.0, through automation, internet of things, among others. Even though the relevance of the technological skills will vary across different specialisations, the dynamic nature of the technological applications will require keeping up to date with the technological development in order to stay aware of what is obtainable. The multidisciplinary approach also requires exposure to both management and entrepreneurial skills to drive multi and transdisciplinary collaborations and interactions. At the South African universities of technology most of the courses offered under CESM's art and culture are still focused on siloed training. Therefore, we argued that in order to adapt to the technological drivers of change in 4IR, a multidisciplinary approach in developing skills sets for future jobs in new media art is one way to address this challenge of siloed training.

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Anticipating IR 4.0: Conceptualising a human-centred contribution to the design of emerging complex technological systems

Terence Fenn, *University of Johannesburg*

Abstract

Emerging IR 4.0 systems have the capacity both negatively and positively to disrupt. While currently much of the design in this regard has for practical reasons focused on technical systems, there is an urgent need to ensure that these systems due to their physical fabrication, pervasive deployment, and autonomous capabilities, are integrated into our human world in a manner that enhances the human condition and ensure planetary sustainment. Supporting this urgent need, this paper suggests that human-centred design (HCD) can make a substantial contribution, albeit with a recasting of its traditional design role. Consequently, HCD is positioned as an anticipatory mode of research focused on developing both plausible future scenarios, as well as recognising potential enabling activities and contexts for reaching or avoiding these scenarios. Exemplifying, this type of anticipatory inquiry, a scenario detailing a possible human-centred approach to IR 4.0 systems design is provided. The scenario is complimented by an introductory range of suggestions articulating the tactical steps that a design learning programme could implement to ensure the next generations of designers are prepared adequately to engage with the realities of the emerging technological developments.

Keywords: Anticipatory design, discursive design, design education, IR 4.0, human-centred design

Introduction

In the *Fourth Revolution* (2014), information philosopher Luciano Floridi suggests that the future of human reality will be shaped by the growing pervasiveness of digital and physical cyber systems. Many of these systems that Floridi refers to can or will be regarded as ‘third-order technologies’ capable of autonomous behaviour and seemingly intelligent behaviour.

In fields of design associated with product design, such as industrial and interaction design, the technical knowledge required to engage with the internal material dynamics of third-order technology meaningfully and directly is for most practitioners beyond their know-how. In this sense, many of the emerging cyber technologies of the fourth industrial revolution (4IR) have fundamentally rolled back the democratisation of digital technology that emerged during the Third Industrial Revolution (3IR), requiring advanced specialist technical knowledge to both conceive of and implement strategic intentions. Thus, the development of these technologies typically falls under the remit of technology-centred professionals such as software engineers and computer scientists.

In response to this brief problematisation, this paper explores first, how human-centred design (HCD) approaches can meaningfully impact the design of technology at the level of complexity presented by third-order technologies and second, presents a set of requirements that can strategically guide design education to anticipate this emergent need.

The methodological approach of this study is premised on Inayatullah's 'six pillars of future thinking' (2008). As such, the first section of the paper 'anticipates' and 'deepens the future' of a human-centred commitment to design in the age of 4IR by providing a brief outline of key technical characteristics of emerging technologies, as well describing valuable design and futures orientated approaches for considering such technologies. The second section 'engages with alternatives' by presenting a brief a scenario describing a HCD approach for engaging with large-scale technological systems associated with concepts such as the IR 4.0, and smart cities (collectively referred to as IR 4.0 systems).[1] Lastly, the third section 'backcasts' from the proposed scenario a suggested set of criteria for design curricula, seeking to address the impact of IR 4.0 systems.[2]

Section 1: Anticipating the role of HCD in the 4IR deployment

This paper is foremost concerned with a role that HCD as a socio-cultural practice can bring to the development of highly sophisticated large-scale technological systems associated with IR 4.0. At the time of writing, it is evident that these techno-visions of our immanent future have given rise to a great deal of anxiety around their implementations. While not necessarily misplaced, this anxiety is often compounded by a poor understanding of the composite technologies likely to enable emergent IR 4.0 systems. Hence, while this paper is primarily concerned with a scenario in which human-centric design is applied to lessen the likelihood of these social anxieties materialising, this initial discussion will introduce and briefly contextualise a broad technological framing of IR 4.0 systems.

At an essential level of understanding, IR 4.0 systems can be defined by the differences between first, the Third (3IR) and fourth industrial revolutions, and second, the characteristics of *first*, *second* and *third-order* technologies.

3IR (often referred to as the digital, computer or information revolution) is typically characterised by the ubiquitous use of computational technologies in both the work, home and mobile. From a technological perspective, 3IR includes hardware such as personal computers, mobile devices, 3D printers utilising the networking infrastructures of the world wide web, and largely focuses on the communication of information.

In turn, IR 4.0 systems are defined by their third-order technology abilities.

Floridi (2012, p. 27) describes *first-order* technologies as characterised by a direct relationship between people, technology, and the natural world. For example, if one uses a garden spade to dig a hole in the ground.

In *second-order* technology, an individual's engagement with one technology is mediated through the use of an 'in-between' technology. For example, the use of a key to open a gate. Here, the key is the technology 'in-between' the user and the gate.

Lastly, in *third-order* technology, the human-user sits outside of 'the loop' of at least one technological order. This inner-loop involves at least one primary technological 'agent' initiating the use of a different secondary technologies that may in turn, mediate a third level of technologies (Floridi, 2014, p. 29). These third-order technologies act and interact 'intelligently' in the sense that they "process information logically and autonomous" (Floridi, 2014, p. 94). In this manner, third-order technologies, while associated in popular culture with artificial sentient intelligence, are more accurately

[1] IR 4.0 refer specifically to 4IR as applied to industrial settings.

[2] 'Backcasting' is a method of 'reverse engineering' the activities and conditions that need to be in place to increase the likelihood of a particular scenario of the future occurring (Inayatullah, 2008, p. 18).

exemplified by engineered intelligence concepts such as machine-learning, neural networks, situated robotics and light IA.[3] Consequently IR 4.0 systems can be understood as relating to both a new manufacturing society in which data and information have superseded raw materials and energy as the real source of added value, and the digital fabrication of a world in which humans are no longer the sole intelligent actors (Floridi, 2014, p. 218).

Consequently, IR 4.0 systems, which often make use of 3IR hardware infrastructures, are differentiated by their highly complex abilities to absorb, process, and autonomously respond to data at unprecedented scale and levels of sophistication.

While this explanation of IR 4.0 systems and the three orders of technology is purposely introductory, three further points are relevant to the general discussions.

First, and fairly evident, is that emerging digital technologies and infrastructure, be they 3IR or 4IR, are highly complex technical environments and are becoming ever more so.

The second, less apparent point is that IR 4.0 systems are largely projections of a future. They do not as yet exist. In this sense, much of Klaus Schwab's *The fourth industrial revolution* (2016) is written in the future tense, Floridi's *Infosphere* is a futural place where IR 4.0 systems have become pervasive, and our cities are at best trying to be smart (Snow, et al., 2016, p. 92). This is not meant to be a provocative statement but rather to suggest that much of the seed technology for these visions has or is in the process of been developed and while isolated examples exit, it is far-fetched to suggest our everyday experience of the world pervasively exceeds 3IR. This is particularly true of African contexts where for many 3IR remains aspirational, for as Schwab (2016, p. 8) notes, more than 1.3 billion people on the planet still lack access to electricity.

Thirdly, while IR 4.0 systems are for now 'futural', they are on the technological horizon. Thus, there is every indication that our emergent work, home, and urban experiences will converge with these technological environments. For unlike the digital technologies of the 3IR, those of 4IR will be fabricated directly into the physical environment. In this manner as Floridi cautions, our "physical and conceptual environment" will be overwhelmingly an artificial one, shaped by often invisible and opaque technologies.

Consequently, there is a chance that these pervasive techno-environments, which will define our future human condition, will be driven by technological concerns such as what is "the best or easiest, or indeed sometimes the only, way to make things work" (Floridi, 2014, p. 150). However, if considered properly, these technologies do provide the opportunity for us to address the problematic state that our previous 100-odd years of technological advancements have brought about. For example, we have the opportunity to ensure our cities are more sustainable, our food chains more productive, and our education systems more accessible and equitable. To achieve this, Floridi advocates the role of "human intelligent design" to shape the future world and our human experience within it (Floridi, 2014, p. 150).

Philosophical approaches to design

As noted by several researchers, contemporary design can be categorised into different approaches, each suggestive off a particular set of philosophical concerns. Krippendorff (2006) and Giacomin (2014), for example, both recognise the design paradigms of technology-centred design (TCD) and human-centred design (HCD), while Giacomin adds a third, environmentally sustainable design.

[3] See Floridi (2014, pp. 141-143) for further explanations regarding 'light' and 'heavy' IA.

Technology-centred design

TCD is primarily concerned with technical novelty (Giacomin, 2014, p. 607) with an emphasis placed foremost on the ability of a technical system to perform a prescribed objective. In this discussion, TCD is associated with disciplines such as information science, engineering, city planning and computer sciences.[4, 5] From a historical perspective, TCD can be understood as emerging during the industrial era, placing its design focus on product functionality.[6] As such TCD is historically influenced by a range of theorists, including Buckminster Fuller, Sydney Gregory and perhaps most famously Herbert Simon and his 'science of the artificial' (1982). TCD typically uses *design science* methodologies, which inherits much of their knowledge from the sciences and typically emphasises objective approaches to research yielding generalisable results (Buchanan, 2007, p. 57).[7] In this manner, TCD amounts to shaping the future world but is not typically concerned with shaping the human experience within it.

Critique levelled at TCD is that it tends towards a deterministic technological viewpoint based on the rationales that "technology develops autonomously and by its own logic", and a framing of technology as culturally neutral, implying that people can and should adapt to any resulting change (Krippendorff, 2006, p. 13). However, it is worth noting that much value in the world originates in the ingenuity and innovation that originates in TCD.

Human-centred design

At its broadest definition, HCD is a philosophical paradigm of design that situates the practice as foremost a social activity orientated towards supporting peoples' conceptions and desires, and as such cannot be separated or abstracted from the context of their lives (Krippendorf, 2007, p. 71).

Historically, HCD emerged from a varied range of disciplines. For example, Victor Papanek, an early influential industrial designer proponent whose seminal publication *Design for the Real World* (1971) questioned design's commercial agenda. Other notable critiques of design practice at this time include architects and urban planners Horst Rittel and Melvin Webber (1973), who collectively recognised the need to address social complexity when considering urban infrastructure. Likewise, in the field of human-computer interaction, albeit slightly later, influential scholarships such as Lucy Suchman's work on situated action (1987) and Winograd and Flores's *Understanding Computers and Cognition* (1987) suggested the design of computational technology be reliant on the relations among and between people and the "culturally constituted worlds that they inhabit" (Rogers, 2012, p. 45).

HCD acknowledges that designers are first people and as such, participate in the social constitution of reality, both in terms of what they produce, as well as how they produce it. Consequently, designed products contribute to knowledge in the world, but also must be understood as perpetuating specific knowledge dispositions pre-existent in the world. In HCD the emphasis is, thus, placed on the designer to ensure (to the degree that they can) that their worldview does not obscure that of the community, expected to use the resulting technologies. In this manner, the resulting technology is required to respond to the lived experience of people, not disrupt it.

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[4] Don Norman's The Design of Everyday Things (1990) is a seminal text that critiques technological determinism in design

[5] The remainder of this paper uses 'technologist' to collectively describe professionals from these fields.

[6] As outlined in *Making the Modern* (Smith, 1994).

[7] See Hevner, et al. regarding Design Science (2004).

Therefore, from a paradigmatic viewpoint, HCD can be understood as interrelated set of philosophical, epistemological, and methodological approaches to design, geared towards a consideration of the people who perceive, interpret, use, and live with designed artefacts (Krippendorff, 2000, p. 4).

HCD is not immune to criticism. First, while HCD often claims to represent the lived experience of people, in practice it is often characterised by poor application and understanding of ethnographic methods adapted from the social science (Baskerville & Myers, 2015, p. 28). Second, in commercial practice, HCD has often been deployed to enable unethical business and social engineering practices.[8] Third, HCD's emphasis on human experience as the primary criteria for evaluating the validity of design has become a growing concern as the harrowing effects of climate change become apparent (Russel & Lyndon, 2020, p. 3). While one could argue that many of these problematic aspects arise from a misunderstanding of the intent of HCD, often brought upon by the appropriation of the term by design consultancies foremost concerned with innovative business practices, this paper takes the position that the continuation of human existence is a direct consequence of planetary sustainment. As such, the remainder of the paper conflates environmentally sustainable design with HCD.

The shortfalls of TCD and HCD in terms of IR 4.0

While TCD and HCD present distinctly differing philosophical views for approaching design their relationship should not be viewed as oppositional or absolute. Hence, for example, it would be naïve to suggest that engineers never have any regard for human-users or that UX designers have no conceptualisation of programming structures. While both approaches have their individual drawbacks, a more helpful view is to consider TCD and HCD in relationship to what multiple authors have referred to as designing for the 'inner' and 'outer' loops or environments of technology (for example, Floridi, 2014; Simon, 1982). In this manner, TCD can be associated with inner-loop design, which can be understood as focused primarily on the development of the internal structure and operations of technological systems. In comparison, HCD can be conceptualised as addressing outer-loop design and, as such, is concerned with how technologies interface outwards, towards people, and, reciprocally, how people interact with technologies. Consequently, and exemplified in the contemporary digital industry, it is reasonable to suggest that most technology benefits from the consideration of both loops of design.

However, due to the scale and complexity of emerging IR 4.0 systems there are few HCD designers directly involved with their design. This is unsurprising for two interrelated reasons.

First, as emerging technologies much of the current concern is focused on system functionality rather than a specific real-world application. In this manner, these technologists are still largely resolving general problems as opposed to contextual ones.

Secondly, HCD, particularly within its concern for specific user-communities typically is contextually located and idiographic in nature. Therefore, HCD tends to not scale easily to the level of the types of general problems currently required in the TCD of IR 4.0 systems.[9]

The consequence of the absence of outer-loop design is that these systems are currently largely conceptualised from technologically orientated frameworks. Consequently, design decision-making is

[8] This type of unethical persuasive design is often referred to as 'dark pattern' design.

[9] As noted by Mani-Kandt (2021), HCD struggles to resolve complex, large-scale systemic problems.

at worst driven by technocentric views, and at best, by professionals with little, if any, training or sensitisation to guide implementation in the social world.

Unlike previous generations of digital technology design, IR 4.0 systems will be fabricated into the built environment of our surrounding cities, homes, workplaces, and vehicles. This physicality implies that the ability for the outer-loop design to catch up with the inner-loop will be drastically curtailed due to among other criteria, extremely high costs. Thus, there is an urgent need for design approaches that are concerned with the impact of IR 4.0 systems from socio-cultural and planetary perspectives to contribute meaningfully to their development. Failing this we may find ourselves set on a path from which there is little chance of deviation. For as noted by Townsend (2013) Greenfield (2017), Zuboff (2019), we may soon find that the very businesses that currently control and profit from social media will be designing our homes, workspace, neighbourhoods and cities.

Discursive speculations

While product design fields such as industrial, interaction and user-experience design have contributed much to the human-centric design of contemporary digital technologies, this contribution is typically limited to tactical concerns such as usability and directly embodied experience. These fields have largely embraced HCD in terms of what Baskerville and Myers (2015, p. 27) refer to as *ethnography for design* (E4D) characterised by user-studies involving research methods such as interviews, observations, participation, among others. More recently, fields such as service design (Polaine, et al., 2013) and strategic design (Nixon, 2016) have been deployed at a broader scale of focus to direct organisational service offerings from a strategic perspective. These fields have tended to expand on E4D methods to account for their human-centric positioning, albeit often within the limitations of corporate or governmental organisational contexts, short-term temporal considerations, and restricted to preferable and implementable change.

Outside of E4D practices of HCD, there is a growing set of discursive design (DD) practices that collectively seek to explore alternative future states.[10] While sharing a legacy with other historical design practices, DD came to prominence through the extensive contribution of Dunne and Raby (2001) (2013), as well as other influential researchers such as Gaver (1999) (2001) Sterling (2005) (2013), Bleeker (2009), Malpass (2013) (2017) and more recently Tharp and Tharp (2018).[11]

While DD is a rich and varied field, there are multiple aspects that resonate with outer-loop design in terms of IR 4.0 systems.

First, the defining attribute of DD is its application of design creativity to communicate ideas, generate debate, and change mindsets rather than the creation of utilitarian products typically associated with routine design practice (Tharp & Tharp, 2018, p. 7). In this manner, DD is not overly concerned with implementable and usable product design but rather seek to orientate its audience towards a particular viewpoint or understanding.

Second, Dunne and Raby specifically connect DD with the use of design as “a means of speculating how things could be” to open up novel perspectives on complex, social problems in order to enable and generate discourse about “alternative ways of being” (2013, p. 2). In this manner, DD often makes uses of future scenarios that extend beyond any short-term expectations of the future in order to free up considerations of how life could be, from how life is (Dunne & Raby, 2013, p. 6).

[10] Arguably, the most well-known of these practices are *critical design*, *speculative design,* and *design fiction.*

[11] The use of ‘discursive design’ as a composite term for these types of speculative design originates in (Tharp & Tharp, 2018).

While largely driven by the imagination, best practice in DD suggest the use of theoretical frameworks and/or consults with external expertise to envision the deployment and impact of possible future socio-technology scenarios in everyday use (Malpass, 2013, p. 338). Thus, while not without rigour, DD's focus on speculation allows for designers to engage with technologies that are either inaccessible or are themselves largely in the state of conceptualisation in order to account for "the domestication of up-and-coming ideas in the sciences and applied technology" (Malpass, 2013, p. 338).

In this manner, DD does appear to speak directly to the role that outer-loop design could take as a mode of enquiry into the various permutations and effects of IR 4.0 systems. However, DD does present several drawbacks that limit its direct application to the consideration of IR 4.0 systems. Chief, among these is that the conceptual thinking at the centre of its design activities is overwhelmingly designer-driven. As such, many of the suggested alternative futures are highly subjective reliant on personal viewpoint with very little evidence of academic rigour (Tharp & Tharp, 2018, p. 306). Second, DD does not seek to address probable outcomes but rather focuses on the limits of what is realistically possible, so as to "unsettle the present" (Dunne & Raby, 2013, p. 88). As such, DD does not, and never claims to predict a plausible future. Third, DD describes itself as an audience-centred practice, however, this audience is often only vaguely identified (Tharp & Tharp, 2018, pp. 236-7). In this manner, DD while often including technologists in consultant roles, does not place an emphasis on communicating its discourse to this audience.

Anticipating futures

The emerging field of *anticipatory design* (AD) (De Smet & Janssens, 2016; Morrison, 2018; Hunt, 2019) shares many foundational concepts with DD in terms of applying design practice to both speculate on, and create discourse around, alternative future states. However, in comparison to DD, AD is concerned with the "implications of plausible near futures and in doing so allowing designers and their designs to match the velocity of the future before critical impacts occur" (Lindley, et al., 2015 , p. 58). In this manner, AD uses DD's temporal divergence from the reality of the present but does so with in touching distance of the present. Consequently, AD is concerned with plausible emerging events and technological developments.

In addition to emphasising the plausible, approaches to AD such as *anticipatory ethnography* (Lindley, et al., 2014; Lindley, et al., 2015) apply HCD E4D methods of enquiry, and consequently, include a level of rigorous exploration into the life-worlds of particular communities. As such, AD embraces ethnographic knowledge but not at the exclusion of larger cultural and planetary concerns.

However, one issue that AD does not address adequately is the issue of an expected audience. In this manner, while many AD projects anticipate change, they tended to focus on building consensus with affected communities rather than communicating specifically to those who have the capacity to affect change. For example, Morrison's (2018) work with a community highlighting the change that global warming may bring to the Artic.

In the scope of IR 4.0 systems design, there is a very specific audience consisting of technologists whose work has the potential to be enriched or supplemented by articulate and rigorous enquiry into future social impact and possibilities for these emerging technologies.

Importantly, this is not a novel concept. The broad field of *futures studies* (futures) an interdisciplinary field intersecting with the humanities, natural sciences, politics, and design (Ollenburg, 2019, p. 51) has positioned itself in this role. In particular, and sharing multiple similarities with AD, *critical futures* scholarship recognises 'the future' as inherently a domain of ideation and imagination, which while incapable of being directly experienced has "real and material consequences" (Candy & Kornet, 2019, p. 5). As such, much like DD and AD, critical futures employ "the design of situations and stuff from the future to catalyse insight and change" (Candy & Dunagan, 2017, p. 137).

The recognition of the conceptual overlapping of DD, and particularly AD with critical futures is in the scope of this discussion important for two pertinent reasons. First, the field of futures positions itself as a consultancy practice. In this sense, futures offer a range of skills and concepts focused on articulating alternative scenarios for describing future possibilities. Importantly, while futures thinking may suggest the necessary steps for any one scenario to unfold, it makes no claim in terms of delivering the projected futures. In this manner, futures plays an advisory role rather than an artefactual productive one and, as such, is deployed as a service to a client entity.

Second, critical futures provide multiple theories that can provide a level of conceptual substance to inform outer-loop design that focuses on anticipating emergent IR 4.0 systems. These include, for example, frameworks such as Inayatullah's *Six Pillars of Futures Studies* (2008), Candy and Kornet's *Ethnographic Experiential Futures* (2019) and Ollenburg's *Futures-Design-Process* (2019).

To conclude this section's discussion, while IR 4.0 systems can be considered highly complex and at this stage developmental, there is an urgent requirement for these systems to be anticipated through a human-centred lens in order to highlight concerns and generate dialogue as to the best way forward before their physical implementation lessens the opportunity to do so. Consequently, the next section presents a brief scenario, describing a possible approach.

Section 2: A scenario of anticipatory design 4.0 (AD 4.0).

AD 4.0 can be described as a philosophically humanity-centred, design-led approach to research concerned with the generation of plausible design speculations that explore from a socio-cultural and planetary lens, the potential impact and opportunities presented by emergent IR 4.0 systems.[12]

AD 4.0 exhibits the following characteristics. First, AD 4.0 uses the processes and material qualities of design to explore and communicate concerns and opportunities. In this manner, it can be closely associated with discursive approaches to design. However, unlike most DD projects AD 4.0 is foremost a research activity.

As such, AD 4.0 contributes knowledge in service to other technologists involved in the TCD (and decision-makers) of IR 4.0 systems. In this manner, AD 4.0 uses its discursive nature in support of routine design practice and does not explicitly seek to resolve problematic situations through artefactual production. Consequently, AD 4.0 doesn't suggest how a system should operate but rather how they should behave.

AD 4.0 is communicative; it recognises that its audience are technologists and is mandated to communicate its discourse in a manner accessible to this audience. To this point, AD 4.0 anticipates the impact and opportunities of emerging technology through both the generation of exploratory scenarios, as well as in articulations of potential routes for achieving or avoiding identified scenarios. Supporting this intent, AD 4.0 is both persuasive and able to articulate how idiosyncratic attributes of individual designs can be generalised at least to a level whereby they can be applied to or attuned to other design contexts.

Section 3: Backcasting components of an AD 4.0 orientated teaching programme

As a scenario, AD 4.0 is itself anticipatory. For while there is a need for AD 4.0 or similar approaches to engage with and respond to disruptive technological change, currently in South African design education landscape approaches of this type are at best propositional. Hence, the important question

[12] 'Design-led' can be equated with practice-led approaches including research through design and research through practice.

is: *if AD 4.0 is an aspirational scenario of the type of design practice that is or will become important and meaningful, what are the tactical actions design educators can begin to introduce into their teaching programmes?*

To answer this question, this section outlines three focus areas that can potentially develop the required knowledge and skills to engage with AD 4.0.

First, a clear proposition that discursive and anticipatory orientated design research has a role to play in advancing IR 4.0 systems and/or other complex technologies requiring consideration at community, city, regional and/or global levels must be communicated. In this manner, this requires a framing of HCD as a consultancy research activity akin to anthropology, but more suited to engaging with creative activities and industry. Design education and academic researchers are vital in this capacity. For academics practising and describing AD 4.0 activities are vital for extending knowledge in this developing area. For educators, positioning design-led research as a valuable and viable career focus is important. Collectively, with the practitioner community, design educators and academics need to be able to narrativise these abilities of HCD to other stakeholders.

Second, while staking a claim in these regards is important, developing conceptual abilities to conduct AD 4.0 type practice is fundamental. As an initial starting point, the following inclusions are suggested:

1. A range of conceptual frameworks that account for a rigorous and in-depth understanding of emerging technological developments, social accounts of technology and lastly, critical theories that specifically address the previous two points are required. Consequently, human-technology studies should be a core aspect of a HCD education.
2. A rich and detailed understanding of social contexts is mandatory. This implies an engagement with social and anthropological theory, as well as a fundamental understanding of other forces which may impact futural states such as politics, economics, and histories.
3. Conceptual frameworks that prioritise planetary sustainment or a non-negotiable consideration.

Third, design practices that emphasise scientific rigour and imagination, strategical and tactical thinking, as well as knowledge generation at both idiographic and general levels should be included.

In terms of scientific rigour, the teaching of ethnographic research methods must ensure resulting insights are relevant and valid. Failing this, it will remain hard to convince other stakeholders that subsequent anticipatory work has any merit.

In order to develop student's design imagination, projects with speculative concerns should take place in addition to projects with routine design concerns. The central point is not to develop practitioners of DD per say, but to develop students' thinking skills to extend beyond overly rational, problem-solving approaches. While conceptual approaches such as 'blue-sky thinking' have long been applied, utilising the frameworks presented in critical futures (and possibly other approaches to futures) can help to create more credible futures scenarios.

To develop strategical and tactical thinking, product agnostic design approaches such as service design should be practised. These approaches emphasise data-driven methods that require in-depth enquiry into the particular context of the design in order to inform any subsequent design action. These types of analytical approaches can be complimented with anticipatory scenarios and the backcasting of actions required to achieve preferred scenarios.

Lastly, while the natural terrain of design practice is 'ultimate particulars' (Nelson & Stolterman, 2012, p. 39), AD 4.0 research requires the extraction of more general considerations such as emergent patterns, interrelationships, prescriptive situations, and relationships rules to be made more explicit from, and during practice. To develop these abilities, design students need to develop their skills and knowledge in the meta-structuring of information. This, the author has previously argued (Fenn & Hobbs, 2014), (Hobbs & Fenn, 2019) is the domain of information architecture, an invaluable field of practice for any designer facing design uncertainty brought on by contextual complexity.

Conclusion

Emerging IR 4.0 systems have the capacity to disrupt our current lived experience both negatively and positively. While currently much of the design in this regard has for practical reasons focused on technical systems, there is an urgent need to ensure that these systems due to their physical fabrication, pervasive deployment, and autonomous capabilities are integrated into our human world in a manner that enhances the human condition and ensures planetary sustainment.

This paper anticipates first, how E4D approaches can be combined with discursive, speculative approaches to futural considerations, in order to address the deployment of emerging IR 4.0 systems in a socially and planetary sustainable manner and second, the key design education factors that require implementation in order to ensure the next generations of designers are prepared adequately to engage with the realities of emerging technology environments.

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Critical design futures: Challenging the gender data gap through pedagogy

Ashton Margerete Mosley, *University of Johannesburg*

Kimberly Bediako, *University of Johannesburg*

Abstract

As we enter the era of the fourth industrial revolution (4IR) faced with potential ethical and security risks, ensuring sustainable and inclusive innovation within the design industries will be essential. However, this proves unlikely when the design industry itself has inherent biases and inequalities.

Historically, student enrolments in design institutions reflect notions of gender socialization whereby women are connoted to the decorative and aesthetic and men to technology and invention. As a result, women are underrepresented in fields such as industrial design, digital design, and architecture and men are underrepresented in the fields of fashion, textile, and jewellery design. Gender inequity within design disciplines at a professional level, not only perpetuates gender stereotypes but creates a gender data gap whereby the products and services we create are designed according to male data, resulting in markets that are underdeveloped concerning the specific needs of users.

While student enrolment gender ratios (in some disciplines) seem to show significant levelling out over the past 20 years, the same transformation does not reflect in the design industry. A study conducted by The British Design Council in 2018 identified that although 63% of all UK Art and Design graduates are female, the UK design workforce reflects a 78:22 male to female gender split, in comparison to the 53:47 gender split of the wider UK workforce. While some studies looking into the gender gaps within design industries exist, further research is required to develop an understanding of why a large percentage of female graduates are leaking out of the pipeline that carries them from university to industry. In light of these points mentioned, a research project unpacking issues of gender in design was initiated.

Funded by the Global Challenges Research Fund, the Unequal Stories research project between two universities in the United Kingdom and South Africa is a three-year cross-national comparative study that aims to investigate gender equality, diversity, and representation in the design disciplines in higher education and industry. This pilot project investigates gender in design across the two countries through developing a website to collect qualitative and quantitative evidence for those studying and working in design, as well as creating a pedagogic intervention in the form of a student project toolkit.

Driven by 4IR, this project was facilitated by digital technologies such as an interactive website, asynchronous lecture videos, and online teaching and learning methodologies. Guided by ethnographic research methodologies and critical design thinking, specifically speculative design and Afrofuturism, students were invited to deepen their understanding of gender equality and critically respond to their findings using the research and design conventions provided in the

Unequal Stories Toolkit. These critical design outcomes were then shared and showcased via an online gallery ultimately enabling discussion on design and gender inequality in the design disciplines from a cross-national perspective.

The authors, two young female South African academics from contrasting disciplines of Industrial and Fashion design, each conducted this project in their respective departments. This paper unpacks and describes the pedagogic intervention that was applied in the development of the Unequal Stories Toolkit project for students, and reflects on the project outcomes in both contexts, and subsequently aligns to the conference focus on design education, Afrika, and 4IR.

Keywords: 4IR, critical design, design education, design futures, gender

Introduction

Gender is commonly defined as a social construct based on the social, cultural, psychological, and behavioural influences and characteristics of masculinity and femininity (Wienclaw, 2021). Based on these influences, one's gender identity is realised (Wienclaw, 2021). Gender and the practice of traditional gender roles are an intrinsic part of social interaction and community. The observation of gender roles in various industries is broadly accepted. However, with initiatives progressing the rhetoric of gender equality and gender representation, notions of traditional gender roles and gender bias are being questioned and challenged. According to Sellers (2017) "women have always been, and remain, a significant part of the design profession as practitioners, commentators, educators, and commissioners". Yet, although having gained entry into the design industry in the late nineteenth century, women have been historically and institutionally marginalised by it, and their achievements have been the silent story of history for too long (Toksvig, 2004; Sellers, 2017).

Ensuring end-users are at the forefront of the design process has become increasingly valorised over the last decade as evidenced by the growth of approaches such as user-experience design and human-centred design. Hearing diverse stories is vital to ensure fair access to the industry, and to ensure that its outputs are a true representation of society. To do this, the design discipline itself needs to be diverse (Moseley & Campbell, 2019). When this is not the case, the lack of tacit insights required in the design process leads to underdeveloped products and services which do not meet the nuanced needs of the identified market. Prejudices and assumptions in the sphere of design exacerbate social inequalities and the results can be divisive, discriminatory, or even fatal (Criado-Perez, 2019).

'Design' is a broad sector encompassing numerous sub-disciplines such as graphic design, industrial design, digital design, advertising, architecture, and fashion. "The concept of 'design' came to maturity in the twentieth century and, as such, inherited that era's prejudices" (Sellers, 2017). Historically, men and women have been grouped into different categories of design education and employment through gender socialisation whereby women are commonly connoted to 'soft' design fields such as fashion and interior design, where the perceived design focus is on the decorative and aesthetic, and men are associated with 'hard' design disciplines such as industrial design and digital design, focusing on invention, functionality, and technology (Clegg & Mayfield, 1999; Lockhart & Miller, 2015; Lockhart, 2016; Reimer, 2016).

Within higher education, the student enrolment gender ratios, in most disciplines, have shown significant levelling out over the past 20 years, yet the same transformation is not yet reflected in the design industry and one cannot ignore that the design industry as a whole, remains, "irrefutably patriarchal" (Sellers, 2017, p. 7). Not only is this a problem, but it is an issue that is relatively under-researched, with a quantitative and qualitative data and awareness gap due to a paucity of research on gender equality in comparison with STEM disciplines that face similar gender bias and pipeline and retention issues (Reimer, 2016; Lockhart & Miller, 2015). In response to this, the Unequal Stories project seeks to contribute to this area of research and stimulate dialogue that advances the exploration of possible solutions to issues of gender within design fields.

Unequal Stories is a third-year collaborative, Global Challenges Research Fund (GCRF) funded research project between universities in the United Kingdom (UK) and the Republic of South Africa (RSA). Guided by Sustainable Development Goal #5 (gender equality), this cross-national comparative research project explored gender diversity, equality, and representation across various design disciplines within higher education (HE) and industry. Prompted by an analysis of statistical data around gender and diversity (or lack thereof) in design disciplines, the Unequal Stories project aimed to assess and explore attitudes and perceptions towards gender diversity, equality, and representation across different creative disciplines in HE and industry in the UK and RSA, and compare findings cross-culturally, and to respond to these findings through a pedagogic and/or industry intervention/s.

This paper describes the pedagogic intervention - where postgraduate students were invited to explore gender equality and critically respond to their findings using research and critical design thinking conventions- and reflects on the project outcomes in both contexts.

Contextualisation

According to Reiners (2021), bias exists in every aspect of our lives as our brains are hardwired to categorise things to make sense of the complicated world around us. However, biases can cause us to form prejudices which allow for inequalities to form (Reiners, 2021). Gender bias is a form of unconscious bias whereby one unconsciously makes evaluations and/or assumptions of another person or group based on gender-based stereotypes (Madsen & Andrade, 2018; Reiners, 2021). Ely, Ibarra, and Kolb (2011, pp. 475) define gender bias as “the powerful yet often invisible barrier to women’s advancement that arises from cultural beliefs about gender, as well as workplace structures, practices, and patterns of interaction that inadvertently favour men”. Gender bias is a term often used to refer to the preferential treatment men (specifically white, heterosexual males) receive, and is most prevalent within professional settings (Reiners, 2021). The design industry has numerous inbuilt biases and inequalities, and unconscious bias not only manifests itself in the design workplace but filters into the products and services we design (Kemp, 2019; Moseley & Campbell, 2019).

The leaky pipeline metaphor attributes the lack of female participation in the design industry to the ‘leaking out’ of women from the pipeline that carries students from school through university and on to a job in the industry (Moseley & Campbell, 2019; Blickenstaff, 2005). "It is evident that there exists a leaky pipeline in the design disciplines" (Moseley & Campbell, 2019). While female students now generally outnumber their male counterparts in design education globally, the same cannot be said about the workplace (Sellers, 2017). Gender biases in the workplace have contributed to the creation of a glass ceiling in design disciplines acting as an intangible hierarchical barrier that prevents women and minorities from reaching upper-level roles in leadership (Reiners, 2021). As a result, the farther along the pipeline, the fewer women are present, with a disproportionately small number of women in leadership roles (Sellers, 2017; Moseley & Campbell, 2019).

The Design Council (2018) Design Economy Report revealed that although 63% of all UK art and design graduates are female, the UK design workforce comprises a 78:22 (male to female) gender split, compared to the 53:47 gender split of the wider UK workforce. In RSA, although data specific to gender diversity or equality in design disciplines is patchy or difficult to obtain, the data that is available shows similar trends. For example, only 21% of registered Architects in RSA are women (Property24, 2016) and the industrial design industry comprises a 74:26 (male to female) gender split (SABS Design Institute, 2008). A 2017 study of the world's 100 biggest architecture firms across the world indicated that only three of the 100 firms are headed by women and only two have management teams that are more than 50% female (Fairs, 2017). Even more shockingly, sixteen firms showed to have no women at all in senior positions (Fairs, 2017). The Visual Arts is an umbrella term for several artistic disciplines, including ceramics, drawing, painting, sculpture, printmaking, and photography (Spencer, 2019). A stereotype that exists in the Visual Arts is that women are perceived as muses, rather than creators, and the contemporary art market is dominated by men (Spencer, 2019). Although women constitute 70% of the workforce in museums and galleries, female artists are underrepresented in both settings representing only 13.7% of living artists showcased by galleries in Europe and North America (Spencer, 2019).

Designers shape the world around us through the built environment, the digital world, and the products and services we use (Design Council, 2018). Designers' gender and cultural background influence the products and services they create (Dietrichson, 2017). Diversity within design teams is therefore important to arrive at suitably diverse, appropriate, and innovative outcomes that accommodate for as many as possible (Dietrichson, 2017; Moseley & Campbell, 2019). The underrepresentation of women in design at a professional level creates a gender data gap which is both a cause and a consequence of the mindset that perceives humanity as almost exclusively male (Criado-Perez, 2019). The data gap results in 'gender blindness' and a 'one-size-fits-men' design approach (Criado-Perez, 2019) which not only perpetuates gender stereotypes and clichéd concepts of masculinity and femininity but at a professional level, ultimately renders many experiences unaccounted for contributing to the proliferation of products, services, and markets that do not meet the specific needs of women and are inaccessible to billions of people across the globe (Kemp, 2019; Ely, 2015).

Numerous examples of how such an approach negatively affects female users exist. According to Ely (2015) women are stereotypically assumed to be less "handy" than men. Building and fixing things has culturally and historically been considered men's work. Consequently, hand tools are often designed around male data, in a way that makes these tools more difficult for women to use (Ely, 2015). In many office buildings, the algorithms that determine temperature settings were calculated for the average male. Women, with smaller frames and less muscle mass, naturally feel a bit colder than men do and as a result, many women feel uncomfortably cold in the workplace (Ely, 2015). The consequence of unconscious bias can have far more severe safety implications. For example, car safety tests don't account for women's measurements (Criado-Perez, 2019). For many years, the requirement for car safety tests was a single crash test dummy based on a 50 percentile male (the average man). As a result, women are 47% more likely to be seriously injured, 71% more likely to be moderately injured, and 17% more likely to die when involved in a car crash, and it's all to do with how the car is designed and for whom (Criado-Perez, 2019; Ely, 2015).

Although some data and research exists on this topic and is increasingly gaining traction, further research is required to deepen our understanding of why a large percentage of female graduates are leaking out of the pipeline between university and industry and identify how this can be addressed and combatted. The first step is raising awareness of the issue, particularly at a HE level. To contribute to this discussion, a pedagogic intervention, in the form of a project toolkit, was developed and subsequently tested with students in the UK and RSA, as part of the larger Unequal Stories research project.

Methodology

Design education is shifting where teaching and learning methods are becoming more concerned with ethnographic methodologies and approaches like critical design thinking, fostering an awareness of social, cultural, and ethical issues to consider design solutions effectively and inclusively (Allen, 2019). Ethnographic research is a qualitative research approach that investigates cultures and societies through exploring aspects related to cultural or social phenomena (Shagrir, 2017). Critical design refers to a kind of design practice that seeks to use critical and/or fictive design to increase the awareness of social, cultural, philosophical, or ethical issues and bring these into an everyday context in a novel yet accessible way (Allen, 2019). Speculative design and Afrofuturism are concepts that branch off from critical design. Speculative design is a multidisciplinary approach that derives practical methods from disciplines such as graphic design, industrial design, and fashion design to conceptualise and materialise alternative futures (Dunne & Raby, 2013). Speculative design encourages and thrives on imagination to create new perspectives on socio-political situations. The premise of imagining, conceptualising, and materialising speculated future scenarios aims to act as a catalyst for "discussion and debate around alternative ways of being" (Dunne & Raby, 2013, p. 2). Afrofuturism is a term used to define various media, artistic genres, and philosophies rooted in reimagining speculative futures that represent the advancements of Black people and social culture (Woodrow, 2018). Afrofuturism incorporates African ideologies and aesthetics of pre-colonial Africa and a contemporary techno-genesis of Black identity influenced by technological advances in the current digital age (Woodrow, 2018; Anderson & Jones, 2016).

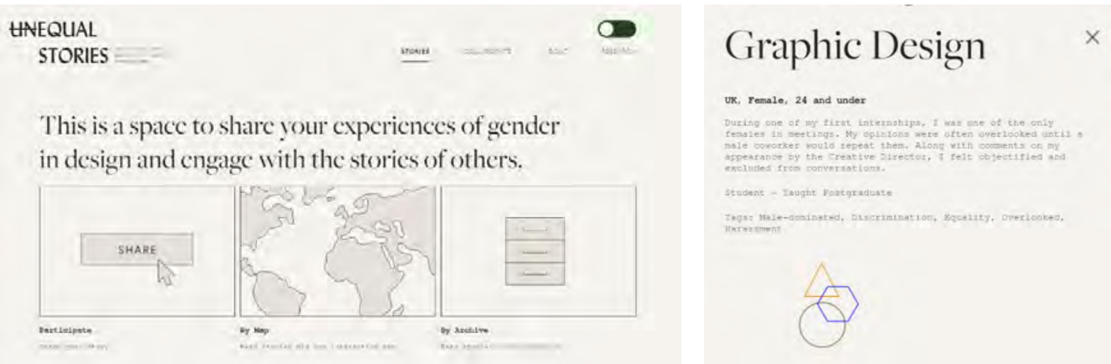

Figure 1: Unequal stories website (2021)

The first phase of this pedagogic intervention included the development of an interactive online platform. The transnational nature of the project required that a blended approach to teaching be followed. The content had to be accessible to students in the UK and RSA and thus, a website was best suited. Moreover, the current COVID-19 pandemic has accelerated the need to align teaching and learning methods to that of a blended approach. Using this website, participants from HE and industry were invited to share their stories and experiences related to gender bias, anonymously. This data was then mapped through data visualisation, allowing viewers to compare and contrast the stories according to tag, location, and discipline.

In the second phase, a student project was designed with the intention that it be facilitated by design lecturers using the provided Unequal Stories Toolkit. The toolkit is a comprehensive teaching and learning tool and resource, available for download from the Unequal Stories website (available via this link). Provided with this Unequal Stories Toolkit, students in RSA and UK were tasked to use ethnographic methodologies to deepen their understanding of gender equality and respond to the data provided on the Unequal Stories website using a critical design approach. A selection of students' findings, insights, and responses was then shared on the online gallery, as a way of enabling discussion around gender inequality in the design disciplines from a cross-national and cross-disciplinary perspective towards addressing industry bias.

The resources in the Unequal Stories Toolkit included a brief (project requirements, structure, and schedule), a series of four asynchronous theory lectures, a reading pack, and a list of additional resources. Students were encouraged to refer to the website for supporting data. The four asynchronous lectures were between ten to thirty minutes long and introduced the underlying theories guiding the project and brief. Lecture one provided background and contextualisation of the project. Lecture two introduced students to existing research and statistics around gender and design. Lecture three introduced critical design thinking and the design approach of speculative design. Lastly, lecture four provided an introduction and discussion of key concepts related to Afrofuturism. The incorporation of Afrofuturism to the project toolkit offered inclusivity and representation to the discourse of gender in design disciplines outside of Western rhetoric and literature. Gender is a nuanced area that intersects with culture, race, and class, and it was necessary for the project to reflect this reality. The five readings in the reading pack supported and expanded on the content of these lectures.

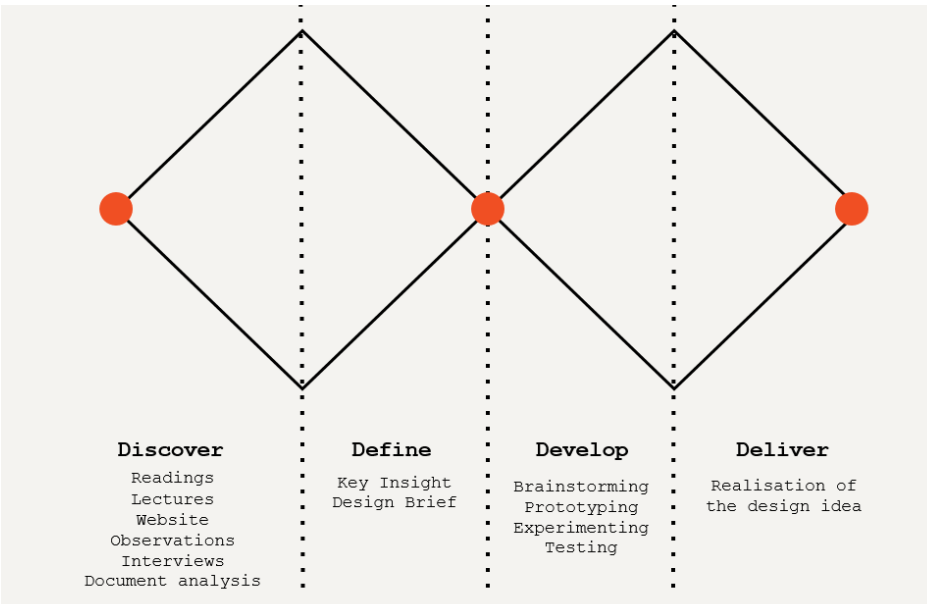

Figure 2: Double diamond model (2021)

Every design discipline has unique approaches and ways of working, however, there are some activities common to all designers. The project structure was designed according to the four phases of the Design Council's 'Double Diamond' model: discover, define, develop, and deliver. In the Discover phase, Students were required to apply ethnographic research methods in exploring gender in design through identifying a related research problem to probe either through observation, interviews, document analysis, and subsequently articulating the research findings (Alpert, 2016, pp. 9). In the define phase, students are required to analyse and compare the data to develop a clear critical design brief. A brief template was included in the Unequal Stories Toolkit to assist students in writing this up. During the Develop phase, critical design responses are imagined, conceptualised, prototyped, tested, and iterated through brainstorming, prototyping, experimenting, multi-disciplinary working, visual design, testing. Finally, the deliver phase involves the realisation of the design idea. As a transdisciplinary project, this could include any number of design outcomes such as photographs, 3D objects, publications, concept drawings, and/or videos. The structure of the Unequal Stories Toolkit was designed to be as open and flexible as possible. By structuring the project according to the four phases, rather than defined timelines, the project could be run as a design sprint across four days or as a longer brief over four weeks (or any variation). This flexibility allowed for a range of approaches, suited to the varying needs and schedules of each institution, department, or module. It also allowed for educators and students to pursue cross and transdisciplinary work, as well as group or individual projects.

For this paper, the researchers observed ethical considerations by assigning non-gendered code names such as 'student A' to the selected students discussed in the findings. The students' confidential information such as names, surnames, and student numbers are eliminated from any included images.

Findings and discussion

To test the efficacy of the Unequal Stories Toolkit, the project was facilitated in three design departments in the UK and RSA in the form of a pilot study. In RSA, the project ran for four weeks in a postgraduate Industrial design department with 11 students, and for six weeks in a postgraduate Fashion Design Department with eight students. In the UK, the project was facilitated with 13 MA Communication students, over four weeks.

Ethnographic research methodologies were applied by students in various ways. Some of the students in the fashion department used the secondary data provided on the website of the data mapping to inform their speculative design, and Industrial design students used social media polls and personal reflections to inform their insights and responses. However, the majority of the students across all three departments sourced primary data through interviews and discussions with design professionals and their peers.

The project toolkit aimed to be flexible – in that it could be integrated easily into varying modules and programmes, encourage multidisciplinary research and design, and incorporate nuances related to gender through the inclusion of Afrofuturism**.** Three projects -one from each participating department from RSA and the UK were chosen for discussion to illustrate the efficacy of the Unequal Stories Toolkit in achieving the above-mentioned aims**.**

Figure 3: Student A SA Department of Industrial Design: "Man-hand" (2021)

As the Unequal Stories Toolkit was designed to be facilitated, either over a sprint four days session or spanning over four weeks, the efficacy of applying an ethnographic approach may vary depending on the time allocated for the project. In the instance of the three departments, the projects were facilitated over multiple weeks and allowed students to adequately engage and apply the processes and methods of the discover, define, develop, and deliver phases. The longer duration of the project enabled students to conduct iterations of the discover, define, and develop phases, allowing students to reflect, discuss and refine their thinking. 'Man-hand' is an example of such a project and process, which lead to the realisation of a strong creative response. Student A identified that the lack of inclusivity in design has major implications for women, often discouraging many women from pursuing certain career paths or doing certain tasks. Women are often made to feel incompetent and blame themselves for being unable to do certain jobs or tasks successfully, when in fact the products designed for that job have not been designed with female considerations in mind. The speculative design approach was applied in the creation of a product titled "man-hand". Man-hand speculates a dystopian future depicting the process that is followed when a girl is born, a male hand is stitched onto the girl's hand. The stitched man-hand will allow females to use most of the products in the world with ease because most products are designed from male data. Although these females will be able to use a smartphone with one hand, hold a brick comfortably, or use a power tool easily, the stitches, scars, and blood remain for life, symbolising the discomfort women have had to endure for years, simply because products were not designed with female considerations. The added piece of skin is a physical and striking mark that emphasises the adjustments women have to make to use products designed around male data for women. This is a strong visual statement to encourage dialogue and reflection on the importance of diversity and inclusivity in design.

The concept of Afrofuturism was not compulsory for students to explore. However, its inclusion contributed to the nuances and intersections that occur when gender is concerned. Through qualitative research and interviews, Student B created a campaign titled ‘Intersect’ that raises awareness about some of the microaggressions that women of colour face in the fashion design industry. Inspiration was drawn from popular culture, specifically from a meme titled ‘show me the receipts’, culminating in creating a literal receipt of some of the micro-aggressions and overt discrimination that women of colour face within the fashion design industry. Depicted in Figure 2, at the bottom of the receipt, a total amount is calculated representing the unconscious bias and micro-aggressions someone has expressed towards a BIPOC (Black, Indigenous, and Other people) woman. Intersect prompts people to confront their unconscious bias and creates a more significant conversation and awareness around gender disparity and the importance of intersectionality within design fields. The speculative scenario depicted in the project, emphasises developing a positive representation of black identities through provoking conversation around accountability and inclusivity. These objectives outlined in the project are synonymous with Afrofuturism and its core ideology.

Figure 4: Student B SA Department of Fashion Design: "Intersect" (2021)

The open, multidisciplinary approach of this project encouraged students to explore all design disciplines, not only their own, and allowed the freedom to produce design solutions that fall outside the scope of their particular discipline. 'Impractical' is a good example of this, whereby a communication design student communicated their response in the form of a fashion design output. Through interviews and research with designers and creative directors, student C identified many glaring disparities within the design industry, precisely fashion. Research shows that less than 50% of womenswear brands are led by female designers (Pike, 2016), making it evident that women are significantly underrepresented in leadership positions within the fashion industry. The under-representation of women in leadership positions juxtaposes the statistics that reflect female consumers purchasing clothing more frequently than men (Brennan, 2013). This results in a data gap and the creation of less inclusive or impractical clothing for female consumers. From discussions that student C had with women from within and outside the design industry, similar points were raised repeatedly that women's clothing is restrictive and often reflects a definitive lack of practical consideration. Student C refers to designs showcased in fashion runway shows, as well as office wear. From the research done, student C created a garment capsule collection titled Impractical, which sought to translate the restrictive nature of women's clothing to the modern man. Focused on the inequality within the fashion industry, the collection is committed to encouraging a discourse surrounding the lack of female designers within the industry in leadership positions. The result of which is the imposition of limiting and impractical clothing by men, for women. The garments in the collection depict illogical and impractical pieces designed for men to highlight the disparaging data gap.

Figure 5: Student C UK Department of Graphic Design: "Impractical" (2020)

The GCRF funded Unequal Stories project established a method and model focused on gender in the UK and RSA. The project ultimately served as a pilot for a larger, expanded effort to raise awareness on this topic. The Unequal Stories Toolkit proved its efficacy within the pilot project among the three departments that facilitated the project. The pedagogic Unequal Stories Toolkit was created to be accessible to students in both the UK and RSA. With COVID-19 and the subsequent adoption of blended learning, the Unequal Stories Toolkit integrated successfully into each module's teaching and learning planning. The blended approach applied in the toolkit made facilitating and incorporating the project in one's teaching and learning possible as it had been designed to be open or flexible in how lecturers facilitated the project to students. This flexibility in facilitation may have assisted in curbing issues related to students learning remotely and barriers related to the digital divide. Students in RSA were encouraged to use resources available to them for conceptualising and developing their final project and resources in the respective departments were also available. The approach of blended learning and the application of interactive digital resources such as the Unequal Stories website and project toolkit align with Industry 4.0 guidelines. Building on the successes of this pilot, the project team has since expanded to include industry and research partners in New Zealand and South Korea, and the team is currently applying for further funding to consolidate and expand the model into a holistic inclusive, intersectional, and global one.

Conclusion

While industry 4.0 offers exciting new opportunities, improved AI, and increased automation, it also presents potential security and ethical risks which threaten to amplify current inequalities. As we enter the fourth industrial revolution, design will have an important role to play in bringing about appropriate, sustainable, and equitable innovation, ensuring that new technology is human-centred and useful to an increasingly diverse population. Diversity within design teams is critical to arriving at suitably diverse, appropriate, and innovative outcomes.

Higher education has a crucial role to play in shaping the educational and societal transitions necessary to adjust to Industry 4.0 (Gleason, 2018, p. 5). Gender bias in design is a topic that design educators, researchers, and students need to engage with, not only to prepare our students for the workplace but also to begin to change the patriarchal dominance of the design industry (Moseley & Campbell, 2019).

The Unequal Stories Toolkit was successful in engaging students in this conversation and adding to it through provocative and insightful design outcomes that serve as catalysts for discussion and debate and can be shared and engaged with across the globe.

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DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

4IR, the photographic curriculum and the South African higher educational context: A case study

Jakob A. Doman, *Vaal University of Technology*

Abstract

From inception, the Camera Picture, being a technological medium, has been inherently in a volatile relationship with innovation that required a constant re-structuring of the academic curriculum in the formal education of the practitioner to embrace the possibilities offered through new imaging technologies, a process which occurred over a period of decades, sufficient time to adapt and engage in a meaningful manner with the discourse of both making and teaching.

Then, seemingly as if all at once, the disruptive technological Digital Still|Motion Camera (DSMC) and Media Convergence created an apocalyptic watershed, the 4IR of the Camera Picture, which meant that what was known became obsolete almost overnight and the educational programme taught either embraced the possibilities on offer through 4IR or persisted with the structures in hand, facing an uncertain future, at best, not only within the educational context but in the professional arena as well.

As it stood, innovation and adaptation of the academic curriculum through strategic analysis combined with phased curricular implementation has always been at the core of the educational programme to ensure the vocational relevance.

However, re-curriculation is never a rash or quick decision.

Rather, it is a natural evolution and the outcome of years of academic struggle, of programme content development and testing, technological engagement and critical reflection on educational outcomes – all in the midst of socio-political, financial and academic pressures encountered at the Institution.

Consequently, in this working paper, a narrative case study is presented wherein the evolution of the Camera Picture as vocational academic programme taught at a South African higher education institution is described and contextualised as it responded to the challenges encountered, both inherent to African educational context and those from arising from 4IR, allowing for "the time to pause, reflect and engage in meaningful conversation" (Schwab, 2016) on the nature of this change through the lens of the practitioner as educator.

Keywords: 4IR, disruptive technological innovation, media convergence, photographic re-curriculation

Introduction

The fourth industrial revolution – a socio-economic construct defined wherein the fusion of the human self and the Technopoly foreshadows an augmented dystopian world of cobots, AI and nanotech, as if direct from Asimov's *I, Robot* (1950) – transhumanist; pure science fiction, or so it would seem, and hence, of little relevance and easily dismissed, I thought, given the shocking realities faced in sub-Saharan Africa.

From a socio-economic perspective, a conservative estimate indicates a substantial sub-section of the population have not even entered mechanisation or the first industrial revolution, being mostly subsistence agrarian, with roughly 50% of the population having no access to electricity, "crucial for poverty alleviation, economic growth and improved living standards" (Ritchie & Roser, 2019a), where roughly 7.5% of deaths are from unsafe water sources and lack of sanitation, "a leading risk factor for infectious diseases [that] exacerbates malnutrition, and in particular, childhood stunting" (Ritchie & Roser, 2019b; WHO, 2019; CDC, 2014) and with, on average, 21.4% of the population undernourished (Ritchie & Roser, 2019c).

If the lens is directed to the context of Education in sub-Saharan Africa, the situation appears as dire as the socio-economic reality described. 39% of the population, on average, is illiterate (Ortiz-Ospina & Roser, 2016) and of those remaining, many have only basic literacy. In South Africa, the literacy statistics are confounding with "78% of South African Grade 4 children [who] cannot read for meaning in *any language*" (Spaull, 2017) and where the 2015 TIMSS/PIRLS evaluation placed South African Grade 9 learners last of the 39 countries assessed in terms of Mathematics and Science skills-and-understanding (Janse Van Rensburg, 2019). Furthermore, Gakusi (2008, pp. 9-10) comments that "the African education sector continues to face serious challenges of low and inequitable access to education, inappropriate curricula with low [qualification] completion rates, inadequate education financing including a shortage of resources allocated to the education sector and misallocation and misuse of [fiscal] resources, [a lack of] education system capacity with a poor link with the world of work".

Hence, in such a socio-economic and educational context, thinking about automated drones, 'big data' analytics and quantum computation do seem inappropriate, to say the least. But, intrigued, given that in my discipline, the Camera Picture is technology dependant, I did start reading around the periphery of the 4IR debate, mostly to fathom predicted changes and the new skills and technology that would be required, both as practitioner and educator. This was done partly in order to ensure that the programme offering, and the teaching thereof, were to remain current and effective and partly to see what the trend forecasters thought might lie ahead.

In doing so, I realised that the collective focus on 4IR as a singularity, seemingly called into existence in 2016 by Karl Schwab, is misdirected. Rather, it is more appropriate to consider 4IR as an *evolution*, a continuum of the construct of the industrial revolution (IR)[1] as technological,

[1] The term Industrial Revolution is herein considered as a 'catchphrase', a construct that describes "acceleration in the processes of technical innovation brought about [through] an array of new tools and machines. It also involved [subtler] practical improvements in various fields affecting labor, production and resource use. The word "technology" encompasses both of these dimensions of innovation. The technological revolution, and that sense of ever-quickening change, began much earlier than the eighteenth century and has continued all the way to the present day. Perhaps what is most unique about the Industrial Revolution was its merger of technology with industry. Key inventions and innovations … shape virtually every existing sector of human activity along industrial lines while also creating many new industries" (Wilkonson, 2020). Furthermore, as Buchanan (2020) explains: "The term Industrial Revolution, like similar historical concepts, is more convenient than precise. It is convenient because history requires division into periods for purposes of understanding and instruction. The term is imprecise, however, because the Industrial Revolution has no clearly defined beginning or end and is still proceeding in our own time. The term Industrial Revolution must thus be employed with some care [and, most

socio-economic and cultural agent-of-change. Following, if 4IR is reduced to the fundamental principles of *convergence* (UNIDO, 201; Davis, 2015; Meldrum, 2019; Ghandi, 2018) and *disruptive innovation* (Christensen, Raynor & McDonald, 2015), I realised that having embraced the impact of the Digital Stills|Motion Camera Technology (DSMC) on the Camera Picture[2] as discipline when we, as educators, focused the re-definition of the programme during the 2013 HEQSF qualification re-alignment around *media convergence* as basis of the curricular transformation (Ou, 2013, p. 57), we had, in effect, embraced 4IR. Therefore, I thought, cast in this light, I might be able to contribute meaningfully to the conversation on 4IR in a South African design educational context through a 'thick' description of the experience and the challenges we encountered.

Consequently, in this working paper, a narrative[3] case-study[4] is presented wherein the evolution of the Camera Picture as vocational academic programme taught at a South African

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typically] to describe an extraordinary quickening in the rate of growth and change" and is therefore "merely one about the efficiency of discourse" (Mokyr, 2018, p. 2).

[2] A Camera Picture is a unique type of picture. While a picture is defined as an artifact that creates the appearance of a subject, a "visual representation of an [object] not present" (Peters 1977, p.,2), a Camera Picture is the outcome of an electro-mechanical instrument used to control light through a lens to form a visual record of a material object on a light-sensitive material. Peters (1977, p. 3) comments that since "the essential notation of the Camera Picture is by photo-mechanical or electronic means..[therefore] in the material sense, the [Camera Picture] consist of the 'impressions' or 'traces' which are left by light reflected or emitted by the perceivable objects which are in front of the camera lens. Looking at a Camera Picture makes us realise that the depicted object must have been present in front of the camera lens". The concept of the Camera Picture include therefore not only the medium of Photography that isolate a single fleeting moment [of its existence in time and space] and presents it as a Still Camera Picture but also Cinematography, which is not 'freezing' time and space, but allows time and space to unfold in a Motion Camera Picture that simulates the human experience thereof.

[3] In this narrative case study, I employed the Stoic Philosopher Epictetus (AD c. 55–135) construct of the *Theatrum Mundi* as a research methodology, in which the evolution of the Educational Curriculum over a 30-year period is described in various Acts, following the Ancient Greek Narrative Arc as method, as defined by Roman Grammarian Aelius Donatus and described by Ephraim Chambers.

The Theatrum Mundi, as constituted in *the Enchiridion of Epictetus* (108 AD), is a philosophical trope that describes the that each 'man' is designed to play a role in the world, consciously or not, and the world is the stage upon which this role is enacted, as Hoffmeister (2009) explains, "The idea that human life is like a play scripted and directed by a mighty producer (God, Fortune, Fate), a play in which each player is given an allotted role, goes back to Greek philosophy".

The Ancient Greek Narrative Arc is described by Ephraim Chambers (1728) as follows:

> *Protasis*, in the antient Drama, the first part of a Comic, or Tragic Piece; wherein the several Persons of the Play are shewn, their Characters and Manners intimated, and the Action, which is to make the Subject of the Piece, propos'd, and enter'd upon. The antient Protasis might go about as our two first Acts. Where the Protasis ended, the Epitasis commenc'd (Chambers, 1728, p. 900).
>
> *Epitasis*, in the antient Poetry, the second Part, or Division of a Dramatic Poem; wherein, the Plot, or Action, proposed, and enter'd upon, in the first Part, or Protasis, was carried on, heightne'd, warm'd, and work'd up, till it arrived at its State, or Height, call'd the Catastasis (Chambers, 1728, p. 328).
>
> *Catastasis*, in Poetry, the third part of the antient Drama; being that wherein the Intrigue, or Action set on foot in the Epistasis, is supported, carried on, and heightned, till it be ripe for the unravelling in the Catastrophe (Chambers, 1728, p. 171).
>
> *Catastrophe*, in Poetry, the Change or Revolution of a dramatic Poem, or the Turn which unravels the Intrigue, and terminates the Piece. The Qualifications of this Change are, that it be probable, and necessary: in order to be probable 'tis requir'd it be the natural Result or Effect of the foregoing Actions, i.e. it must spring from the Subject it self, or take its Rise from the Incidents; and not be introduc'd merely to serve s Turn. The Discovery in the Catastrophe, must have the same Qualifications as the Catastrophe it self, whereof it is a principal Part: It must be both probable and necessary. To be probable, it must spring out of the Subject it self; to be necessary, it must never leave the Persons it concerns in the same Sentiments they had before. Sometimes the Change consists in the Discovery; sometimes it follows at a distance, and sometimes results immediately from it, which is the most beautiful Kind. The Catastrophe made the fourth and last Part in the antient Drama (Chambers, 1728, p. 171).

[4] A case study is defined as the first-hand "study of a phenomenon or a process" as it develops within a singular instance (Swanborn 2010, pp. 8-9); it is "the study of an instance-in-action" (Adelman, et al., 1980 *cited in* Cohen, Manion and Morrison, 2005, p. 181) that allows the "exploration and understanding of complex issues" (Zainal, 2007). The case study method is flexible in nature, capable of being utilised in a diverse range of contexts (Darke,

higher education institution is described and contextualised as it responded to the challenges encountered, both inherent to African educational context and those from arising from 4IR, allowing for "the time to pause, reflect and engage in meaningful conversation" (Schwab, 2016) on the nature of this change through the lens of the practitioner as educator.

Act 1: The Technikon NDip (Photography)

Formal higher education in the discipline of the Camera Picture commenced at the Institution as the National Diploma (Photography) in 1983, in the then Department of Photography and Graphic Design, following the 1979 re-framing for technikon higher education institutions to offer, in addition to Science and Engineering qualifications, qualifications in Commerce, Arts, and Social Sciences. The duly constituted and curriculated NDip (Photography) had the focus to prepare the student for a career in Professional Photography in line with international vocational offerings (Cooper 1994, pp. 2–3; Smith, 2016; Hallet, 2008). The vocational curriculum offered instruction in the theoretical knowledge and practical skills required in commercial application of the medium with the primary outcome a professionally compiled portfolio of Camera Pictures which would enable the graduate to enter the labour market and complete any reasonable photographic assignment with confidence.

This was in complete alignment with the purpose of technikon qualifications "whose main educational task [was] to provide education and training in order to supply the labour market with personnel who possess particular skills and technological and practical knowledge that ensures that they practise their occupations effectively and productively" (Department of National Education, National Education Policy Branch, 1988, p. 22 *cited in* Raju, 2006, p. 5).

After 1994, various distinct challenges presented themselves to the Photography Programme.

The Higher Education Act (101/1997), which had as its purpose the transformation of the South African higher education system and its institutions, formulated an educational strategy focused on Outcomes-Based Education and Training (OBET). As Janse van Rensburg (2003, pp. 1-2) comments, it was "therefore, necessary for higher [education] institutions to follow a fresh approach in addressing critical skills that complement the formal education system", with the key to implementing OBET being *modularisation* of the programme curriculum into short learning units designed to achieve one or more leaming outcomes (Janse van Rensburg, 2003, pp. 2–3, Du Prè, 2000, p. 2). Unfortunately, this modularisation tremendously inflated the cost of the Photography Programme, as each module had a predetermined minimum course cost and associated laboratory fee.

Simultaneously, the Photography Programme had to come to terms with the rapid developments in digital imaging technologies and the impact it had on the medium and its education. This required both investment in infrastructure and re-curriculation.

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et al., 1998 *cited in* Iacono, Brown and Holtham, 2011, p. 57). Case studies can be exploratory, descriptive or explanatory (Yin 1994 *cited in* Iacono, Brown and Holtham, 2011, p. 57) and support most types of philosophical paradigms. McDonough and McDonough (1997 cited in Zainal 2007) suggest that descriptive case studies may be in a narrative form, it "a story about a real-world situation facing people or groups and how they addressed it. It includes a concise but thorough account of the facts of the situation and commentary to help the audience understand the causes of the problem, the forces behind the solution, the outcomes of implementation, lessons learned and connections to theories, concepts, policies and tools relevant to the situation" (ACSP, 2021)

National Development Grant (NDG) funding was secured and, through strategic alliances with key industry partners, allowed a Photography Computer Laboratory[5] to be established and Digital Imaging Equipment procured at a fraction of the real-world cost.

In the curriculum, an Image Media Software (IMS) compulsory module in the Practicum was introduced that focused on the concept of a *Digital Darkroom* while key theoretical aspects of Digital Imaging Technology were included in the theoretical subjects, with learning units from Digital Sensor Design to Interactive Multimedia and the internet offered. The digital revolution had been embraced and the curriculum, in retrospect, was a critical revision and extension of the constituted technikon programme curriculum, with a similar pedagogy except with relevant content that addressed contemporary technological developments and aesthetics, the outcomes of which are best illustrated in a select portfolio of photographs from alum practitioners Jakob Doman[6] and Carine Strydom.[7]

FOLIO | Jakob Doman©

[5] This replaced the senior student traditional black-and-white darkroom, which were renovated but the enlarger bays left intact where each now contained a digital workstation.

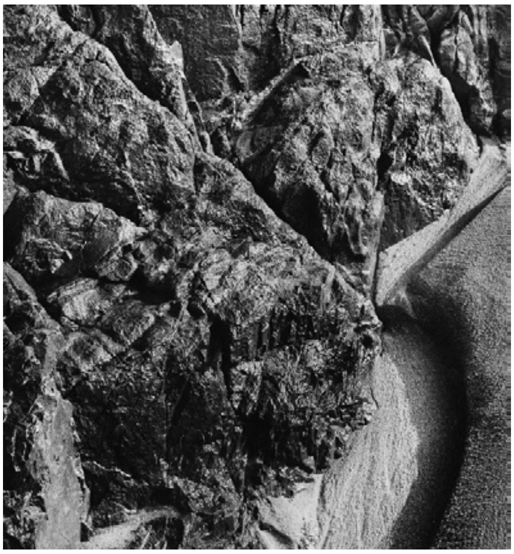
[6] My background is grounded in "a combination of experience in the Commercial Advertising, Editorial and Fine Art arenas" for which I have been honored with Loeries, a D & AD – wooden pencil (London) and a silver Clio (New York Art Directors Club) Awards (Doman, 2021). In 2004, I was nominated for the DaimlerChrysler Award for South African Creative Photography with Angela Buckland, Stephen Hobbs, Brent Meistre, Zwelethu Mthethwa, Jo Ractliffe, Guy Tillim and Andrew Tshabangu. As an educator, I focus my interests on "the diverse disciplines of moral theology, applied aesthetics, digital image sensitometry, digital convergence and practise-based arts research methodologies. By creating a synergy from these seemingly disparate fields, I employ a multi-faceted and holistic educational approach that, hopefully, offers intellectual stimulation and creative awareness to students and colleagues alike" (Doman, 2021). When this fails, as it often does, I can be found taking solace behind a camera making some pictures.

[7] She wrote "I was born in a small town and then I grew up. Along the way I went to photographic school, where I received my degree. From my early days of mixing fixer in the darkroom, learning the zone system and processing 4x5 negatives, I realised that photography is my calling, my passion and the thing that will undoubtedly keep me sane. Through the years I lived in different cities and done work for well-known brands. I've won a bunch of impressive awards for what I do. I hope to continue to do what I do for some time still to come" (Strydom. 2019). Unfortunately, she lost her battle to cancer in 2019. She was my best friend and business collaborator (Cooper, 2016; Ludwigm, 2020). At the very least, she brightened up any day, especially if the assignments and work did not. We both *felt* successful, in-business, if not in life or love. Eventually, she joined the faculty at VUT as academic and we spent a handful of years working together teaching to the best of our abilities.

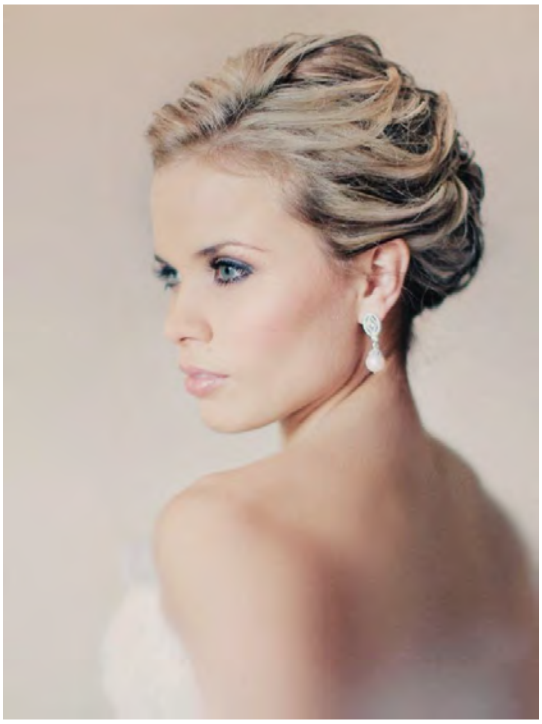












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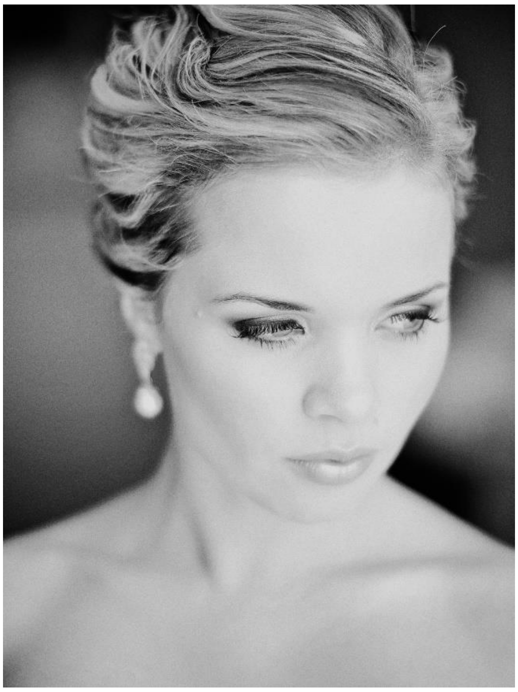

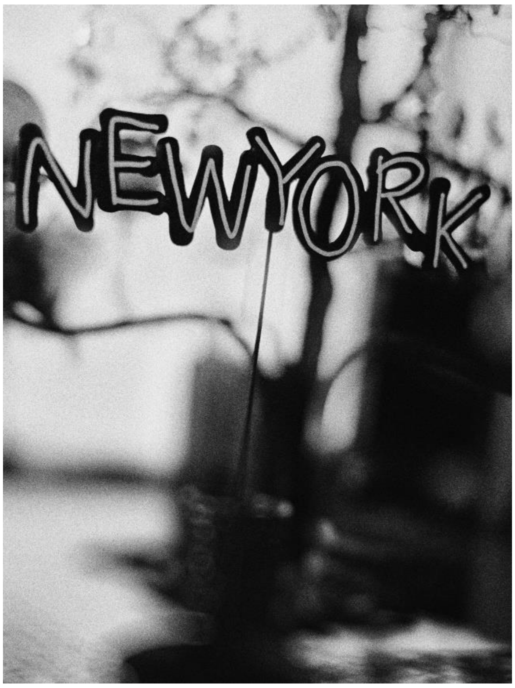

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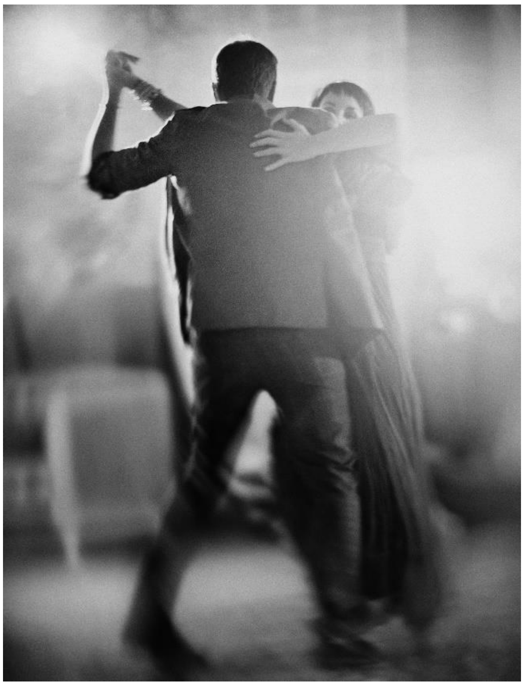
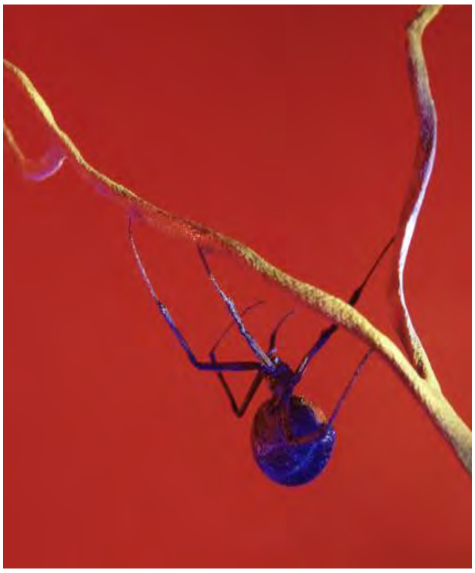


FOLIO | Carine Strydom©




HOT LUNCH


vodacom
BULLS

Act 2: The University of Technology NDip (Photography)

At the start of the twenty-first century, the call for transformation in higher education "precipitated a series of massive shifts in policy in education" (Menon & Castrillón, 2019, p. 8). The National Commission on Higher Education argued that "the profile of technikons posed several questions in relation to the restructuring of the higher education, [specifically] how the existing system of racially-divided colleges, technikons and universities be reconstructed into a more articulated and coordinated system" (Cooper, 1995, p. 243). In essence, the construct of a technikon had become a stumbling block since "no matter how widely Technikons were regarded by industry and commerce because of the suitability and relevance of their programmes, and no matter what the extent and quality of their [qualifications] were, they continued to suffer from the perception that they were inferior to [traditional] universities" (du Pré, 2010, p. 8) and in 2003, the Minister announced a re-designation to a University of Technology. Consequently, a re-structuring initiative commenced at the Institution, both in organisational structure and in the qualification matrix on offer. Departments were amalgamated, Faculties renamed to re-align with a new vision of 'being a University' while programmes were tasked to re-curriculate and re-conceptualise their qualification offering to align with the new 'status' of university. Specifically, the National Qualifications Framework facilitated through the South African Qualifications Authority (SAQA) established Critical Cross Field Outcomes (CCFO) for all higher education qualifications in South Africa (Menon & Castrillón, 2019, p. 8) with the "challenge of maintaining the required balance between generic skills and disciplinary skills [that] should be understood within the context of divergent approaches and perspectives on pressures internal to higher education to serve the needs of disciplines, as well as external social, economic and political demands placed on institutions" (Ntshoe, 2004, p. 214). This manifested itself in a "general move from a disciplinary curriculum to an interdisciplinary and transdisciplinary curriculum" (Ntshoe, 2004, p. 215), a mandate taken to heart in the newly formed Department of Visual Arts & Design. I re-entered Academia just as this highly charged transformation was effected and the Photography Programme tasked with re-curriculation to the broad NQF requirements while preparing students for the requirements of a career as professional practitioner. It was decided that the best way in which to resolve the dichotomy between vocational and the interdisciplinary neo-liberal curriculum was to introduce a critical/decolonialised pedagogy in the theoretical components of the curriculum and restructure the Practicum to reflect the changing context in which we functioned.

As it were, the collector's market for Art Photography had come of age and, for the first time, photographers could make a living from their engagement *through* the medium, and I proposed a re-curriculation in third-year practicum outcomes that included a *longform Personal Project* module to be exhibited in a gallery-context for final evaluation and an Applied Commercial module,[8] in which students receive specialised training in equipment, materials, processes and certain commercial techniques, i.e. advanced studio portrait lighting, large format portraiture, editorial portrait multiple strobe lighting techniques on-location, digital capture workflow, photographing architecture for publication, studio still – life: advanced lighting and the editorial photo essay, advanced post-production skills, i.e. multiple image compositing and retouching and advanced digital effects and colour treatments.

[8] For the final presentation, we had individual handmade portfolios done by the *The Bookbinding Company* in Cape Town. These were in black leather with archival sleeves, the student's name carefully debossed with an internal pocket into which each student had to place promotional *callcards* with either a single or series of images and their contact detail, exactly as was needed in the industry since Art Buyers and Art Directors often kept these pinned to their walls as visual reminder of who might be most suitable for any given project or assignment.

In terms of infrastructure, the digital revolution was well under way and it rapidly became apparent that in order to remain relevant to industry, further investment in digital technologies was required, that included high-end digital image acquisition technologies (20 MP$^+$ Phase One Digital Backs & DSLR Camera Technology), an expanded Computer Laboratory Large-format Inkjet Printers to make archival giclée prints as the Art Photography context demanded large prints.[9] The biggest challenge, however, was the transformation of the Photographic Programme to reflect the new South African context, which Luvalo (2019 *cited in* Masindi & Roux, 2020, p. 31) described as "(1) action to ensure wider access to black African students; and (2) Africanisation and decolonisation of the curriculum".

As to the question of access, at the time, only a few African students had entered the programme at this stage. This could be ascribed to four possible factors, namely:

1. the lack of the perceived value in Technikon/UoT qualifications as "second or third choice after universities" (du Pré 2010, pp. 7-8) and even within the Technikon/UoT, Science, Engineering, Computer Technology and Management programmes were preferred career choice qualifications;
2. the lack of marketing of Photography as a career within both the local and broader national educational context with a perceived lack of respect in *studying* to become a photographer, prevalent in the African community were photographers were seen as a 'cameraman', not as a career which you went to 'study'; the prescriptive entry requirements of Mathematics and Physical Science as Grade 12 subjects, a holdover from the analog Diploma, both of which are perceived as difficult subjects in themselves at school (Cooper, 2004, p. 8), with those having successfully matriculated with these subjects showing a preferred career choice for Science, Engineering and Technology programme qualifications;
3. the cost of the programme, which with the modularisation had escalated tremendously and that had made the programme one of the most expensive to attend in terms of tuition. In addition thereto, the costs of purchasing a camera and photographic materials to do projects, funds to be able to travel to various locations to shoot and re-shoot projects, to purchase suitable subject matter/props for commercial orientated projects, especially commercial studio still-life, and the expense of digital printing, both for project assessment and the final portfolio assessment at the end of the Academic Year, added a significant additional financial requirement which, despite some bursary funding being available through the NSFAS-scheme for qualifying students, did not allow for these 'hidden expenses' as the bursary provided tuition fees, accommodation and food allowance.

At the 2003 strategic discussions, wherein the above curricular changes were proposed and the infrastructure requirements indicated, the matter of social transformation was raised, and it was agreed to start an initiative to address demographic transformation from *within* the programme as a matter of urgency. To facilitate this, the Programme Co-ordinator liaised with Institutional Marketing and organised school visits in which matriculants were made aware of Photography as a Profession and student work showcased, while the entry requirements of Mathematics and Physical Science were amended and ratified to *highly recommended* to allow

[9] I commenced with an extensive research project to calibrate and characterise any printing substrate to the visual response function of the Human Eye. In order to do this, a second order quantic polynomial function is applied. However, before this can be done, a computational model to map Digital Code Values to Visual Density is needed. This formed the basis of my M.Tech-degree, entitled, *A Method for the Sensitometric Characterisation of a Digital Stills and Motion Camera*. I did finish the math a long long time before the completion of the dissertation, and by 2008 we were making exceptional quality giclée prints on 100% archival cotton rag. It truly is WYSIWYG. If I were not going to run afoul of Institutional Policy, I would have released the function and computational model. Alas, the politics of innovation and technology transfer at an entrepreneurial university.

access for those who were interested but who may not have had or done well in these subjects. Furthermore, adjustments in the how the laboratory fee of each module was used made it possible to facilitate the payment for basic project assessment print requirements, including the final exhibition and printing and presentation, while a range of still-life products and backgrounds were acquired and stored, which students could access and use to complete the commercial studio projects.

Then, as to the second, the Africanisation of the curriculum, learning units on the role of African Photographers in South African Photography were introduced and many of the Photo Practicum project outcomes re-aligned to the rich and varied subject matter that Africa presented to critical enquiring minds.[10] It was not perfect, but within a few years at least 50% of the programme were African students, many of previously disadvantaged backgrounds who, despite the challenges faced, were able to make it work. As the first decade of the twenty-first century drew to a close, the re-structured Photography curriculum was highly successful and the vision of a new South Africa higher education model within the programme were unfolding.

Students quickly realised that they were capable of producing work that rivalled and were on par with that produced by professional practitioners and excelled in showcase competitions such as the Fuji Profoto Awards, the Africa Photographic Awards and PIEA while participation in the annual Cape Town MOP, the Bamako African Biennale of Photography, Bonani Africa (2010) and the Museum Africa Student Showcase were highlights on the academic calendar.

[10] During this time, my personal photography as practitioner were focused on street photography,[10] which quickly had me end up in local townships10 and informal settlements. Not being extremely proficient in the various languages, I often requested some of the African students if they were willing to go with and translate and facilitate access, with the understanding that they had to bring a camera and produce their own work while we were there. These images were then either submitted as extra practical work credit, or if thematically suited, became the projects for the Personal Project module. The students responded with great enthusiasm as they realised that they had access to the most visually rich of subject material which those living in suburbia had not. Keen, all of the students embraced the change. As I became specifically interested in exploring the built environment as a socio-cultural expression of identity, I commenced a long-term project on Sharpeville as spatial construct in-and-through time. The project quickly took on a life of its own, with students requesting to go and shoot with and, not being able to fit that many into the car, VUT vehicles were booked and students taken to shoot just across the road. Before long, an Exhibition Project was launched which commemorated the 50th anniversary of the Sharpeville Massacre in 2010 and celebrated the township's unique role in the history of South Africa through photography. The exhibition had an immensely positive reception and was exhibited in the local community, nationally and abroad and resulted in a documentary feature produced by Sabido Productions, eTV's then prestigious international documentary unit, entitled Sharpeville Echoes for local broadcast and which featured on the History Channel.

This curriculum changed lives and to date, the most successful alums from the curriculum are Isaac Mofokeng,[11] Warren van Renburg,[12] Jabulani Dhlamini,[13] and Nocebo Bucibo.[14]

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[11]Isaac Mofokeng was introduced to photography in 1996 and quickly he became passionate about the medium. He studied Photography at Vaal University of Technology and commenced his commercial career in 2004, focusing his lens "on capturing the vibrant colours, cultures, spaces and people of South Africa" (Mofokeng, 2021). He has completed numerous advertising, commercial and editorial photography assignments which has seen him "deliver captivating work for various advertising agencies, media houses and corporate clients" in South Africa.

[12] Warren van Rensburg finished his degree in Photography at Vaal University of Technology in 2003. He has been working as professional commercial photographer even as a student and has produced work for "both for a variety of clients, both locally and internationally" (Van Rensburg, 2021), which include "Cell C, Converse, Vodacom, Steers. In Draft FCB, Grid, Hello World, Jupiter Drawing Room, JWT, King James, Lampost, Lowe Bull, Metropolitan Republic, Network BBDO, Ogilvy and Mather, Trigger, Terraplane, Urban Brew to name but a few. His Editorial Commissions have been published in Cleo, Clash (UK), Cosmopolitan, Dossier, ELLE, ELLE Decoration, Exceptional (UK), FHM, GQ, House And Leisure, Joburg Style, Lowveld Living, Masterclass (UK), Men's Health, One Small Seed, SA Cricketer, SA Rugby, Sandton Magazine, Session, Skateboarding, SL, Sport and Street (Italy), This Is Fly (New York), Wanted, Y Mag" " (Van Rensburg, 2021).

[13] Jabulani Dhlamini lives and works in Johannesburg, South Africa. He studied photography at the Vaal University of Technology, graduating in 2010. In 2011, he received the Edward Ruiz Mentorship. His work focuses on the social structures of contemporary South Africa. In Umama, Dhlamini "pays homage to single mothers and explores the challenges faced by women raising children on their own in South African townships" (Dhlamini, 2021). For his Recaptured series, he returned to Sharpeville, in which he had found his voice as a student in 2008 working with his mentor and lecturer, Jakob Doman. And "interviewed and photographed several individuals who traced their movements and emotions on the day of the Sharpeville Massacre, relocating themselves within the collective memory" (Dhlamini, 2021).

[14] Nocebo Bucibo is a photographic researcher living and working in Johannesburg. She is currently a Development Studies, PhD candidate in the Research Chair, Department of Anthropology and Archaeology, Faculty of Humanities, University of Pretoria. She works as a photography lecturer at Vega School as well as at the Market Photo Workshop. She has worked on various photographic projects including the 20018/19 Market Photo Workshop Incubation program, the Wits Roodepoort/PARI project and the VUT Sharpeville commemorative project, *Sharpeville echoes*. She was a 2009 Sasol signatures finalist and SABS Young Design Achievers finalist in the same year. Her doctoral research critically examines the role photography plays in the (re)making of the Thokoza hostels. Nocebo holds a MFA from Wits University (with distinction), where she was awarded the Wits Institute Fellowship from 2017-2019 and is a member of the Golden Key Society (2019). Her master's dissertation, entitled A Just Image: South African Hostels and Contemporary South African Photography which continued her work on Hostels from her BTech (Photography) – Project completed at VUT. She has a BTech (Photography) and National Diploma (Photography) from the Vaal University of Technology. In 2018 she had a solo exhibition titled: 'iHostela Ngeliny'iKhaya: Regarding Photography as a Just Image' at the Workers Museum in partnership with the City of Johannesburg. Some of the images from this project where part of a group exhibition, at the Turbine Art Fair (2018). Her body of work titled 'Ikhaya'lam' (2010) was exhibited as part of a group exhibition at The Lovell Gallery during the 5th Month of Photography in Cape Town (2012). This work was also exhibited at Constitution Hill as a solo exhibition (2014) and at the JOBURG Fringe, under Kwasuka gallery (Maboneng in 2015). A selection of images from 'Ikhaya'lam' have also been exhibited in a group show titled 'Invisible Borders: Cultural Time Zones in Johannesburg and New Delhi', Johannesburg Institute for Advanced Study and at the 2016 Pingyao International Photography Festival (PIP).

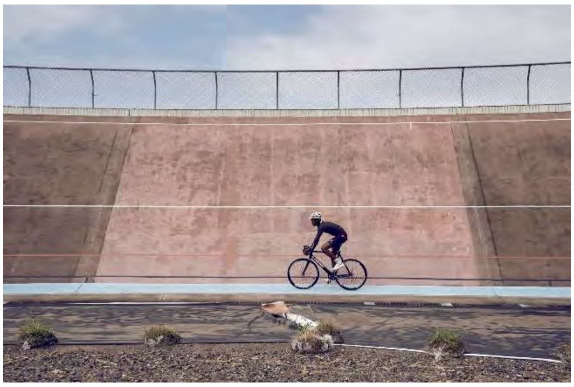
FOLIO | Isaac Mofokeng©

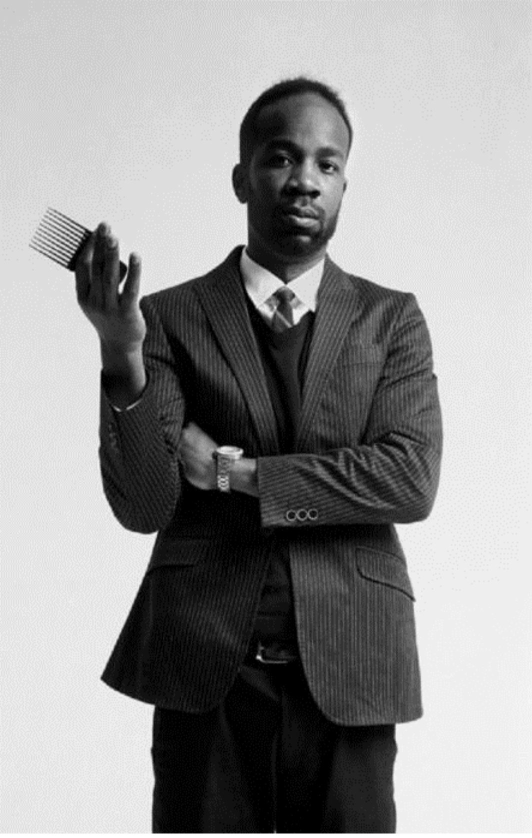


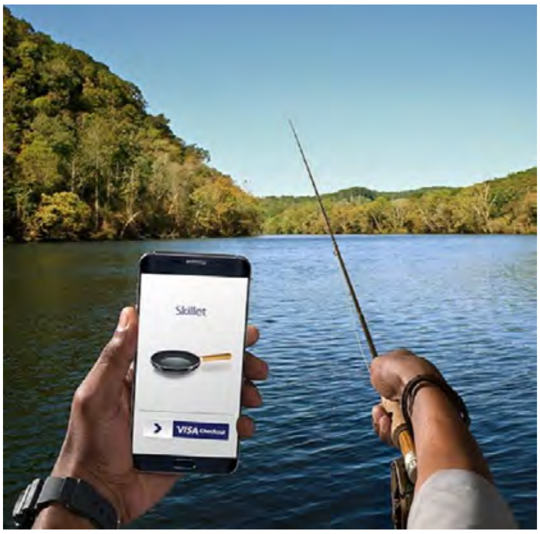





FOLIO | Warren van Rensburg©



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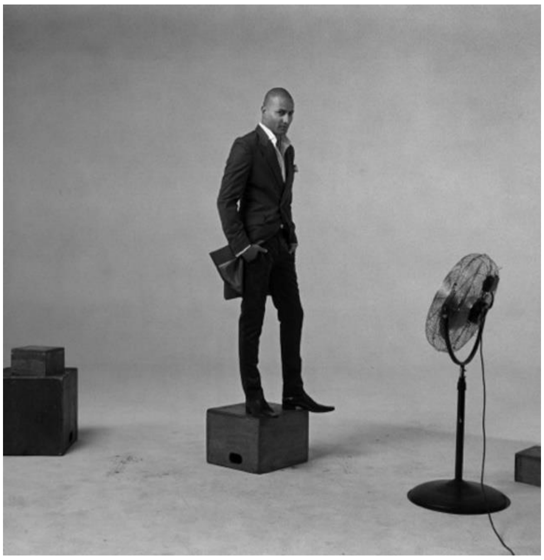

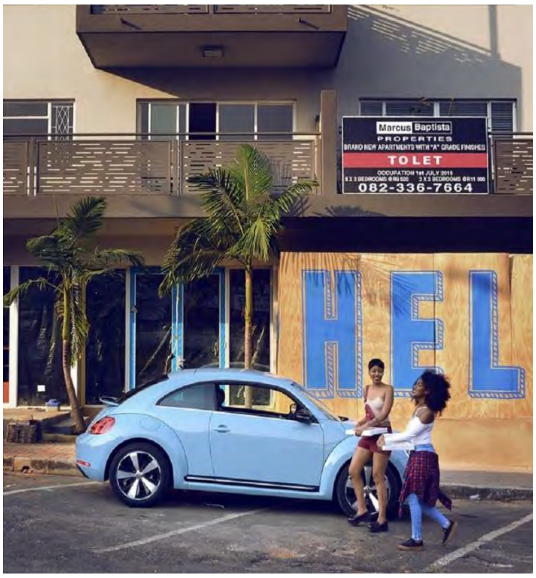
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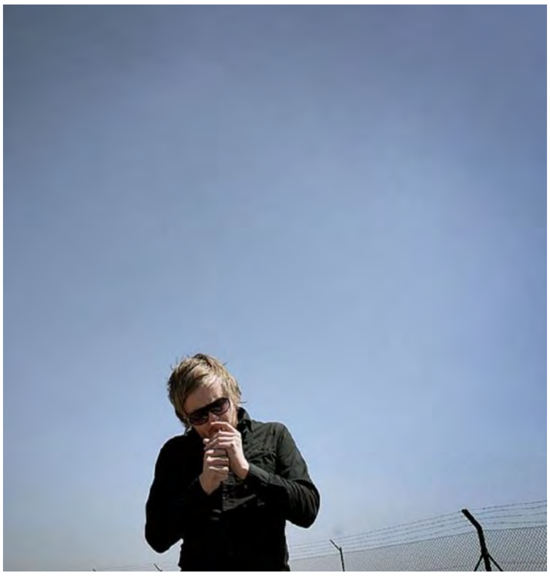

FOLIO | Jabulani Dhlamini© (from Sharpeville, recaptured)






FOLIO | Jabulani Dhlamini© (from uMama)

Act 3: The revised University of Technology NDip (Photography)

By 2010, despite having met the strategic requirements specified,[15] change, inevitably it seems, was once again in the wind.

Firstly, we were faced with the grim reality of South African higher education whereby economic concerns became fundamental to the Institution (Heymans, Styger & Van Vuuren, 2016, p. 261) and affected practical operations and to a certain extent, the curriculum we could offer. These were argued by Ntshoe (2004, p. 203) who explains that, "globalisation and marketisation had tilted the balance in higher education from internal, essentially academic concerns, to external issues such as institutional positioning and reconfiguration of missions to ensure financial survival with government departments, funding councils, and other agencies having developed strategic policies to reinforce the notions of a *market* culture and resource allocation, which changed HET into a quasi-market".

The dramatic result of this thinking was that Executive Management started to question the financial sustainability of Departments/Programmes, especially the Creative and Industrial Arts, at an institution such as a University of Technology, despite the Photography Programme being fundamentally a Technological Medium and being funded at the same level as STEM qualifications (Naidoo 2007, Thathiah, 2013) and Seltzer & Bentley (1999, p. 17 *cited in* Thathiah, 2013, p. 55) arguing that "using knowledge creatively is central to realising economic and social value, and to developing individual potential to thrive. It is as important to overcoming exclusion as it is to competitiveness in the high-value, high-reward sectors of the economy. Creativity is vital to meeting the social, political and cultural challenges of the next century".[16]

However, despite much debate, the message was clear – massification had become a popular means to address the problem of financial sustainability by "establishing targets for the size and shape of higher education" (Ntshoe, 2004, pp. 203, 211). Hence, all programmes were under pressure to grow significantly over the next five years to ensure their future.

Secondly, Digital Camera Technology had evolved to such a degree that it had, in almost all aspects, replaced analogue light-sensitive materials as the price-point of the technology rapidly dropped. With the shift in the student demographic attained,[17] most of whom were funded by NSFAS and from disadvantaged backgrounds, meant that many did not have the financial means to procure a DSLR camera or meet the expenses accrued in the execution of the Practicum projects.

[15] The Photography Programme having:

- increased its intake over the previous five years by 150% to ± 35 first-year students, far beyond the strategic projection required at the time;
- increased its NDip (Photography) qualification completion to roughly 50%, meeting the Institutional and National requirements;
- re-aligned its student demographic to equitable proportions in alignment with the call to transformation by the CHE; and
- implemented Africanisation of the curriculum where possible with reasonable success.

[16] A sentiment echoed by the WEF 20 years later that had placed Creativity as one of the top three most important skills needed to survive and thrive during the 4IR, "Creativity will become one of the top three skills workers will need. With the avalanche of new products, new technologies and new ways of working, workers are going to have to become more creative in order to benefit from these changes" (Gray, 2016), which are crucial to economic growth and success in the twenty-first century.

[17] Roughly 80% of the student complement were African at this time, a statistic we were proud to have achieved as it meant the measures both the programme and the Institution had put in place were working to address the matter of equity and access.

Therefore, paramount to increase access and student numbers was to reduce the cost to the students of the programme, *significantly*.

Working with the Centre of Academic Development, the modularisation implemented previously were rescinded and the NDip (Photography) Programme returned to the nominal four main subject offerings as duly constituted. This allowed for a significant decrease in tuition fees. Thereafter, NSFAS and VUT Management were approached and an agreement was reached to allow the acquisition of a basic DSLR in collaboration with an industry partner as part of the Practicum laboratory fee while many of the Practicum costs were included in the laboratory fee or addressed through meticulous selection of projects.

These measures allowed greater access to the programme and the programme grew exponentially despite the facilities and equipment held within the programme being insufficient for the volume of students that needed to use equipment to complete the curriculum as constituted and described.

We managed, but it became evident that the quality of work produced, both academic and practical, was in decline, which could be ascribed to:

- The lack of adequate facilities and sufficient equipment;
- Lack of access to suitable subject matter, i.e. working on-campus with subject matter of limited visual interest; and
- The increased number of students resulted in less individual attention from lecturers to students who in reality required more due to basic verbal and visual literacy of students entering into the programme being inadequate for success in the academic programme on offer.[18]

Hence, given the challenges, an alternate educational strategy was needed for the Photography programme, which, as it happened, coincided with the National HEQSF reform.

Act 4: The Dip (Photography)

In August 2013, following the promulgation of the Higher Education Qualifications Framework (HEQF) in 2007 that provided for the establishment of a single qualifications framework for national higher education, the revised HEQSF (Notice 1040 of, 2012; Government Gazette No. 36003 of 14 December 2012) was promulgated in terms of the National Qualifications Act, 2008 (Act No. 67 of 2008). The new HEQSF framework required higher education institutions to revise and align qualifications or develop new qualifications that met the requirements specified. This became a unique opportunity for the Photography programme to either re-invent itself, define a new niche and re-design the curriculum accordingly or to develop a new qualification to address the difficulties outlined above. Tentatively, we commenced strategic discussions on the future direction the programme might take.

[18] This could be ascribed to the fact that expanding access allowed students who were not adequately prepared by the Secondary Educational system into Higher Education (Evans, Mendez & Acosta 2021, p. 18; Mohamedbhai, 2011, pp. 2-4; Gakusi, 2008, p. 8) and made it difficult for them to adapt to the academic rigour to meet the outcomes required. Students were struggling with successfully completing the theoretical components and the lack of visual literacy meant little to no understanding of what constitutes a good Camera Picture or the need and manner in which to produce such an image – given, it was our task to teach this, but the lack of the discernment made it extremely difficult to engage with the complex concerns within the medium.

The discussions were informed by the following three dynamics, driven, as it were, by 4IR:
A rapid decline in commissioned commercial work in the advertising, corporate and editorial arenas (Clifford, 2010), which, in combination with the accessibility of digital photography[19] (McAughtry, 2020) led to a significant increase in the use of stock-photography with "the quality of licensed imagery virtually indistinguishable now from the quality of images commissioned" (Clifford, 2010; McAughtry, 2020) at a fraction of the price, and that "the emergence of *web 2.0* in the first decade of the twenty-first century was itself a revolution in the short history of the internet [that] fostered the rise of social media and interactive, crowd-based communication tools" (Dentzel, 2014, p. 240) within a globalised creative economy (Malcolm, 2020). This shift in the market meant that the focus of the photographic curriculum needed to be re-aligned with developing markets in the digital communications industries which Schwab (2016) had alluded to in stating that "major shifts on the demand side are also occurring, as growing transparency, consumer engagement and new patterns of consumer behaviour, increasingly built upon access to mobile networks and data, force [professions] to adapt the way they design, market and deliver products and services";

Technological advances in electronics, nano-technology manufacturing practises and photonics combined to impact on digital worldwide telecommunication networks and resulted in the super-integration of digital communication information acquisition, storage and display systems (Kumar-Pal 2008) that led to a cultural disruption in the media communications industry, termed *media convergence*;

Flew (2017) explains that media convergence "involves the interconnection of information and communications technologies, computer networks and media content, a direct consequence of the digitisation of media content and the popularisation of the internet. Media convergence transforms established industries, services, and work practices and enables entirely new forms of content to emerge", to which Holliman (2010) added that Media Convergence is about integration and interoperability, while "the processes that facilitate media convergence are shaped by, while also shaping, social practices and cultural values; the ways that we produce and consume digital media to communicate". As such, Media Convergence is a multi-dimensional construct with four dimensions (García-Avilés, Masip & Salaverría, 2012, p. 25):

- Integrated multimodal artefact;
- Multi-skilled professional producer;
- Multiplatform digital delivery; and
- Active engaged audience;
  resulting in "the blurring of the limits between different professional media skills, formats [and] production strategies [as well as] between the roles of producer and consumer" (Domingo, et al., 2007);

The constant feature-driven improvement in high-end digital camera technology meant the arrival of the professional Digital Stills|Motion Camera (DSMC)[20] as 4IR Disruptive

[19] The consequence thereof has been that, as de Castella (2012) remarked, "everyone now is a photographer; everyone now likes to record everything endlessly. It has become so easy, meaning that people don't really think a picture has any intrinsic value" in and of itself.

[20] The advent of DSMC technology emerged in 2008 when Nikon introduced a DSLR with HD video capabilities that "quietly ushered in the convergence of stills and video" (Lesko, Britt & Patel, 2011, p. 1). Initially, the DSMC was designed for "Reuters and Associated Press as a single unit that [the] photojournalist could use to shoot stills and video footage for their respective news outlets" (Lesko, 2011, p. 2). But, photojournalist Vincent Laforet produced a film short which went viral and made known the "capabilities of this camera [technology] and the beauty of its cinematic film look" (Lesko, 2011, p. 2). A large part of the enthusiasm showed by the photographer for the new technology and medium resides in the fact that, unlike with conventional video technology, where the small size and resolution of the digital sensor therein creates a 'plastic look'. The new DSMC technology captured video that had the appearance of film; a cinematic look that is achieved by the combination of the three

Technology[21] (Bower & Christensen, 1995). The DSMC imploded archaic typologies of the Camera Picture as product, which when combined with media convergence, resulted in the emergence of a new 'hybrid' creative artefact in which it is possible to combine photography, cinematography, audio, graphics and text (Kraus & Steinmeuller, 2010, p. 2) wherein the message was communicated in the most appropriate medium, initially termed a Multimedia Production (MMP) (De Sola Pool, 1983, pp. 52, 212) or a New Media Production (NMP) (Flew, 2005) and eventually, a digital media Production (DMP). The DMP became the cultural embodiment of the phenomenon of 4IR Camera Picture that required an innovative future-ready curriculum to train multi-skilled media professionals that could produce integrated content for any digital platform using a variety of technological tools in the production process (Nwammuo & Nwafor, 2019, p. 57).

Thus, at the end of 2012, following an extensive Advisory Board discussion, we enlisted the assistance of Professor Emeritus Ken Kobrè, leading international educator on multimedia storytelling and videojournalism, for an intensive re-curriculation workshop during which we implemented a modified approach of the Clayton Christensen disruptive innovation model for product design (Bower & Christensen, 1995). As part of the outcomes, we requested that the BTech (Multimedia), a qualification that had been dormant in the Department, be re-integrated back under the auspices of the photography programme, which we intended to use as a testbed for developing a digital media production educational programme especially as the qualification allowed entry from any of the Creative Arts and we submitted a new qualification to the CHE, the DIP (Media Production), with the purpose of providing formal vocational higher education for a career in Media Production, grounded in practical media production skills and visual storytelling informed by a photographic visual sensibility wherein video and sound content in the curriculum would affirm the contemporary media relevance of the new qualification to prepare and enable an independent entrepreneurial media practitioner.

Our decisions were not perfect, and in the beginning, explorative. We promoted the new BTech focus to practitioners in industry and it had a reasonable reception in 2013 with about eight students. Structured weeklong workshops and classes in cinematography and documentary video production were offered by Eddie Stanley (Camerawork/Sound Recording & Design) and Charlene Stanley (Producer/Story Development) of the then Sabido Productions[22] while Video Editor Karin Schonken handled the non-linear Video Editing training.

The first student to complete the new BTech (Multimedia) focus was alum Herman Verwey, with his documentary production on hardcore wrestling:

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aspects: shallow depth of field, the 180-degree shutter angle rule that incorporate appropriate frames per second to capture natural motion blur and an extended dynamic range. These aspects have meant that the 'plastic look' of the video-camera, so disliked by the professional, is no longer evident and a more realistic, although slightly different, image results (Lesko, 2012, p. 9; Lancaster, 2011, p. xviii; Kraus & Steinmeuller, 2010, p. 4).

[21] A disruptive technology "displaces a well-established product or technology creating a new industry or market" and hence, the "practical application of the technology may not have been proven yet, often attract a small audience and generate performance problems" (Christensen, Raynor & McDonald, 2015; Cascio & Montealegre, 2016, p. 353; Bower & Christensen, 1995).

[22] Sabido Productions was "a South African production company that commissions, produces and co-produces documentaries and feature films. Sabido Productions is committed to the business of producing powerful African content for international broadcast with a team that is experienced in all aspects of film-making; from the commissioning process to in-house development and production, Sabido Productions employs a dynamic and multi-faceted strategy to ensure that all content made by the company has an appeal to international markets and is supportive of local filmmaking talent and the African film and documentary production industry" (Sabido, 2013).

At the end-of-the-year strategic discussions, it was quite evident that:

1. The number of additional skillsets required to produce a digital media production was more that could be handled in a single academic year and required a foundation laid in an undergraduate programme
2. A substantial capital investment in motion production equipment was needed
3. Re-skilling of staff was an immediate concern
4. Additional specialist lecturer/s would be required to develop and present the envisaged DIP (Media Production) programme to its fullest extent.

The first concern was addressed in the submission of the new qualification, DIP (Media Production) to the CHE.

The need for capital investment was addressed, I believe, through discretionary funding secured from the Institutional Block Grant (TDG/RDG) of 2013/2014, which was the last time that "universities were able to use their funds at their own discretion…funds were not necessarily directed at teaching development initiatives [with] important categories of expenditure for teaching development funds are: 1) investment in human resources; 2) core infrastructure and 3) curriculum development and teaching support initiatives" (DHET (SA), 2013, pp. 330-332), as well as a substantial educational contribution of 30 DSLR cameras from Nikon to support the programme.

As to the concerns regarding staff, re-skilling was undertaken by staff at their own initiative who attended the workshops offered to students by the professional practitioners contracted in to assist and used online teaching resources to re-tool, while a contract lecturer was appointed to oversee the third-year academic programme for staff on research leave, who proceeded to work on a postgraduate qualification in the requirements for digital media production education, as noted, professional practitioners were contracted to teach specific specialist knowledge application components, either in workshops or on a weekly contact basis.

Unfortunately, in 2014 we were informed that our application for a new qualification was declined in the context of the programme mix on offer at the Institution. Rather, it was recommended by CAD that the National Diploma (Photography) be realigned into a niche Diploma offering unique within the broader photography and digital media educational context in South Africa and be based on visual storytelling through the creation of multi-modal creative artefacts that incorporated stills, video and sound technologies, and appropriate theory, to support this focus. This, it was suggested, were to commence with doing a 30% re-curriculation of the programme on a yearly basis, which did not require Faculty Board or DHET approval immediately, to assess viability before the submission of the new DIP (Photography) and commencement thereof in 2017 and that after a successful cycle of the new DIP (Photography), we could apply to have it renamed to the DIP (Digital Media Production).

Hence, in 2015, we started adding a motion specific Practicum to second and third year, specifically a narrative motion portrait[23] DMP, with addition of relevant technical aspects to the Theory of Photography subject and media production aesthetic components to the Visual Communication subject. This proved quite effective, albeit not ideal. The Practicum learning unit was an ideal method for engaging students with all of the skills aspects required in making a digital media production, and students responded positively, even though it was a tremendous amount of work for an individual to complete. The following example by alum practitioner Nigel Stockl illustrates the typical outcome:

The biggest problem encountered was logistical; the fact that students took a long time to complete the project, most a full academic semester, given all the various technical and aesthetic skillsets that had to be obtained, despite the third-year contract lecturer showing them that it can be done in two days from pre-production to final export:

Following, in 2016, we revised the curriculum by 30% again and introduced in the Practicum subject a full semester of Digital Motion Production training with two additional learning units focused on production skills development – one focused on the technical production and asset acquisition skills and the other on non-linear video editing, which culminated in both years

[23] A portrait, though broadly defined as a likeness of a subject, is so much more than the mere recording of a face. Rather, it should be considered more as a intimate moment of engagement between subject and photographer that presents a moment of clarity, sometimes both accident and gift. A portrait is made both powerful and memorable when it challenges, amuses, enlightens or disturb our preconceived notions and ideas about the nature and identity of the sitter. The difference between an ordinary likeness and a truly striking portrait lies in the photographer's ability to see past the obvious and into a more intimate aspect of the identity of the subject. Though many photographers are naturally inclined to relate to the subject and bring out an aspect of their personality, many do not understand or see the emotional value of the subject's surroundings. In this, then, can the single image truly present a portrait, or is what is needed is engagement through time with the sitter to present a deeper portrait, an interview with the subject, " a-portrait-as-a-story". In this multi-modal portrait, the intent is to set the scene, introduce the character/s in their own words, evoke a mood and show aspects of a life lived with all its dramatic consequences as seen and experienced by the subject. A motion portrait is then an exploration of a person's life, their loves, their home and/or work, their essential nature, a collaboration between the subject and the practitioner.

with the motion portrait DMP learning unit, which we had revised to be completed as a cooperative learning unit experience.

It worked extremely well, especially as the second year functioned as introduction to basic skills and knowledge development and in the third year the level of execution had to approximate a Professional DMP Production standard. We felt ready for the new DIP (Photography). We had some in-house motion equipment, a strategy that enabled students to procure a DSMC as part of their studies and a curriculum that was enabling and functioned well in preparing students for the envisioned world-of-work.

At the onset of 2017, we deployed the new DIP (Photography), which was re-curriculated as follows:

Table 1: HEQSF articulation – NDip (Photography) to Dip (Photography)

EXISTING NATIONAL DIPLOMA: Photography CESM CODE: 0304 (030401 / 030402)	DIPLOMA: Photography CESM CODE: 0304 (030401 / 030402)
Existing subject specification	**New subject specification**
Visual Communication 1 – 3	Applied Media Aesthetics[24] 1 – 3
Professional Practice 1 – 3	Professional Practice[25] 1 – 3

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[24] Despite the enormous and constant volatile changes that the digital revolution has brought about in creative practise, creative artefacts are created to communicate. They do so not only through content, but through a sensory evocation, their aesthetic appearance. Clive Bell (1914, pp. 7-8) has argued that the aesthetic appearance is a very specific attribute shared by all creative artefacts.

> What quality is shared by all objects that provoke our aesthetic emotions? What quality is common? Only one answer seems possible – significant form. In each, [aesthetic attributes] are combined in a particular way whereby certain forms and relations of forms stir our aesthetic emotions. These relations and combinations of [aesthetic attributes], these aesthetically moving forms, I call significant form; and significant form is the one quality common to works of [creative expression].

Then, since we, as lecturers and practitioners, accept that the aesthetic appearance significantly affect the communicative potential of acts of creative expression, it is imperative that the student be educated to move beyond the basic judgment of 'like' – to move beyond an everyday reflexive judgment to an approach to creative problem-solving with educated judgment as to the affect the aesthetic has on the creative artefact. Therefore, within the programme, we embrace the discipline of applied media aesthetics as an indispensable tool for structuring the appearance of content to communicate, defined as per Herbert Zettl (2011, p. 4),

> Applied media aesthetics is not an abstract concept but a process in which we examine a number of media elements, such as lighting and sound, how they interact, and our perceptual reactions to them. Second, the media content elements, in our case primarily photography, video and sound, are no longer considered neutral means of simple message distribution but essential elements in the aesthetic communication system. Third, whereas traditional aesthetics is basically restricted to the analysis of existing works of art, applied media aesthetics serves not only the analysis of the various forms of media productions but their synthesis – their creation – as well.

Applied media aesthetics therefore deals with the aesthetic, intellectual and emotional aspects of digital media practice. In this subject, there is a strong focus on understanding the craft of the camera picture in relation to its aesthetics, which will offer you the knowledge to effectively analyse, evaluate, understand and create visual/multi-modal messages, while engaging with aesthetics and the underlying principles of visual storytelling.

As such, applied media aesthetics, as subject supports the practical component of the programme in that:

- It broadens your visual frame of reference and develops your visual literacy.
- Develops a fundamental understanding of visual persuasion and digital media practise communication strategies.
- Develops a critical understanding of digital media practise production components.

[25] From your first engagement with Professional Practice, you realise by now that what you are studying is not a hobby, but a specialised media field aimed towards a profession. However, professional digital media production worldwide is not a regulated profession. This means that you can enter the market without any qualification obtained at an education provider. The challenge therefore is to enter the complex creative industries and media market of South Africa, and maybe the wider international market.

Professional photography is mostly an entrepreneurial profession that enables the individual to establish and manage their own business. Professional practice provides an overview of business related concepts that aims to

Applied Communication Skills	Applied Communication Skills 1 – 2
EDL	English Language and Literacy Support
Theory of Photography 1 – 3	Theory of Media Technologies[26] 1 – 3
Applied Photography 1 – 3	Media Practice[27] 1 – 3

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safeguard the future professional Photographer against uninformed business decisions. The subject will deal with "real" issues that the photographer as one-man business will encounter from day one. The issues will hopefully engrain principles of good practice that will stand in good stead for the duration of the photographer's business career. The aim is not to create an expert in the areas covered, but rather to equip the prospective business person with business savvy, or acumen, that is based on basic principles that guides "good practice".

We will focus on current realities, debate these, search out current photography practitioners, financial experts, agents, retailers, associations, among others. By doing this we hope that current business thinking and doing, patterns and principles will emerge, and assist you with a sober mind-set when you do enter the marketplace. Survival is the underlying theme that permeates our discussions when we engage with current business realities. We need to debate personalised and geographic relevant business solutions for a volatile economic environment as well as an over populated photography and media industry.

[26] The photographer, during the heyday of chemically based imaging, was revered as someone with near magical powers. He (mostly he at the time) had a deep understanding of the appropriate chemistry, a choice of optics, tripod, flash powders among others, in order to render the best possible reproduction of the scene in front of the camera. Today, although technological advances have progressed dramatically, the photographer still uses an enormous array of technological devices to craft an image of the chosen subject matter for personal and public utility and enjoyment.

In theory of media technologies, the subject not only familiarises you with photographic technologies, but also introduces you to the plethora of media production technologies available to the digital media producer. The already complicated variety of technological choices increased exponentially as the medium entered the digital domain. As digital media producers, our choice of capturing technology and array of lens technology is complimented by motion and static stabilisation technology, artificial light source options for on-camera, studio and location scenarios, specialised devices and attachments for any of the previously mentioned technology, necessary electronic and digital connectivity options and computer hardware and software tools and peripherals for image processing, among others.

A craftsman needs to surpass the accepted norms of competency associated with the chosen tools of the trade. A revered connection between the tool and maker elevates the technology from mere object of technology into an invisible extension of maker. The student should not search for factual information about the technology at hand, but also search for specific tools that can become more invisible in the process of making. This is the aim of the subject at hand.

[27] Though technique is not to be regarded as an end in itself, consistent creative expression is only possible through the control and command of the technical aspects of the medium of creative expression. In mastering the various technical aspects, processes and skills, a greater variety of choices from which one may create visual artefacts that communicate the intended message is possible, enabling creative visual problem resolution and more effective communication with the audience.

Within the discipline, the different modes of production and content elements, whether photography, videography, motion graphics or sound design, have historical traditions and highly-technical specific requirements to accomplish distinct outcomes. As such, the programme aims to expose the student to as many different historic and contemporary methods and approaches as possible, allowing the student the opportunity to acquire a diverse array of technical skill which give the freedom to decide what will work to solve a given content requirement without being didactic.

Media practice as subject focus on the development of practical competencies that plays an important role in the structure of the photograph and digital media production. The focus of this subject is on learning to apply and synthesise skills in applied media aesthetics and with technology in combination with idea/concept development. Within the field of photographic practise, the learning will be deal with lighting on-location for a variety of subject matter and with the development of skills towards contemporary aesthetic standards through Adobe Creative Suite as digital ecosystem. In the digital media production practical component, learners will focus their energies on pre-production planning incorporating a storyboard and shot list, followed by visual and audio asset gathering and NLE editing and grading towards optimum output quality in order to create a digital media production meeting the minimum professional and technical requirements.

During the course, students will be expected to develop and eventually master the following skills:

- Creative use of camera controls towards achieving intended visual results
- Creative and effective use of visual design elements
- Lighting on location and in a controlled environment for a variety of subject matter
- DSLR motion capture techniques with various stabilisation options
- Visual storytelling principles
- Digital media production planning
- Digital image software skills towards contemporary aesthetic standards for stills, i.e. retouching, comping and creative tone and color control and grading for video towards optimum output quality
- Time-based non-linear editing software and principles

The newly articulated subjects supported the aim of the envisaged DIP (Photography/Digital Media Production), which was described as follows:

> *To equip learners with the knowledge, skills and entrepreneurial acumen to be creative digital media producers for the* digital communications industry. *These could include digital media productions for corporate, SMME, public relations, and NGO clients to be delivered on digital platforms such as WWW and social media such as Facebook, Twitter or Instagram.*

The practical outcome the programme aimed to achieve is best illustrated in the work of alum practitioner Marius van Rensburg of MVR Films.

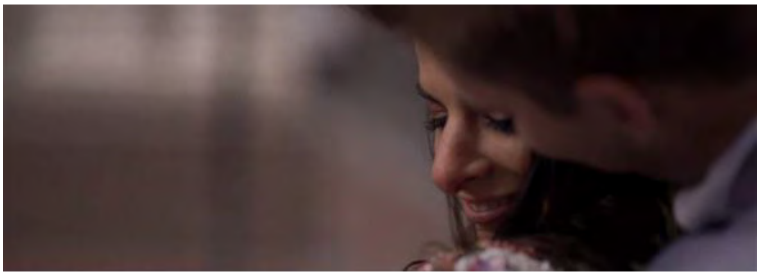
FOLIO | Marius van Rensburg©

DMP Production – Bouchard Finlayson Liquid Gold

DMP Production – Benjamin

DMP Production – Bouchard Finlayson Estate

- Basic sound recording and sound mixing that meet minimum professional standards and apply some creative application



DMP Production – The wedding of Caylee + Steve

Act 5: The Dip (Digital Media Production)

2017 arrived, and with the new digital media focus in the programme, we had a dramatic increase in student intake that doubled from 2014 to roughly 75 first-year students in the newly deployed DIP (Photography).

Then we got blindsided.

It was a year in which the challenges faced by the Institution, similar in nature to that Gakusi (2008, pp. 9-10) described in that "the African education sector continues to face serious challenges of low and inequitable access to education, inappropriate curricula with low [qualification] completion rates, inadequate education financing including a shortage of resources allocated to the education sector and misallocation and misuse of [fiscal] resources, [a lack of] education system and [research] capacity with a poor link with the world of work", reached a critical point.[28]

As a result, the shortage of funding allocated, combined with misallocation and mismanagement of funds allocated led to a lack of educational resources (Gakusi, 2008, pp. 9-10, Naidoo, 2007; Fengu, 2019a; Fengu, 2019b; DHET, 2017, pp. 3, 10) that combined with the "breakdown of governance, along with maladministration and pervasive corruption" (Pityana, 2020) caused fiscal distress where "in this unforeseen phase, increased pressure is put on their habits and practices of operation, and levels of anxiety and tension are raised" (Perlman, 2009, p. 201) and little to no capital investment in programmes were provided.

In an attempt to address the dire situation, new Institutional Policies were designed and implemented, some of which had a significant impact on the educational programme.

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[28] These included:

a) a general uncertainty regarding the 'core business' in contemporary South African public universities, with a "multiplicity of conflicting but coexisting narratives about what universities should do in South African society – producing excellent research, preparing a labour force or addressing societal inequalities – exposes a persisting tension surrounding the purpose of a public university [where] the current financial constraints had made income generation a primary concern across the sector" (Swartz, Ivancheva, Czerniewicz & Morris, 2018, pp. 567-568).
b) significant shortcomings in governance and leadership that were destabilising and undermining the effective functioning of the Higher Educations Institution (Mba, 2017; DHET, 2017, p. 3).
c) restructured and reduced government/public funding while a significant increase in student debt accrued (Heymans, 2016; Naidoo, 2007; BusinessTech, 2016; DHET, 2017, p. 10).
d) low student qualification completion rates which meant increased financial pressure as the New Funding Framework (NFF) formulas, implemented in 2004, are based upon qualification completion (Heymans, 2016, p. 260; Naidoo, 2007; Vossensteyn, 2004, p. 43).
e) low institutional research output meant a lack of income from research and research-related industry funding (Mohamedbhai, 2011, pp.2-4; Naidoo, 2007).
f) disruptions of academic programs because of the financial and academic exclusion of some students and the frequent closure of the campus as a result of political and/or student unrests (Cloete, 2015; Mohamedbhai, 2011, pp. 2-4; Gakusi, 2008, pp. 9-10).

Specifically, the requirement that Educators, Examiners and Moderators hold a minimum of a master's degree is ill-suited to vocational programmes utilising successful professional practitioners on a contractual basis, as these most often do not hold advanced postgraduate degrees, while at the same time, questionable public procurement policies and practices[29] (Ntshoe, 2004, p. 203) had an immediate and direct impact on the educational programme.

The most notable being that the professional practitioners, with decades of practical experience and numerous industry accolades, could no longer be used to facilitate educational outcomes resulting in a critical devaluation of practical knowledge that affected programme implementation and development and has led to a distinct lack of connection with the world-of-work and vocational validation of the outcomes achieved by students (Leask, CronjeII, HolmI & van Ryneveld, 2020; Campbell & Rajaratnam, 2013). Furthermore, due to policy matters relating to capital asset insurance, students were no longer allowed to use Institutional camera equipment to work off-campus on Practicum outcomes whilst, at the same time, the procurement ‘situation’ meant that the acquisition of DSMC for students through the Institution was discontinued in 2019.

Reeling under the circumstances, the programme made do with the facilities, equipment and the infrastructure we had on-hand, adjusted the curriculum to projects that attempted to work around the limitations by working on-campus with various Academic and Service Departments while lecturers re-skilled on-the-fly and capital investment by the Institution for the acquisition of DSMC in the programme was requested, but given the fiscal challenges of being under administration (Pityana, 2020), none was forthcoming. Then COVID-19 landed, which left the programme effecting e-Learning with minimal Practicum time on-campus and on-equipment and ended the implementation of the very successful collaborative Practicum projects.

As before, we needed an alternative.

In the 2020 Advisory Board and Strategic Planning discussions, the situation was extensively deliberated and it was agreed that technologically, the programme could re-focus strategic undergraduate components towards mobile DSMC technologies and its use and implementation in SMME digital media practise entrepreneurial solutions in social media content production (cf. illustration 1) as an educational strategy.

Hence, once again, by focusing on disruptive innovation and using technological leapfrogging, this decision foreshadows a vocational future in the discipline that includes smart capture technology, autonomous aerial drones, computational photography, cloud-based team collaboration, algorithmic video editing and social-media specific content platforms (*cf*. Aldredge, 2017; B3M, 2020; Davidson 2014; Jirsa, 2020; Preimesberger, 2018; Shankland, 2018; Fox, 2015).

That is, the 4IR Camera Picture, incarnate, embraced.

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[29] The Institution, under ministerial instruction, had been investigated by Prof. Pityana and Prof. Ralebipi-Simela, who commented that “at the heart of it is a morality that sees the university as a place to be exploited for its resources and giving as little as possible to make the institution sustainable…there is a pervasive and shameless sense from certain organised formations – including unions, students and service providers – that they have a right to milk the institution dry with impunity. In other words, not only did we not have any sense of public revulsion at the wholesale looting of the institution’s resources, but local businesses, suppliers and local government were either observing as spectators and not lifting a finger to stop this or were also part of the problem in that they were paying kickbacks and successfully undermining [the Institution’s] supply chain management system. In the process, we have found, the mission of the university got lost” (Pityana, 2020).

Illustration 1: Smart Technology DSMC (Beastgrip, 2021)

Conclusion

The Camera Picture, being a technological medium from inception, has been inherently in a volatile relationship with disruptive innovation that require the practitioner to constantly adapt to and manage technological change, constantly re-learning and re-skilling and re-educating in order to remain ‘current’, ‘competitive’; *relevant*. As Scott (2017) commented,

> *The responsibility for establishing a personal visual language for work is perhaps the most important aspect in creating an honest and substantial foundation for a [media practice] in the twenty-first century within an over-populated marketplace. The [media practitioner] today is a conduit, a publisher, a writer, a marketer, a filmmaker and – perhaps most important of*

all – a storyteller*, that can fully use all the tools available to them to find, tell and disseminate their stories. In a digital age, these tools are more powerful than ever before but require skills previously less relevant to the photographic medium. The role of the [media practitioner] has changed from that of creator to creator and disseminator, and it is in that dissemination that the [media practitioner] has inherited the power of communication that they have for so many years cried out for.*

Consequently, it is imperative that the formal education of the practitioner, as expressed in-and-through the educational curriculum, should not only speak to the multifaceted nature of the Camera Picture but need to be equally adaptive, open to re-definition and responsive to technological innovation experienced. This perspective is echoed by Adams Becker, Cummins, Davis, Freeman, Hall Giesinger and Ananthanarayanan (2017) and Albrectse, Devlin, Fadel, Serban and Shapiro (WEF 2017a) who indicate that a successful 4IR educational programme requires:

Future-ready curricula – Johnson (2001, p. 7; Alsubaie, 2016, p. 103) comments that "the goal of a successful educational programme and thus effective curriculum development should be to meet the needs and current demands of the culture, the society and the expectations of the population being served". Therefore, curriculum development and the educational process should continually undergo review, revision, be updated and adapted "on a rolling basis based on insights and forecasting regarding the evolution of local and global labour markets and trends in skill demands with input from relevant stakeholders" (WEF, 2017a, p. 8);

Digital fluency – Apart from basic visual, verbal and digital literacy, "Technology should thus be embedded across the educational experience giving learners a deep understanding of how to apply and innovate [through] technology so they can play an active role in the shaping of the future [of their discipline]" (WEF, 2017a, p. 8);

Professionalised educators – Evident from vocational programmes is that the teaching of a skills-based profession should require educators involved "in their own professional development [and who] are given adequate opportunities to re-skill or continue their professional development over the course of their [educational and professional] careers" (WEF, 2017a:8);

Creativity culture – To advance a culture of innovation and entrepreneurship, creativity, by definition, "is the ability to create something novel and appropriate" (Amabile & Khaire, 2008), and flourishes with collaboration, when "when people of different disciplines, backgrounds, and areas of expertise share their thinking [as] sometimes the complexity of a problem demands diversity" (Amabile & Khaire, 2008), and an educational culture that "accept failure as an important part of the learning process" (Adams Becker, et al., 2017, p. 8) in achieving success;

Redefined pedagogical approaches – An emphasis on learning as a social-construct that requires "the mastery of content that engages students in critical thinking, problem-solving, collaboration in peer-to-peer or group activities and self-directed learning. To remain motivated, students need to be able to make clear connections between their coursework and the real world, and how the new knowledge and skills will impact them" (Adams Becker, et al., 2017, pp. 8); and

Blended learning design – "The affordances blended learning offers are now well understood, and its flexibility, ease of access and the integration of sophisticated multimedia and technologies are high among the list of appeals. The current focus of this trend has shifted to understanding how applications of digital modes of teaching are impacting students. Many findings showcase an increase in creative thinking, independent study, and the ability for the student to tailor learning experiences to meet their individual needs" (Adams Becker, et al., 2017, p. 8).

Considering the criteria, most had already been engaged with within the programme with some degree of success. The biggest struggles ahead lie in:

- Developing time and space for the educators to re-skill and develop their 4IR professional DMP capacities, given the significant staff turnover experienced recently and the limited time in the academic timetable;
- The challenge to develop the visual and verbal student vocational literacy has become imperative, which, as Sharita Bharuthram (2012, p. 208) explains, is "one of the most significant challenges that African higher education institutions are currently experiencing, [that] many students enter higher education unable to read and write at the level expected of them", a carry-over from the lack of literacy achievement during the formative years at school; and
- The transition to e-learning and blended learning which is a constant pedagogical challenge to contend with as the COVID-19 pandemic is addressed within a practical vocational educational offering.

But, as the educational narrative *described* hopefully illustrate, though the challenging reality in-the-trenches of African higher education are often quite different from the idealised educational narrative oft *proposed* in the literature, it is possible to adapt and innovate, if the programme, and the educators therein, are responsive and constantly striving to educate their students to be competitive in real-*contemporary* real-world practice.

Therefore, the strategic re-alignment *towards* 4IR Smart Technology, we believe, will again empower students at VUT, where on 19 February 2021, a new era in the education of "camera(wo)men" [30] in the South African higher education context was ushered in when approval and ratification were given for the application and name change of the Diploma: Photography to the Diploma: Digital Media Production.

And so, in a surreptitious manner, that which was, was no more and the future promised by 4IR embraced. And though 4IR is a threat to the unprepared, it is regarded as a tremendous opportunity for the Digital Media Production Programme at the Institution to innovate and educate professional practitioners under dramatically new marketplace rules *on our own African terms*.

Annotation

An initial draft presentation of the paper read and copyrighted to DEFSA was presented at the 2021 Vaal University of Technology – Faculty of Human Sciences – Research Seminar. The research seminar is an annual non-accredited developmental initiative for academic researchers to receive scholastic feedback before final presentation and submission to the intended publication or conference. Hence, the title and abstract thereof appears on the List of Abstracts of the Research Seminar at https://www.vut.ac.za/wp-content/uploads/2019/04/List-of-Abstracts.pdf. The 2021 Seminar Organiser, Dr H van Staden, granted

[30] "A person who operates a camera as for [photography], motion pictures or television" (Merriam-Webster, 2021)

permission for the re-publication of the title and abstract and noted the above, including that the full paper was not distributed, the communication of which is held by the 2021 DEFSA editorial committee and President-elect.

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SESSION 4: Digital pedagogies, ethics, and design

Design Education Forum of Southern Africa

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Measures by an advertising company to mitigate the impact of COVID-19: A case study and the Next Normal for design education

Sean Kreusch, *Tshwane University of Technology*
Selma Schiller, *Tshwane University of Technology*
Rudi W de Lange, *Tshwane University of Technology*

Abstract

This study aimed to identify the measures taken by a large international advertising company to mitigate the impact of COVID-19, and how these measures could be applied to design education. We interviewed a senior business partner of the company and determined the measures they took and their business variables affected by the pandemic. The results show how the pandemic affected interaction between design professionals; how they develop and present their creative solutions and how they brainstorm, collaborate, and remain inspired. The company will not be returning to their previous way of operating, and neither do they see the need to do so. Applying these measures to design education, we must prepare students to work in an isolated online work environment where strong self-management skills are essential. Design education must further consider small online didactical practices and must endeavour to develop students' self-motivation and self-management skills. Furthermore, students will need a comprehensive knowledge of digital platforms, design software, and workflow systems. Rapid technological changes make it even more critical to prepare students to be active, effective, and independent lifelong learners. Moving design education online will not be without challenges – a digital divide exists, sharply delineating those with and those without readily available access to the internet.

Keywords: Advertising agency, design education, mitigating COVID-19, Next Normal[31]

Introduction

SARS-CoV-2, more commonly known as COVID-19, reportedly originated at a live wildlife market in the Chinese city of Wuhan. The virus has subsequently spread to most countries around the world and, at the time of writing, has already caused an estimated 4,9 million deaths globally (as of 18 October 2021).[32] Relying on the Disaster Management Act 57 of 2002

[31] The term next-normal or Next Normal is a widely used term in the business world to refer to how a business envisions the post-pandemic reset. McKinsey and Company shared some thoughts on their website: https://www.mckinsey.com/featured-insights/coronavirus-leading-through-the-crisis#

[32] Johns Hopkins University, 18 October 2021, https://coronavirus.jhu.edu/map.html

(South Africa, 2002), the South African State President declared a Level 5 lockdown, commencing on 26 March 2020.

Due to the threat of infection and the varying levels of lockdown, consumers now spend more time indoors. As a direct result, they have increased their online social behaviour, purchase online items geared to their new normal, and embrace digital communication technology (Sheth, 2020). The lockdown furthermore reduces the demand for services and affects service industries such as hotels and restaurants and the hosting of sporting events (Arndt, et al., 2020). This reduced demand, in turn, affects business revenues and ultimately design, marketing and communications budgets. The shrinkage of marketing budgets results in fewer design briefs, billings, staff compliments and remuneration within the design industry.

The South African National Editors' Forum (SANEF), for example, reports that the effects of COVID-19 spared no sector of the South African media. The most visible casualty is the magazine industry. Other casualties include online news, radio, and television with reduced revenue due to advertising loss. The estimated drop in advertising ranges between 40% and 100% (Rumney & Balliah, 2020).

COVID-19 and its related effects have a considerable impact on a country's economy. An analysis of the pandemic's impact on the creative industry in the United States of America, for example, estimates a loss of 2.7 million jobs and more than $150 billion in the sale of goods and services. The aforementioned study spanned 1 April 2020 to 31 July 2020 (Florida & Seman, 2020). The United Nations assessed the socio-economic impact of COVID-19 in South Africa. Their impact assessment suggests that the South African economy may not even fully recover by 2024. The GDP may fall 7.9 per cent under a pessimistic scenario, and the economy may take at least five years to recover to the pre-2019 levels (UNDP, 2020, p. 21).

The study aim

This aim of the study was twofold. The first was to determine the measures taken by a large international advertising company to mitigate the impact of COVID-19. The second aim was to discuss and propose how one could apply some of these identified industry measures to design education.

The method

The first author interviewed a senior business partner to determine the company's measures to mitigate the impact of COVID-19. The interview took place via an online meeting in Fourways, Johannesburg, and used a series of open-ended and probing questions regarding the company's response to COVID-19. A faculty ethics committee from the Tshwane University of Technology granted ethical clearance. The application for ethical clearance requested permission to list the interviewee and the international company by name. The interviewee, Nicole Dickens, a managing partner at Ogilvy South Africa,[33] kindly agreed to the interview and

[33] Ogilvy, a New York-based British company, is one of the largest advertising, marketing and public relations networks in the world. The company, according to their website, has 900 staff members employed in its South African office, http://www.ogilvy.co.za/about-us.

did not object to her or the company being identified by name in the conference paper, thus significantly adding to the validity and integrity of the results.

The interviewee received a detailed information letter and a copy of the ethical clearance before the interview. The response from a senior partner of a large international company, likewise, adds to the validity of the results. We transcribed the interview and followed a qualitative interpretive analysis to evaluate the interview results. Afterwards we supplied a copy of the transcript and our analysis to the interviewee. We allowed the interviewee an opportunity to verify the accuracy of the transcript and to respond to our interpretation thereof; due to the busy nature of her work portfolio, she regrettably had to decline our invitation to respond.

The process of analysing the transcription, obtaining an overview of the answers, thematically summarising the results, and supporting the themes with an extract from the transcriptions was guided by an approach followed by Elliot and Elliot (2005). In addition, the paper also leaned on a thematic framework theory proposed by Attride-Stirling (2001). A copy of the application for ethical clearance, the ethical clearance letter, and a copy of the transcript is available from the Open Science Framework (https://osf.io/8a4nd/?view_only=87539cda3a97490f9 ae065996c4e3d0d).

The results

We were able to identify five themes. The pandemic, first and foremost, visibly affected interaction between design professionals. The pandemic furthermore changed how the company develops and presents its creative solutions, how brainstorming and other collaborative endeavours are approached, and highlighted questions on how exactly one is to maintain an inspirational working environment. The pandemic influenced the company's working environment in that they will not be returning to their previous way of operating. Neither do they see the need to return to their pre-COVID approaches, strategies, and methods. Here we clearly encounter a situation that has been aptly termed the Next Normal.

Interaction between design professionals

The interviewee indicated a significant shift in how the creative individual engaged their peers and how they engaged client service and ultimately the client. The hard lockdown, during which no one was allowed free movement unless to perform an essential service, meant that planning and operating alternative workplace solutions required an innovative response from management.

Creative teams generally work in close-knit groups and primarily on desktops. South Africa received a week's notice from the lockdown announcement to prepare for physical isolation. Online meeting platforms, which were generally reserved for corporations and teams working remotely, became mandatory for design professionals. Overnight 'Zoom', 'Microsoft Teams' and 'Cisco Webex' became buzzwords and go-to platforms for day-to-day meetings. Creative teams broke up and individual team members started working in isolation. This change created an immediate need for laptops, as well as short-term insurance to allow for home and remote work. This sudden, unexpected and unprecedented demand on employers also impacted our interviewee:

> *We've had people who are on desktop computers that we've had to arrange to have laptops; our business wasn't equipped for that.*

Greater demand for information technology support

The shift to laptops meant that the isolated creatives needed access to a stable data network that was fast, affordable and preferably uncapped. Assuming most creatives already had internet access at home, the question centred more on the stability and the cost of internet access. The need for quality internet access created a logistical challenge. The company had more or less ten creative teams consisting of five persons each. There were also art directors and creative heads that required internet access. Logistically IT departments became stretched as they needed to connect employees and had to ensure that all the hardware was integrated. Software issues relating to licences, upgrades and conflicts of programs at a cost to the company presented further challenges.

> *Our strat [sic] and the way we gather insights, um, especially in the beginning of lockdown where everyone really couldn't go out, from a production perspective, the way we shoot on set has changed and the financial implications of that have been quite huge for us.*

The initial lockdown also brought about workflow and idea exchange challenges. What initially was an interactive boardroom meeting with a creative team, a client director, a service provider and a client, now became an online platform where participants would see a few faces and hear a few voices. Individuals could log in but nonetheless busy themselves with other responsibilities and activities and not actively participate in the meeting. Online meetings became unmanageable as conversations would run over each other. Brainstorming sessions excluded the creative connection that is only possible where everyone is present in the same room. Work rate became a major issue as designers and art directors would decide for themselves when they would work and engage each other. This flexible but incongruent work style meant that some members of a creative team may still be in bed while others worked through the night. Accountability and work ethic became a risk, and management needed a way to control this. However, the design and integrated marketing and communications industry have project management and workflow systems in place. It became about synchronising the workflow to ensure time was not wasted while the team relied on absent and unavailable personnel.

> *I think the traffic delivery programme people have really suffered and I think any of the creative leads like a creative director in ECD, they battled because they … they constantly … trying to do these creative reviews online without being able to sit and engage and interact and I think they've battled with that.*

The hard lockdown effectively lasted for six months, and gradually, with an array of restrictions and precautionary measures still in place, people were once again allowed to more freely venture into the outside world. By this time, however, the organisation had settled into a new way of working, or the Next Normal. The current thought is that the staff would return for two days a week to improve interpersonal interaction and increase work accountability and throughput. The increase in email and digital communication increased exponentially, which meant more time was spent sifting through emails. It also resulted in some content potentially being overlooked and becoming open to misinterpretation. Work descriptions and thus boundaries were blurred. This meant that more meetings could be slotted into the workday, robbing staff of actual creative work time and later hours to execute. It also meant that the more responsible co-workers would pick up the slack as some others retreated behind their screens. Creatives were even more challenged as they needed more engagement and time to evaluate briefs. Administrative functions were less impacted as these were already desk-bound.

The price of COVID-19

While the dissonance of new work methods and approaches played out, the hard lockdown sharply impacted consumer and buyer behaviour. Specific industries came to a complete standstill while others grew comprehensively. Flight and travel and the hospitality industry shut down while FMCGs, i.e. fast-moving consumer goods like basic foodstuffs, grew in demand. The impact of this found its way into the design and integrated communications industry. Some work dried up, while others grew in revenue. The result was thin creative teams in areas where work dwindled and redeployment to where workloads increased.

Staff downsizing was the most significant COVID-19 response as product sales shrank, negatively impacting the commensurate retainers linked to these sales. The respondent indicated that one of their fast-food clients lost 30% sales, and thus their work retainer shrank contractually by the same percentage. This client decided to insource digital expertise at half of the outsourced cost, thus forcing Ogilvy to rationalise its digital capacity. Fee structures were similarly negatively affected. Clients interrogated the hours and rates, looking where they could reduce their costs. Nicole Dickens observed that:

> *We had to reduce our fee and our staff compliment … still in the processes of negotiating what that team looks like now ... We've had to rationalise … it's not just from the initial lockdown and initial fee cut, it's everyone is going to the next fee discussions with huge trepidation because now they are not on thirty per cent fee, they are thirty per cent sales down.*

Payment terms also became an issue. Where traditionally 30 days were allowed for payment, 60 or even 90 days suddenly became the norm on invoices. Liquidity became a shared challenge between what the client had in the bank and what the organisation had to pay its staff. Costs linked to courier services, internet access, cellular phones and short-term insurance also increased.

The effect on human resources and the mental and physical health of staff

The pandemic took its toll on human resource management. Contracts and job descriptions were at stake, while working hours and staff attendance were closely scrutinised. A good example was the traffic manager, whose traditional function was to chase work briefs through the various layers of the organisation. In most cases, this was done physically by moving paperwork and briefs from one desk to another. With the advent of COVID-19, these roles were redefined as that of project managers who worked as remote facilitators bringing together the various skills within the organisation on a particular project.

The pandemic and the promulgated protocols for meeting in person meant that any public gathering to execute creative work would have to comply with the necessary and prescribed requirements, precautionary measures and formalities. The number of individuals working on a television commercial, generally requiring 75 people, was reduced if the venue had restrictions on occupancy.

> *The shoot costs now are … are becoming a little bit prohibited because what the … the, you know, the directors need to provide for a medic on shoot, um, all the protocols need to be followed … which adds an extra day to the shoots … which adds an extra day's worth of costs.*

Medical staff needed to be present to check temperatures and keep record of all the participants. This meant adding extra days to shoots to manage all the procedures that needed to be adhered to. Other challenges faced by the organisation related to the sourcing of music and other rights to use copyrighted material. Whereas normal timeframes would span six weeks, it now became ten weeks and longer as the organisation needed to deal with other organisations globally who were also fundamentally locked down. Sony Music, as an example, had lain off staff. Although they had skeleton staff in place, some business relationships simply no longer existed, and new people had to deal with the paperwork. The organisation eventually resorted to using stock footage, stock imagery and stock music to reduce the standard production length of a television commercial.

The next normal

The impact of COVID-19 meant that clients began to direct their attention to their relationship with customers, marketing, and e-commerce to deliver their products and services. Clients also began to insist on using their in-house social media platforms to avoid traditional marketing platforms like print and radio and television. This meant the organisation could not rely on the commissions obtained by placing advertisements in these media channels. Direct email campaigns increased, and e-commerce as a marketing tool accelerated. If anything, COVID-19 accelerated the migration to digital communication strategies as both a cost-saving device and a way to reach the intended target market.

Nicole Dickens acknowledged that staff can and do work well offsite, and this could be structured to offset expenditures, but that human contact was still critical. As such, partial attendance at the office would be implemented going forward. Workflows will be thoroughly interrogated to speed up workflow and delivery.

> *We are also looking at implementing a workflow system to be able to help us get the stuff out and done and approved quicker online without the tons of emails going backwards and forwards.*

The pandemic certainly has made a lasting impact on the way forward in the design and integrated marketing and communications industry. The respondent indicated that their organisation will not be returning to the way they operated before lockdown and that it will definitely be managed as a hybrid or in a Next Normal-format as the circumstances may necessitate. On the question whether they would consider returning to their previous mode of operation, the interviewee stressed that:

> *No, I don't think we will … We certainly don't see a need to. We see how well people work offsite so we haven't lost productivity. My only concern is that we've lost our sanity. So, it's really affected our mental health because people battle with boundaries.*

Discussion of the results

It is evident from the results that the Level 5 lockdown and the subsequent levels thrust a tremendous amount of dissonance on management and staff within the organisation that had to adapt to and rely on a whole new set of skills. These were altogether mental, emotional, and physical in their experience and required both creative and time-management solutions. Money also became a critical issue as the organisation grappled with identifying and subsequently navigating the best way forward. Additional money on hand was necessary to navigate crises through additional data, call time, courier, insurance, and technology solutions. The creative individual was forced to take a hard look at their time and ethical management principles, realising that ethically no one was watching over their work ethic and time management.

Furthermore, the impact of COVID-19 would have impacted the organisations' leadership structure with business direction and management being strained and, in some instances, performed in a less than optimum manner. The employee would have felt the impact of less than perfect management skills, and the manager would have felt the impact of less than perfect employee compliance. Some of the challenges faced by the employee and employer can be summed up in a number of key areas, namely mental health, time-management, quality of work execution, technology adaptation, teamwork abilities, client management, cost containment, workflow management, the impact of the employee and employer's home life on work, and delays. Traditional design and integrated marketing and communications organisations rely heavily on face-to-face engagement, especially on creative development and workflow management. Client engagement that traditionally used email and telephone had now become more remote.

A golden thread that ran through all that was observed was the move to and strong reliance on technology. Cyberspace was the common variable in communication, brainstorming, and collaboration and that is why the company decided to move to the Next Normal. The United Nations even went on to define technology and digitisation as a 'human right' during COVID-19 lockdown periods (UNDP, 2020:22).

The next normal for design education

This study has shown that design students, against the backdrop of the COVID-19 pandemic, had to and will for the foreseeable future need to master specific, additional skills to succeed in work. However, these requirements can change rapidly, just as the skills requirements changed with the outbreak of COVID-19. How do we as design educators prepare our students for an unpredictable, ever-changing work environment?

1. First and foremost, we must prepare students to work in an isolated, online work environment. This demands strong self-management skills. Design education must further consider small online didactical practices and endeavour to develop students' self-motivation and self-management skills. Furthermore, students will need a comprehensive knowledge of digital platforms, design software, and workflow systems. Rapid technological changes make it even more critical to prepare students to be active, effective, and independent lifelong learners (Schiller, 2013, p. 185). However, moving design education online will not be without challenges – a digital divide exists, sharply delineating those with and those without readily available access to the internet (James, 2021).
2. Design students who seek to enter the industry must change their, traditionally speaking, accepted and established perception of what joining an organisation would entail. According to Eraut (2004), one of these perceptions is that most learning happens at the workplace. However, following the outbreak of COVID-19, creative companies went from being a tight-knit team where mentorship is face-to-face, skills are transferred by looking over an experienced shoulder and having the creative director glance at work to provide input to a situation where the newly employed student could very well be working unaccompanied and, to a certain extent, unsupervised. The physical business culture, work ethic, and critical work environment where learning occurs are no longer there (or is only available in a much-altered configuration). A student seeking employment must have remote work experience before joining their first organisation. Such a student needs more self-confidence and is more proactive by nature. He or she will have to manage their own

time and deal directly with the client and even be involved in cost containment, which traditionally was not the responsibility of a junior designer. These requirements place greater demands on design educators to rethink conventional and long-established educational approaches. The intention of this paper, however, is not to suggest nor champion a specific teaching method, but rather to encourage design educators to develop lifelong learners capable of functioning in a design industry with demands dissimilar to what has gone before, to what many has become accustomed to, and which may again change at a moment's notice.

3. Design educators must provide design students with resources and processes to explore, discover, construct, and develop within different situations (Rooth, 2000). Design educators can achieve this by initiating learning, thus getting students involved in experiencing a design challenge that would include all the industry challenges discussed in this study. These challenges would create a need to learn through searching for meaning. Design students must engage in the learning process, and design educators must, concomitantly, encourage them to construct meaning. After that, learning must be maintained by ensuring that students continue to learn until they reach the best quality of learning (Slabbert, et al., 2009, p. 102).
4. A few years ago, educational experts stated that it is of utmost importance that we design productive learning environments and learning tasks (Slabbert, et al., 2009, p. 105). This observation is still valid, but COVID-19 drastically changed our learning environments, and we did not have any control over the design thereof. We intuitively turned to technology, and interactive video communication became prevalent during this time, seeing as video communications offer plausible communications systems that convey image formation faithfully to ensure personal expression (Kodama, 2020). We now have to take control of and embrace these new learning environments to secure and build on the newfound connectivity with our students. However, we cannot rely on technology alone to develop and sustain this newfound connectivity. We also have to design online environments with the authentic context in mind. In other words, it is not enough to give examples of real-life situations when we educate. We also need to provide the purpose and motivation for learning in this new complex learning environment by encouraging students to collaborate and reflect on their own learning in the online environment – only in this fashion can we properly construct meaning. Conversely, research also revealed that learning management systems like Blackboard and Brightspace could be ineffective for learning since these platforms are used to place information and not to initiate or encourage learning (Herrington, 2006). To steer clear of this pitfall and achieve the desired learning outcomes as described in this study, one thus needs to design appropriate, meaningful and authentic learning tasks.
5. The learning task is a crucial component to ensure authentic online learning, and it requires persistence, competence and experience from the educator. The educator must design activities as close as possible to real-life tasks and briefs. These tasks must be open to multiple interpretations to allow the student to examine the problem from various theoretical and practical viewpoints. Activities must encourage collaboration through promoting interdisciplinary perspectives. These tasks furthermore need to equip and empower learners to make decisions and reflect on their learning as individuals and as social beings (Herrington, 2006).

COVID-19, in conclusion, has had and continues to have a significant effect on the design industry and design education. Design educators now have a duty to apply these newly established industry requirements to ensure design education's long-term, continued and sustainable relevance to the design industry. However, the way design educators convey these requirements is crucial since they have a tendency to change continuously. COVID-19 set in motion a rapid and enormous change, as indicated by this study, but the industry has and will continue to constantly adapt itself due to technological developments and shifts in cliental demands. Something as drastic as COVID-19 can and in all likelihood will happen again. If not, however, design educators still need to ensure that they help create independent lifelong learners that can comfortably and quickly adapt to changes in the work environment.

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Positioning Afro-diasporic speculative design episteme in South African higher education institutions

Anthony Terah Ambala, *University of Johannesburg*

Abstract

The watershed Decolonial and Fallist movements in South African universities have reawakened and reignited the necessary, urgent, and compelling need to foreground and position Afro-diasporic episteme in South African university curricula and everyday practice. This article posits that centrally positioning Afro-diasporic Speculative Design (ASD) episteme in South African higher education design institutions, without necessarily displacing or subordinating other knowledge lenses, could positively contribute to engaging with some of the concerns raised by the Decolonial and Fallist movements in design pedagogy and praxis. It contends that African, and its diasporic, speculative designs draw on the retrospective but also project into the future. It sees this as a confluence between critical and technical design lessons, insights, and inspiration from the past and imagination, projection and visualization into the future. The article proposes that failure to engage with ASD or other Afro-diasporic episteme has the potential of excluding certain knowledge systems, especially from the Global South, from design education curricula therefore denying students an important design lens for their work.

This article lenses these design inspirations on two Afro-diasporic movements, Négritude, a movement that it sees as speculating on a probable past and Afrofuturism, which speculates on a plausible future. It draws parallels between these two movements and the Decolonial and Fallist movement identifying similar progression from alienation to revolt, followed by novelty and invention, and through to self-affirmation and self-fulfilment, which is discussed in all three movements. Afro-diasporic scholars such as WEB Du Bois, Abiola Irele, Kodwo Eshun and Woodrow Winchester III, among others, inform the discourse in the article. It concludes that design departments in institutions of higher learning are the ideal spaces to offer platforms, tools, methodologies, and direction to inspire novelty and invention that could launch design students' journeys towards self-discovery and self-affirmation, positioning them for design journeys into the core of the fourth industrial revolution.

Keywords: Afro-diasporic, afrofuturism, decolonial and fallist movements, négritude, speculative designs

Introduction

Recent Decolonial and Fallist movements in South African universities have reawakened and reignited the need to foreground and position episteme from the Global South, broadly, and those from Afrika and its diaspora, specifically, in university curricula and everyday practice. It is of importance that majority of students who are currently in South African universities are able to see, and believe, that they are capable of being central and integral protagonists in shaping and participating in knowledge generation and design solutions not just in our contemporary times but more importantly, in the future. Eshun asserts that “the powerful employ futurists and draw power from the futures they endorse, thereby condemning the disempowered to live in the past (Eshun 2003, p. 289). Speculating about a probable and possible future, as Eshun asserts, is no longer simply a creative endeavour. It plays a significant role in managing and shaping power.

It is over a century since seminal scholar and civil rights protagonist, WEB Du Bois (1906, p. 2) coined the term double-consciousness, which he described as “this sense of always looking at one’s self through the eyes of others, of measuring one’s soul by the tape of a world that looks on in amused contempt and pity. One ever feels his two-ness […] two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body whose dogged strength alone keeps it from being torn asunder”. This sense of double-consciousness persists, for majority of South African design students, for as long as the epistemic lenses they encounter in lectures and other academic spaces, and use to design and to problem solve, are almost exclusively from the Global North. There is an urgent and compelling need to offer knowledge and design lenses from Africa and its diaspora to South African design students, not necessarily to displace and subordinate other knowledge lenses, but to facilitate equitable recognition and space within academia and design praxis.

Sengers (2018, p. 7), while discussing the designing of contemporary technologies, asserts that current design approaches may be inadvertently narrow because of the dominant design lenses, practice and focus. He convincingly proposes that “how we design technologies reflects what we value; who we think is important, and in what ways; which places, people and possibilities are in our imaginations, and which are not. Current ways of designing technologies frequently narrow these possibilities”. Winchester III (2019, p. 56) concurs, he asserts that it is equally important for designers to be mindful of the sociocultural implications of their practices and designs even as they focus on the technical aspects of these designs. He argues that many contemporary designers are often not sufficiently equipped to grapple with non-technical aspects of design. He sees this narrowed perspective as potentially resulting in “a more monolithic view of both user and context of use that could lead to technological solutions that are devoid of any responsiveness to the needs and considerations of socio-culturally diverse groups (Winchester III, 2019, p. 56). It is imperative that South African universities’ design curricula and praxis foreground and reflect all design knowledge, spaces, communities and, perhaps most importantly, possibilities, that are important. I emphasise ‘possibilities’ as this is central to imagining and speculating into, and about both the past, as well as the future, a core argument in this paper.

How then do South African design institutions, faculties and departments cultivate not just fleeting optimism for our design students’ and practitioners’ design practices, but a sense of feasible and plausible futures in which they see themselves as central and integral protagonists and not just as part of a supporting or peripheral cast? What approach or curriculum content could reflect what South African design institutions value; who they think is important, which ways, places, people and possibilities are in designers imaginations? How can we identify theories or knowledge sources that could lens design education and praxis in South African design institutions?

As one potential pedagogic trajectory, this paper posits that centrally positioning Afro-diasporic Speculative Designs (ASD), could positively contribute to engaging with these challenges. As the terms suggest, ASD is premised on speculative designs from Africa and its diaspora. Wong and Khovanskaya (2018, p. 2) define speculative design as “critically oriented research practices that create artifacts, representations, or depictions of possible and often alternate futures, removed from immediate practical concerns of implementation and commercial viability”. They see speculative designs taking on several forms, which may include design proposals and built artefacts “used to imagine alternate sociotechnical configurations of the world as a way to interrogate questions about values and politics through design”. Dunne and Raby (2013, p. 2) note that speculative design,

> *… thrives on imagination and aims to open up new perspectives on what are sometimes called wicked problems, to create spaces for discussion and debate about alternative ways of being, and to inspire and encourage people’s imaginations to flow freely.*

They contend that speculative designs are premised on a possible future that can be used to better understand the present and to discuss the future that people want and those they would want to avoid. Dunne and Raby (2013, p. 3) argue for an interdisciplinary approach for a more holistic and rounded methodological approach for speculating through design. For them, design speculation should “draw on other fields such as cinema, literature, science, ethics, politics, and art; to explore, hybridise, borrow, and embrace the many tools available for crafting not only things but also ideas—fictional worlds, cautionary tales, what-if scenarios, thought experiments, counterfactuals, reductio ad absurdum experiments, prefigurative futures, and so on”.

A number of speculative design discussions and definitions focus on the future and how this future relates to, or is informed by the present. This article argues that the future is intricately and cyclically intertwined with the past and that it is not only possible but also necessary to speculate about a probable past especially in instances in which deliberate and systemic attempts have been made to subordinate, stifle or erase these pasts by systems such as slavery, colonialism and apartheid. It becomes increasingly important, in these contexts, for designers to speculate about probable pasts so that these speculations can contextualise possible and plausible presents and futures.

Afro-diasporic speculative designs therefore refer to designs that speculate or fictionalise on pasts that are probable, an alternative present that is plausible and believable, and futures that can be inspired by, emerge from and feature people, philosophies and designs from Africa and its diaspora. This paper posits that Afro-diasporic, speculative designs draw on the retrospective but also project into the future. It sees ASD as a confluence of critical/theoretical and technical lessons, insights and inspiration from the past and imagination, projection and visualisation into the future.

This article will be discussing two Afro-diasporic lenses that could offer a theoretical foundation for design pedagogy in South African design institutions. It looks at Négritude, a movement that it sees as speculating on a probable Afro-diasporic past and Afrofuturism, which speculates on a plausible future. Although the focus in this article is on these two theoretical lenses, it is acknowledged that there are several other Afro-diasporic theories, movements and frameworks that could offer a lens through which speculative designs could be understood. Some of these include, but are not limited to, the following; Black Quantum Futurism, African Futurism, Afrofuturismo, and Afrofuturista, Astro Blackness, Afro-Surrealism, Afro-Pessimism, Ethno Gothic, Black Digital Humanities, Black (Afro-future female or African centred) Science Fiction, The Black Fantastic, Magical Realism, and The Esoteric (Anderson, 2016).

Unpacking Négritude and Afrofuturism

Négritude, a literary and ideological movement, was led by French-speaking intellectuals from France's colonies in Africa and the Caribbean in the 1930s who were studying in France at the time. It emerged from experiences of oppression and discrimination by these students who saw the need to revolt against the dominant discourse in France at that time and challenge stereotypes about people of Africa and its diaspora in order to create a new black consciousness. The movement's founders, generally referred to as the fathers of Négritude, were poets Aimé Césaire from Martinique, Léopold Sédar Senghor from Senegal and Léon-Gontran Damas from French Guiana. Senghor (Mazrui, 2014, p. 111) explains Negritude as "the whole complex of civilised values – cultural, economic, mythmaking, the gift of rhythm, such are the essential elements of negritude, which you will find indelibly stamped on all the works and activities of the black man".

Irele (1965, p. 499) opines that "no better phrase could be found to sum up [Négritude's] double nature, first as a psychological response to the social and cultural conditions of the 'colonial situation', and secondly as a fervent quest for a new and original orientation". He argues that Négritudes' imaginative work offers a precious testimony to the human problems and inner conflicts of the colonial situation and that their propaganda writing, their choice and use of techniques such as Afro-surrealism and other activities represent an effort to transcend the immediate conditions of this situation that they found themselves in, by a process of reflection. He asserts that the kind of work that emerged from Négritude's proponents symbolically demonstrated a sense of progression from subordination to independence and that the work had an overarching trajectory that evolved from a place and space of alienation to a demonstration of revolt and eventuated in self-affirmation.

Afrofuturism, a term coined by cultural critic Mark Dery in an African-American context in 1993 has evolved over the years and can now be defined as a philosophy and aesthetic that uses the tools and tropes of science fiction, as well as African and its diasporic references to confront and analyse contemporary concerns faced by people of colour. It lies at the intersection of black cultures, imagination, liberation, and technology (Winchester III, 2018, p. 42, Elia, 2014, p. 83). Eshun, who argues that power functions through the envisioning, management, and delivery of reliable futures, asserts that Afrofuturism provides opportunities for "recovering the histories of counter-futures created in a century hostile to Afro-diasporic projection and as a space within which the critical work of manufacturing tools capable of intervention within the current political dispensation may be undertaken". He contends, "power now operates predictively as much as retrospectively" (Eshun, 2003, pp. 289,301). His assertion is that Afrofuturism, as a philosophy, provides a space to challenge and deconstruct dominant narratives that offer certain histories as the most plausible, and premised on this, project a particular future as the most probable. Afrofuturism therefore has the potential to de-stabilise narratives that have relegated Afro-diasporic people, experiences, and spaces to the margins of power while entrenching those from the West at the centre. He eloquently concludes that Afrofuturism, "is concerned with the possibilities within the dimension of the predictive, the projected, the proleptic, the envisioned, the virtual, the anticipatory and the future conditional (Eshun, 2003, p. 293).

Winchester III (2018, p. 42) seems to concur, proposing that Afrofuturism provides a lens for more empathic, inclusive, and impactful design solutions that facilitate engagement of underrepresented and disenfranchised groups. He sees the philosophy as providing the requisite rigour that can uncover blind spots such as biases, privilege, and power that could prevent the designer from approaching a design dilemma more holistically. Additionally, he contends that Afrofuturism has the ability to enable a more empathic design engagement by placing marginalised Afro-diasporic voices at the centre of the design narrative with the intent of universal betterment through technology.

Journeying back and into the future

Several overarching experiences, actions and intents converge at the confluence of Négritude and Afrofuturism as Afro-diasporic movements. Irele (1965), as already mentioned, identified what he refers to as a symbolic progression that the proponents of Négritude went through, which are alienation, revolt and self-affirmation. I argue that both the proponents of Afrofuturism and the students who participated in the Fallist and Decolonial movements in South African institutions of higher education went through and continue to experience these progressions. Perhaps in addition to Irele's three phases, a phase that entails novelty and invention could be added to the progression. I propose therefore that this confluence between Négritude and Afrofuturism, and to a significant extent, the Fallist and Decolonial movements in South African universities aspire for self-discovery and self-affirmation as the ultimate goal. Proponents of all three movements found, or continue to find, themselves in a context of alienation best captured by WEB Du Bois experience of double-consciousness (1906, p. 2). They then go through a phase in which they revolt against this double-consciousness which usually compels them to be novel and inventive in order to culminate into is a state of self-discovery and self-affirmation.

Alienation

Proponents of the Négritude movement, the majority of whom were Afro-diasporic students studying in France in the 1930s, found themselves in a system that did not fully accept them as members of the societies in which they lived. Irele informs us that for these students to be accepted socially in the world they lived in, they had to deny a part of themselves and conform to the ideals of the dominant French culture at the cost of repression of their original selves (Irele 1965, p. 502). This can be paralleled to the context that proponents of Afrofuturism emerged from. They find themselves in spaces in which their people, cultures and experiences are absent in probable and plausible dominant representations of futures. Where these experiences, people and cultures are included, they are either on the periphery or in supporting and fringe roles, and in many instances in pessimistic narratives of catastrophe, dystopia and futility. I argue that this was a dominant motif in the pre-1980s and 1990s sci-fi and other narratives that projected into the future.

This alienation does not only manifest in narratives and creative works but also in design and technology. Winchester III's study into the design of wearable technologies found that some designers are not sufficiently equipped to appropriately understand and address socio-cultural and non-technical aspects of their designs. He sees this narrowed perspective as leading to a limited consideration of both the design's users and the context in which these design solutions are used. This, he asserts, may culminate into technological and design solutions that are neither responsive nor considerate of socio-culturally diverse groups (Winchester III 2019: 56). He cites an example of current fitness technologies that are neither effective nor efficient for some African-American women. He draws on studies that have established that "error rates in heart rate detection are often higher for individuals with dark skin as the optical heart rate sensors used by many of these wrist-worn devices have difficulty inferring pulses rates of individuals with higher melanin levels, reflective of many Black/African-American women (Winchester III, 2019, p. 58).

The actions of the Decolonial and Fallist South African university student movements within the last six to seven years is arguably a fissure moment for the simmering pent up feelings of alienation and double-consciousness that have weighed them down. These forms of alienation, as documented in the public sphere at the height of the movements' revolt, have emerged, and continue to emerge from experiences of financial difficulties and exclusion, questions of dominant and prescribed languages of instruction, critical engagement and communication. Other sources of these students' alienation have been from a sense of cultural dislocation, subordination and ambivalence that emanate from episteme that are predominantly outside of their realities, experiences, histories and knowledge systems. These are emphasised by the ubiquitous icons, statues and symbols of power, authority and knowledge within their learning and living environment.

Revolt

Irele points out that victims of oppression can take one of two binary reactions – total submission or total refusal (1965, p. 504). Proponents of the Négritude, the Fallist and Afrofuturism movements chose the latter. The Négritude philosophy has been criticised by intellectuals such as Franz Fanon, Wole Soyinka and Ousmane Sembene, among others, as romanticising the African past and endorsing colonial stereotypes related to the intellectual inferiority of the African. Nobel Laureate, Wole Soyinka, for instance criticised the movement in a presentation at a conference in Kampala, Uganda in 1962, arguing that "a tiger does not proclaim his tigritude, he pounces". Meaning that overly focusing on a romanticised African past does not provide a conceptual framework for engaging with contemporary Afro-diasporic challenges, and that a deliberate and outspoken pride in their colour placed black people continually on the defensive.

Although there is merit in these criticisms, the stance taken by Négritude is primarily a form of revolt. An attempt to disassociate from cultures that they felt marginalised and subjugated them as a people. Romanticizing about their past could be interpreted as a suggestion that there is an alternative to the dominant discourse that they were revolting against and that this alternative could be found in their own cultures, histories and traditions. Mazrui (2014, p. 111), for instance sees some positive aspects in the movement's ideology. He argues that, "Négritude is not merely a description of the norms of traditional Black Africa; it is also a capacity to be proud of those values even in the very process of abandoning them. Sometimes it is a determination to prevent too rapid an erosion of the traditional structure". Mazrui concedes that Négritude is premised on a philosophy of nostalgia that idealises the African past but he offers that this can be used as a guide in formulating contemporary policy.

The Négritude revolt unravelled in a context underpinned by a void in conceptual or theoretical direction as the dominant discourses at the time may not have been specifically responsive to their conditions. A significant number of Négritudes were people from the African diaspora who had been torn and dislocated from continental African histories, experiences and cultures. Romanticizing about an ideal African past and reversing or deconstructing Western symbols that were loaded with negative connotations about Africa, its history, cultures and people was not only a form of revolt, it was a way of *speculating* about an African past that could provide a lens through which Afro-diasporic voices could theorise about their condition. It was, and still is, important for the process of speculative histories to gain traction as these countered Western histories that centred, and gave power to, the West while completely erasing or relegating African histories to the periphery, or loading these African histories with negative connotations. Speculation is not only a futuristic undertaking, it can and has been a retrospective process. Speculating about an ideal African past, therefore, offered a framework through which Afro-diasporic excellence and pride could be premised.

Eshun notes that seminal thinkers such as Walter Benjamin and Franz Fanon revolted against colonial power structures that relied on the control and representation of history to rationalise and entrench power on those they had colonised. He argues that this is the reverse in our contemporary times such that, “the powerful employ futurists and draw power from the futures they endorse, thereby condemning the disempowered to live in the past (Eshun 2003, p. 289). Speculating about a probable and possible future, as Eshun asserts, is no longer simply a creative endeavour, it plays a significant role in managing and shaping power.

Similar to the The Négritude revolt, Afrofuturism demonstrates its revolt by subverting and reversing narratives, contexts and designs that completely erase or relegate the Afro-diasporic condition to the periphery, or by loading these African symbols with positive and aspirational connotations. These subversions can be seen in Afrofuturist works such as sci-fi films, fashion design, photography and architecture, among several other design and creative works. Kenyan filmmaker Wanuri Kahiu in her film *Pumzi,* for instance, revolts against pervasive representations of the future in science fiction films that predominantly position African women in peripheral characters. She chooses to place women in key archetypal characters such as the film’s hero Asha, the hero’s key ally the Cleaner and the antagonists – the three Maitu women council members. The protagonists revolts against authority in Maitu in her quest to search for life outside the confined spaces of the Maitu community. The film’s resolution similarly subverts dominant dystopian narrative structures by having the protagonist sacrifice herself for liberation, freedom and improved quality of life.

The South African University students’ Fallist and Decolonisation revolt has, and continue to, manifest in several ways. Some of these ways include critical and academic engagement with their concerns, others have taken expression through poetic, creative and design work while some of the most visible ways have taken on a very public performance of revolt through demonstrations and destruction of icons and statues that represent oppressive forms of power.

Novelty and invention leading to self-discovery and self-affirmation

The quest for Afro-diasporic self-discovery and self-affirmation cannot be achieved merely by revolting against power, it must embrace an approach that uses novelty and invention to advance and eventually achieve its objectives. The Négritude for instance used surrealism as one novel approach to advance their course. Irele notes that, “the surrealist technique is here employed in a manner appropriate to the alienated condition of the black man. It offers the black poet a means of projecting his dream of violence, and becomes in fact a symbolism of aggression” (1965, p. 506). Although surrealism has its roots in the West, the concept is very relatable in African contexts as religious, medicinal and cultural processes operate within surrealist realms.

Architect Diébédo Francis Kéré from Burkina Faso was commissioned to design the iconic tree-inspired Serpentine Pavilion erected outside the Serpentine Gallery in London. The novel and inventive Afrofuturist architectural design is made of “an indigo-blue structure with a latticed canopy and a courtyard at its centre that will be transformed into a waterfall when it rains (Mairs, 2017). The work inventively uses traditional African building methods and materials and is inspired by African cultures and symbols. Kéré says that the design concept was inspired by the form of a tree in the [African] landscape and references the idea of a tree as a gathering space as commonly practised in African communities. In one of his interviews, Kéré concedes that, "Maybe naively, we wanted you to be still connected to nature. As you enter this pavilion you will see the trees, you go inside this void and you will have the connection to the sky” (Mairs, 2017).

Novelty does not only entail technique and design products, it arguably also entails promoting methods, processes, methodologies and persuasive conceptual arguments that can be used by designers to develop their work. Winchester III (2018, p. 42), for instance, proposes that "Afrofuturism represents a means by which diverse solution possibilities can be cultivated and realised, expanding the solution space both in novelty and, equally as important, inclusivity. He emphasises that failure to follow appropriate processes could lead to designs that are stereotyped and biased against those on the margins.

Conclusion

Just like proponents of Négritude and Afrofuturism who found themselves living in contexts of alienation, the protagonists of the Fallist and Decolonial movement in South Africa have the ultimate quest of journeying to a point of self-discovery and self-affirmation. This article has argued that Afro-diasporic speculative design could offer the vehicle through which this journey could be travelled. It concludes that institutions of higher learning in South Africa are ideally positioned to offer platforms, tools, methodologies and direction lensed from Afro-diasporic Speculative Design episteme for novelty and invention that could launch student's journeys towards self-discovery and self-affirmation.

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Digital design ethics

Pia Findlay, *University of Johannesburg*

Abstract

As a socio-technical field, design has always been intertwined with the industrial revolutions. During the continuous growth of the fourth industrial revolution (4IR) in South Africa, it is prevalent for design education to reevaluate what is taught to young designers.

Through the spread of COVID-19, South Africa has experienced an increased use of digital technology within education, work, and leisure time. The access to platforms such as Facebook, Google, YouTube, and Netflix has grown. While the spread of access to information technologies should be encouraged, this paper reveals the problematic designs of digital platforms such as these. The ways in which these digital designs exploit human biases and behaviours are exposed. These designs have caused an increase in the 'time spent on device', social anxiety and addiction to technology that benefits these conglomerates.

Design ethics frames designers as responsible for the products they create. Designers are viewed as agents for social change, as advocates of product users and as mediators between customer, manufacturer, user, and environment. Design can be viewed as a field of agency for improving digital spaces within the rapidly changing environment of 4IR.

This paper explores how digital platforms have exploited human behaviour and advocates for the inclusion of digital design ethics within the South African design curriculum as a method of encouraging the design of digital platforms that serve human needs.

Keywords: 4IR, design education, digital design, ethics, South Africa

Introduction

"Humans were always far better at inventing tools than using them wisely" (Harari, 2019, p. 16). As the fourth industrial revolution has taken a global hold and new technologies are invented, the importance of designing tools that take humans and their need into account is prevalent.

This paper aims to exemplify the need for digital design ethics to be included within South African design education as we move further into the fourth industrial revolution. This need is illustrated through examples of poor digital design that are viewed through a behavioural design lens.

Although there are multiple facets to the ethical issues that surround digital spaces (Borenstein & Howard, 2020), this paper hones in on those that exploit human nature. By exploring human behaviour in comparison to designs that have manipulated these, this paper argues for the inclusion of digital design ethics in South African design education as a method of guiding the creation of a digital world that serves humans, rather than exploiting them.

After going into the changes that the field of design has experienced throughout the Industrial Revolutions, this paper hones in on the South African context and explores how the ongoing COVID-19 pandemic has accelerated the fourth industrial revolution within the country. After pinpointing the need for ethical consideration within growing digital spaces, the paper explores human behaviour. Richard Thaler and Cass Sunsteins' (2008) *Nudge*, Alain de Button's (2014) *Status anxiety* and Natasha Schull's (2012) *Addiction by design* are used as behavioural theories. These theories are placed in comparison to Tristan Harris' (2016) blog *How technology is hijacking your mind – from a magician and Google Design Ethicist,* in which he criticises the design of digital platforms.

The term design is used broadly and with no reference to a specific design field, as it is predicted for the fourth industrial revolution to impact all disciplines (Harari, 2019). It can therefore be assumed that designing for digital spaces will become a reality in all design fields. As the topic of ethics falls within theoretical discourse, it can be applied to all design education fields.

COVID-19: Accelerating 4IR in South Africa

Design is defined as a socio-technical field, which is inseparable from human development, making the evolution of design inseparable from the industrial revolutions (Ferrari, 2017). The First (mid-eighteenth century) and Second (late nineteenth century) industrial revolutions harnessed the capacities of steam and electricity to mechanise and accelerate production (Schwab, 2017). This transformed societies from being primarily agrarian to becoming industrial and capitalist (Schwab, 2017; Ferrari, 2017). The role of design during these two revolutions was predominantly to understand materials and manufacturing processes to enable mass-production and consumption (Ferrari, 2017). The nature of design, however, shifted during the second half of the twentieth century through the emergence of electronic and information technologies (Schwab, 2017; Ferrari, 2017). The third industrial revolution evoked a post-industrial repositioning of society, which meant the role of design moved from being production-centred to including the role of service (Ferrari, 2017). The fourth industrial revolution, which has been building onto the third since we entered the third millennium, is described as the amalgamation of digital, biological, and physical fields (Schwab, 2017). While the effects of the current revolution take an international hold, it is relevant to debate how the role of design will evolve and the impact this change should have on design education.

Although South Africa, as a country in the global south, does not have the widespread access to the internet visible in the global north (Kemp, 2021), the South African government has taken the global rise of 4IR into account. Intentional advances in policies and government objectives, such as the Presidential Commission on 4IR (Government of South Africa, 2020), have been made to better prepare South Africa for the changes that are expected to take place within the job market (Adelabu & Campbell, 2020). Taking the changes of South African policies into account, it would be relevant to look at how the field of design will be impacted by 4IR and in turn how design education within South Africa should be adjusted accordingly.

While only around 65% of the South African population has access to the internet (Kemp, 2021), the spread of the ongoing pandemic COVID-19 has arguably accelerated the accessibility to digital information throughout the country. In March 2020, South Africa experienced its first lockdown, during which non-essential businesses, schools and universities were shut down (Government of South Africa, 2021). Although the majority of South African schools are not equipped with 4IR learning tools, the government partnered with various national sectors that allowed virtual learning to become a reality (Mhlanga & Moloi, 2020, p. 5). A collection of television and radio stations were dedicated to education of primary and secondary school (Mhlanga & Moloi, 2020, p. 5). Various network providers offered zero-rated applications and websites that were used within university education (Mhlanga & Moloi, 2020, p. 6). Some tertiary education sectors made use of free social media platforms in order to communicate class content (Mhlanga & Moloi, 2020, p. 7). Even after the lockdown restrictions were eased, many schools and universities continued making use of online learning. Applications such as Microsoft Teams, Skype, WhatsApp groups, and Zoom have become an integrated norm in South African education (Mhlanga & Moloi, 2020, p. 8). Apart from much of traditional education having moved online, there is also a strong emergence of distance learning, as well as Massive Open Online Courses (MOOCs) (Gallagher & Palmer, 2020).

Apart from an increase in the use of digital platforms for business and educational purposes, there has been a national increase in the use of social media within the last year (Kemp, 2021). Due to the reduction of social events and the restrictions on human movement caused by the ongoing pandemic, there has been a drastic increase in leisure time spent on screens (Zhao & Zhou, 2021). COVID-19 has acted as an accelerator of 4IR, integrating digital technologies into the social norm.

The radical transformation leaves much uncertainty around how technological advances will impact the future. Many jobs that exist today will become redundant, jobs that do not exist yet will come into being, and even the prospect of a life-long career in the same field is speculated to become unconventional (Harari, 2019). This begs the question; how should education systems adapt to this ever-changing landscape? It is evident that South Africa will not be left behind by the changes brought with 4IR. The socio-technical field of design will likewise evolve with this industrial revolution. It is therefore prevalent for South African design education to evaluate what is taught to the new designers who will shape the digital world.

Design ethics

While the technological world rapidly progresses, the law lags behind (Tricoles, 2019), causing the decisions made within the digital evolution to be widely unregulated. As a way of guiding design outcomes in uncharted territory, ethics can be used as a means for making digital design decisions. “Ethics are the set of moral principles that guide a person's behaviour. These morals are shaped by social norms, cultural practices, and religious influences” (Lumen Learning, 2021) which means they are contextual and therefore fluid.

The idea of designers being held accountable for the impact their products have is a relatively new concept. In 1971, Victor Papaneck begins his book *Design for the Real World* with, “there are professions more harmful than industrial design, but only a very few of them” (1971, p. ix) – a then novel idea. He argues that the evolution of mass-production gave the profession of design the power to shape products and environments that mould society. Consequently, the wide-reaching negative impact of design (such as unsafe-cars that have killed millions and the pollution created by mass-production) warranted the urgent need for ethics to be included in the design curriculum (Papaneck, 1971). Papaneck asserts that designers carry a strong social and moral responsibility and that the skills to become a designer need to be carefully taught (Papaneck, 1971, p. ix). He urges design to be viewed as a cross-disciplinary field that includes research in order truly to serve human needs (Papaneck, 1971, p. x). As a designer, “you are responsible for what you put into the world. And you are responsible for the effects those things have upon the world” (Montiero, 2019).

Since then, this opinion has been more widely adopted within the field of design. This is exemplified through developments such as Hippocratic oaths for designers that create an ethical standard designers can hold themselves by (Montiero, 2019, pp. 19-24; Borenstein & Howard, 2020, p. 63). Furthermore, David Berman's book, *Do Good Design*, frames design as a social responsibility (2009) and similarly, Kane discusses the need for morality in design, as a field that influences sustainability, society, and culture (2010).

Rooted in Papaneck's *Design for the Real World*, UX designer Mike Montiero, critically looks at how problematic designs have spilled over into digital spaces and speculates on the ethical responsibility designers should hold over their digital products (Montiero, 2012; Montiero, 2019). Being a designer does not only include the activity of creating, but should include the skill of gathering information (Montiero, 2012, p. 8). To be a designer, it is necessary to understand who one designs for, what their needs are and how one's designs will be used (Montiero, 2012, p. 8). Furthermore, Montiero illustrates designers as gatekeepers with agency and choice over what they create, even when it is being created for a client (Montiero, 2012, p. 9). It is a designer's responsibility to advocate for the people that use or are affected by the products or services they develop (Montiero, 2012, p. 9).

As we move through the fourth industrial revolution, it becomes increasingly important for the field of design to be regarded as a field of agency within the transformation of society. Designers arguably function as mediators between client, manufacturer, society, and the environment. It is therefore important for design education to guide the ethical decision making of young designers. In order to illustrate the need for the inclusion of digital design ethics within the design curriculum, the following section exemplifies the ways in which digital design currently exploits human behaviour. To mitigate this in the future, design education should equip students with the ability to gather information on how humans interact with technology, what they need from it and how one can, through design, create a world in which humans are served by a digital space, rather than exploited by it.

Digital disasters

People like to think of themselves as always making logically decisions. This, however, is mostly not the case, since to be human means predictions and decision making can often be flawed and biased (Thaler & Sunstein, 2008, p. 7). Much of this is due to the two thinking systems of our brain function: automatic system and reflective system (Norman, 2013, p. 49; Thaler & Sunstein, 2008, p. 21; Dare, et al., 2018). While our reflective system is deliberate and self-conscious, our automatic system is instinctive and subconscious (Norman, 2013; Thaler & Sunstein, 2008, p. 21; Dare, et al., 2018). Decisions are often made on an emotional and subconscious level, influenced by feelings that trigger and motivate behaviour (Dare, et al., 2018). This means that the actions we perform are often not deliberate and we therefore do not always think and choose well. This also means that our behaviour can be influenced by design and are therefore "nudgable" (Thaler & Sunstein, 2008). The ability for automatic thinking to be impacted by design, has been the basis for the type of data collected on human interaction with digital technology. User profiling lends itself to the exploitation of the human subconscious (Bilal, et al., 2019), making ethics within digital design a necessity for creating digital technology that serves human needs.

Sticking to the status quo

According to Thaler and Sunstein, human behaviour is influenced by what is coined the *status quo bias* (Thaler & Sunstein, 2008, p. 37). This means that humans are most likely to stick to their current circumstances even when illogical, whether it is always sitting in the same chair within a classroom or continuing to subscribe to a magazine they don't read (Thaler & Sunstein, 2008, p. 37). This tendency results from both subconscious choosing, as well as the fear of losing what we already have or are accustomed to (Thaler & Sunstein, 2008, p. 38). Having to focus on changing what we are used to, requires conscious effort, which takes time and energy (Csikszentmihalyi, 2002, p. 30). This behaviour means that, "default options […] act as powerful nudges" (Thaler & Sunstein, 2008, p. 38). Similarly, the phenomenon of *anchoring* acts as a strong guide to the choices people make (Thaler & Sunstein, 2008, p. 25). *Anchoring* refers to the method of presenting someone with an option or a default and knowing that even if they diverge from that option, the choice they make will be closer to the default than if they had chosen without influence (Thaler & Sunstein, 2008, p. 25).

Technology ethicist, Tristan Harris, takes a closer look at how the design of digital platforms influence our behaviour and exploit our psychological vulnerabilities. After leaving his position as a design ethicist at Google in, Harris co-founded the *Center for Humane Technology* (Human eTech, 2021). In his influential blog, he explores the phenomenon, "if you control the menu, you control the choices" (Harris, 2016). The choices presented to us, guide our actions and we often fail to question why we are presented with certain choices, what other options exist and what the providers' intentions are (Harris, 2016). We tend to feel empowered by the quantity of choices, but neglect to question what other menus exist (Harris, 2016). The choices we are presented with can distract us from our original need (Harris, 2016). The menus in digital spaces have influenced human behaviour. Responding to emails has turned into selecting automatic replies instead of finding more effective ways of communicating. Looking for someone to date has become swiping through a wide selection of faces on Tinder instead of attending local events.

It is important to distinguish user needs from the provider's intentions. Harris compares the design of digital platforms to the layout of grocery stores (2016). Although milk is the most commonly purchased item, it is almost always placed at the back of a grocery store, making all shoppers walk past other items on the way to their intended purchase (Harris, 2016). Using the same method, one cannot make a Twitter post without having to see the news feed. If one is looking for an Event on Facebook, one has to view the homepage filled with new posts first. Likewise, it is often made more difficult to choose an option that is misaligned with a platform's intention, such as unsubscribing – often an inconspicuous button in a smaller font at the bottom of a spam email or hidden in a maze of option tabs within an unwanted app. These options are purposefully designed to be less visible and difficult to follow.

FOMO

A further strong influence on our behaviour is our need to fit in. Philosopher, Alain de Botton explains in his book *Status Anxiety* that we worry "that we are in danger of failing to conform to the ideals of success laid down by our society" (2014, p. 4). This anxiety is provoked when we compare ourselves to others, fearing that we are unable to persuade society of our value (de Botton, 2014, p. 5). This phenomenon has been coined the term FOMO (fear of missing out) and is commonly provoked through digital design (Cambridge Dictionary, 2021).

Social media is often designed to exploit this vulnerability of social anxiety (Harris, 2016). People increasingly judge social approval based on how people interact with one on social media (Harris, 2016). Platforms like Facebook and Instagram encourage this through the creation of likes, tags and comments. Snapchat lists the number of images you have sent as a gauge of popularity. The platform also includes streaks which list how many uninterrupted days one has sent images to another person. These platforms have been designed with these metrics, which have become a method of measuring social value.

To further increase our FOMO, many of our devices are designed to convey a feeling of urgency (Harris, 2016). App notifications are instant and often set with default sounds, vibrations, home screen light-ups. These notifications range from a phone call to a change in weather. Notifications are immediate and constant, providing one with the feeling that one is constantly missing out on something (Harris, 2016). A further design that creates FOMO is the ability to see if someone has read your message. Not only does this cause social anxiety when one is ignored ('blue-ticked'), but it places further pressure on instantly responding to messages. Harris describes these designs as disrupting (2016). These designs disregard respect for attention and fill one's days with unnecessary interruptions that reduce attention span (Harris, 2016).

Addiction by design

Natasha Schull explores the interface between humans and machines in her book *Addiction by Design*. She focuses on the design of slot machines, which create compulsive interaction that gamblers call 'the zone' (Schull, 2012). "Time, space, and social identity are suspended in the mechanical rhythm of a repeating process" (Schull, 2012, p. 13). It is explained that this compulsive behaviour is not driven by the prospect of 'winning' but rather the escape it provides from the "capricious, discontinuous, and insecure" (Schull, 2012, p. 13) nature of the real world. Slot machines purposefully harness this human inclination through multiple design decisions. The 'game' does not end, but instead multiple patterns that indicate various types of 'wins' appear randomly and intermittently (Schull, 2012). These unpredictable 'wins' are known as variable rewards (Harris, 2016) and their unpredictability makes them highly addictive (Schull, 2012). Philosopher Don Ihde explains that in this state one cannot distinguish oneself from a technological product and experiences it as an extension of one's mental and physical abilities (Ihde, 1975).

This merger with technology is being experienced globally, as most people now carry a compact 'slot machine' in their pockets – the cellphone (Harris, 2016). To exemplify the resulting addiction, people check their phones 150 times a day on average (Harris, 2016). When analysing the design of phones, many similarities to slot machines can be observed. Most applications are designed with 'variable rewards' (Harris, 2016). We refresh our email to see if we've received a new message, refresh our Instagram pages to see what new photos have been uploaded, swipe through faces on Tinder to see if we've gotten a new match. These all have unpredictable outcomes, causing us to engage continuously with them, in case the results have changed.

A further alignment with slot machines is that many digital platforms have been designed to appear infinite, enabling endless scrolling on social media platforms. Many of these platforms such as Netflix, YouTube, and Facebook also have the feature of auto-playing the next video, removing the need for one to consciously choose to continue using their platforms. These design decisions increase our 'time spent on device' that aligns with the intention of most platforms (Harris, 2016) at the detriment of the user.

The *Center for Humane Technology* is a strong example of an organisation with the intention of investigating fundamental problems with digital design and challenging these with suggested design changes (Human eTech, 2021). The organisation offers a host of ongoing research, courses, toolkits, participatory forums that reveal problematic digital spaces and offer solutions. This centre is focused on respecting human nature and developing value centred design (Human eTech, 2021). While digital spaces are internationally accessible, values and ethics are personal and circumstantial (Devon & van de Poel, 2004). This creates room for contextualised, empathic investigation into digital interaction in order to guide the creation of digital design ethics that would be relevant to the South African context.

Conclusion

The aim of this paper was to illustrate the need for the inclusion of digital design ethics within design education as the fourth industrial revolution takes hold in South Africa. As a socio-technical field, design has been intertwined with the industrial revolutions and its role will evolve with 4IR as well. COVID-19 has acted as an accelerant of the spread of 4IR technologies within South Africa and the government's policy and strategy alignment with this change, proves that the country will not be left behind during the current industrial revolution.

As a way of navigating the new, unregulated, and evolving digital world, design ethics is proposed as a guide for making design decision. Design ethics place the responsibility of a product outcome on the designer. It includes the theory that being a designer involves understanding how a product one creates will be used and what effects it will in turn have. While design ethics hold designers accountable for problematic outcomes, it also frames design as a field of agency with the power to make an impact on societies.

The need for the inclusion of digital design ethics in South Africa is exemplified through the analysis of problematic digital platforms that are viewed through a behavioural design lens. It is established that many digital platforms have exploited the human bias to stick to the status quo. It is furthermore demonstrated that multiple technology companies exploit human anxiety around social status. Lastly, it is illustrated that technology companies have applied design methods used in slot machines to develop addictive platforms that people on which to spend an excessive amount of time.

While these examples clearly illustrate the need for digital design ethics to be included as a guide for future designers, there is room for further investigation into design strategies that have been used to mitigate human exploitation. Further research into digital design that serves people, stand as a useful exploration that could be included alongside the information within this paper.

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DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

The new 3Rs in design education: A pedagogical suggestion

Donna Pido, *Technical University of Kenya*
Martin Khamala, *Technical University of Kenya*
Odoch Pido, *Technical University of Kenya*

Abstract

In this paper, we do three things. First we discuss the concept of the 3Rs in the anglophone world in the 20th century. Second, we briefly view 3Rs in the context of environmental concerns. Third, we elucidate the three Rs in design education and practice, a concept which we have originated without reference to preliminary models other than Reading, Writing and 'Rithmetic and Reuse, Repurpose and Recycle. We strive to remain a theoretical as we promote the consideration and inclusion of the full range of technologies in our teaching from the simplest to the more complex, plus the ancient to the most recent of materials, tools and processes for designers. Within each range we look to development of the broadest possible material and skills Repertoire for each designer. This means identifying useful materials and acquiring and transmitting as many skills as possible to enable our students to develop Resilience in their design practice and lives. As the innovators of the New 3Rs, we explore and discuss some solutions to teaching the New 3Rs in a digital age cluttered with the internet, the internet of things (IoT), robotics, virtual and augmented reality (VR/AR) and artificial intelligence (AI) as we mine the technologies of our respective cultures and disseminate them to students and the lay public.

Keywords: Design, education, educational paradigms, innovation, range, repertoire, resilience, technology, professional paradigms

Introduction

The twenty-first century has brought unprecedented access to information from all cultures at all times. It has also brought us amazing technologies to reproduce and disseminate our ideas. At the same time, COVID-19 has placed immediate stops on everything we can do and has forced us to rework our approaches to education. Design educators are challenged to redesign our own pedagogies and those of other academic disciplines by using our full array of technologies from simple blades to scissors to laser beams, from chalk and talk to virtual and augmented realities, from building clay pots to printing out crockery in 3D. Because of the interdisciplinary anomalies that place heavier emphasis on so-called 'high tech' in design and education, we in Kenya are also looking at the anomalies of access by ordinary people and the possibilities for the future that may, sadly, include the collapse of global cyber infrastructure, as well as global and local supply chains. We have noted with horror that we now face a generation of students who do not know that their grandparents grew up without shoes and who do not know how to make footwear for themselves. Many of our students simply cannot pay for access to the all-important internet and cyber messaging services.

As a trio and as individuals we have witnessed or participated in many research undertakings that, because of 'theoretical' and 'scientific' 'rigour' have failed to answer the questions they were designed to answer (Moore, 2002, Shuftan, et al., 1993, Pittracher, et al., 2004). We have also advised many advanced degree candidates and colleagues in efforts to steer them away from developing slick theoretical and scientific research designs that do not work (Pido, 2001; Pido, et al., 2018, 2019). Having seen many theoretical frameworks come into and out of fashion and having seen work that cannot be distinguished from the work of the theoreticians and the people under study (Galaty, 1978)We do not try to integrate or contextualise our inquiries within any particular existing framework. This article is not based on a single, finite, bounded 'research' exercise but rather on bits and pieces of data gathered primarily through reading, experiment and participant observation over more than five decades. The authors' cumulative experience in research, teaching, professional practice and life over more than five decades has provided us with a pool of data to cherry-pick in making our points. If we must name our research design it is 'Bricolage,' a French word referring to the process of bringing apparently disparate things together to form a cohesive whole;

In 2019 we published an article entitled "Decolonizing 'Technology' in Kenyan Higher Education and Implications for Development" (Pido, et al., 2019) In that article we pointed to several kinds of technology and the idea sets that had accompanied them up until then. We noted that culture, esthetics and technologies are parts of a comprehensive whole that, sadly, has been divided into compartments that may no longer work. We lamented that, as academics and professionals, we were affected by compartmentalization of various kinds of technology and their classification along several axes such as primitive/modern, hi tech/low tech and male/female (Pido, 2021), which we identified as kinds of colonization that need to be modified or done away with;

In the end we introduced what we call our New 3R's, namely Range, Repertoire and Resilience; of course other design educators and professionals may think beyond our 3R's. The term Three Rs is based on the use of that term in our childhoods and also in the environmental movements. **Range** would be the complete cross and inter-cultural and intra-cultural array of materials and technologies drawn from all cultures and times and now accessible in our local communities and on the internet. **Repertoire** would be the skills acquired and/or adopted, learned and implemented by any particular person or group. **Resilience** is the ability to change or to pivot when circumstances dictate and to adjust to new situations. For designers, this should be the awareness of the range and the repertoire to maximise efficiency at all times and enable greater creativity and productivity, not to mention better recognition of all peoples and their technologies as equals (Pido, 2021). We were acutely aware, and still are, of the ranking of peoples, genders and occupations based on the technologies they use. We noted that the Euro-idea that Africans are inferior to Westerners was generated in connection with the need to justify the massive enslavement of Africans in the sixteenth to nineteenth centuries and women since time immemorial. Within the nineteenth and twentieth-century colonial oppression we grew up learning that Euro-based tools and processes outclassed anything the Africans had ever come up with and were 'modern'. We also learned that most of the technologies that women used to make everybody's life more pleasant were of little importance and should be shunned by males (Pido, 2021);

Here we elaborate on the concept of the New Three Rs explaining them in greater detail and recounting our personal stories that point to the importance of decolonization through the neutralization of perceived hierarchies of worth and importance (Pido, 2001, 2021; Pido, et al., 2018, 2019). Our present discussion is made all the more relevant if not urgent by the recent blow that COVID-19 has dealt against our entire world. It has disrupted our lives and forced us to rearrange the ways we have lived and interacted with each other by forcing social distance, destroying employment systems and supply networks. To be realistic, and for the foreseeable future, all humans must now develop resilience and must reconsider many things that we have taken for granted such as the milk and sugar in our tea, the supply of breakfast foods in our supermarkets, as well as the supermarkets themselves. We can no longer pass around hard copies of documents, including money, for fear of infection. As we write, we are daily seeing reports on the international TV news (MSNBC, CNN, AlJazeera and others) of people in 'developed' countries struggling to adjust and perform tasks that are commonplace to us in Africa;

In academia, we have to revise our approaches to teaching because we may never again be able to stand up in front of a class. We authors, among our many colleagues, are now in the throes of relearning how to impart knowledge and even more so, understanding of the world our youngsters are now entering. We often remark on how, as highly educated people who occupy higher status than those who never learned to read, become instantly illiterate when handed a Chinese newspaper. In the range of orthographies, our repertoire is limited to the Latin alphabet with a little Greek and maybe some Arabic thrown in, but it does not include Chinese, Japanese, Korean, Sanskrit, Burmese, Ethiopian or Russian. Before European-style reading and writing came to Kenya, peoples of this country practised drawing as a form of technology and other methods of making images; but none of those drawing styles developed into Hieroglyphics, as in Egypt. The Egyptian hieroglyphs morphed into the Greek, Hebrew, Arabic and Latin alphabets. Today drawing and painting are among the technologies that designers use to transmit information to others. We can now do this not just by hand but can marshal many technological aids such as templates, machines and computer programs. In so doing, we are abandoning the observation of detail that came with drawing from sight. That many of our students wish to abandon all the technologies of pre-computer days presents a challenge to us educators. We now find ourselves busy adapting to new ways and leaving the more traditional style or the foundation of our range of communication technology;

Kenyans and foreigners alike are amazed to see children in our cities' peri-urban areas code-switching effortlessly between English, Swahili, Dholuo, Ekegusii, Kikuyu and Kikamba. They take their own resilience for granted while we 'privileged' adults stand in awe;

Most Kenyans know bread as a convenience food we buy at the kiosk, but we do not know how to make it ourselves. There are many movements afoot since the mid-twentieth century, to recover and retain the knowledge of the ways humans did things in earlier centuries. In the late twentieth century so many Kenyans were at pains to show themselves as 'modern,' or 'developed' or 'advanced' that many skills and knowledge about our surroundings had been lost. Families that moved their children to the cities to 'escape' their own cultures have generated a population that may not even speak their own languages much less understand the fine points of growing their own food. They may not recognise the plant that brings bees into a new hive or the one that sterilises the milk gourd AND breaks down cholesterol in the bloodstream (Pido, 2016);

Plastic and other 'high tech' materials that can only be produced in big factory settings have supplanted traditional pottery – along with the loss of the knowledge and skills needed to make that pottery. What will we do if and when there is no more plastic? Think of how we used to wrap perishables in banana leaves. Now we live where there are no banana leaves so, when the government rightly banned plastic bags, we were all caught with no good alternatives other than a newspaper – if we could afford it. The communities that used to grow milk gourds for the Maasai have stopped since glass and plastic containers arrived. These are but a few examples. As the global economies, and especially its supply chains, begin to crash around us, we need to consider the three Rs and develop ourselves and the next generation of designers accordingly; and

We now turn to our own life experiences and observations, often through our students, of the cost of neglect of the range of technologies that we should have. Along with this, we consider the need to expand our technological repertoires and cultivate resilience by learning new ways, especially online teaching, without sacrificing our original repertoires. We can now make chapattis with an electric machine AND when there is no power, we can also roll them out by hand and roast them in a frying pan AND/OR buy them from the kiosk or the lady at the bus stage as needed (Pido, 2016). With chapattis, both our Range and Repertoire are enabling our Resilience.

The original 3Rs: Reading, writing and ‘rithmetic

When we authors were very young, in the mid to late 1900s, we learned early on that the 3Rs were Reading, Writing and ‘Rithmetic (Harlan 1907; Cedarmont, 2015). In the Anglophone world, education was about literacy, and numeracy was imparted in an atmosphere of extreme discipline, including corporal punishment (caning) to help us become ’good’ people. Art, music, physical education, history, and science were often de-emphasised or omitted from curricula. By the time we reached secondary school, our cohorts were segregated into those who showed an aptitude for ‘higher education,’ those who just wanted to get on with their ordinary lives and those whose performance in the testable subjects was poor. These children were shunted into learning ‘trades’, a euphemism for manual skills for those who would become blue-collar workers. In East Africa, only a small minority of children ever saw the inside of classrooms and found out about the 3Rs. The rest remained illiterate, meaning, and unable to read and write in Western-style. The few who got to school were carefully selected for aptitude in literacy and numeracy and also for docility and obedience. A tiny percentage of them got as far as university education and became tools that colonial and local politicians freely exploited, thus reaping much benefit.

The environmental 3RS – reuse, repurpose, recycle

By the 1980s when humanity found ourselves wallowing in our own global garbage, the 3Rs took on a new set of meanings – Re-use, Repurpose, Recycle. There are many people alive today who do not remember the original 3Rs that held much broader meaning than the later set. All the same, the three of us managed to grow up and become an engineer, an anthropologist and a solid, start-to-finish design educator. We all now work as design educators and face the challenge of building a new generation of excellent designers. This is no small challenge when we consider the ever-intensifying global changes and pressures on our species, all other species and our planet itself.

By the late twentieth century, it had become clear that the resources we humans had inherited from our ancestors would be depleted if we continued to consume them as if we were. Our environment was deteriorating fast and required urgent attention in order to prevent serious trouble. Packaging, especially connected to the supermarket and its plastic wrappers and shopping bags, was one of the main sources of garbage/waste and environmental pollutants. The culture of disposable packages generated garbage that defied all efforts at waste management, but local peoples everywhere learned to repurpose such items as plastic cooking oil containers and cardboard boxes.

The quest to turn waste into something useful has been with us for some time and now seems to drive the more recent recycling efforts, at least in our respective classrooms. In East Africa we know that people cut broken gourds into plates and trays while we also make sandal straps from skins that are too worn-out to wear. Today's recycling is also driven by the quest to turn waste into useful and beautiful things. Junk Art, made from discarded objects and materials, appeared on the scene in the early 1900s (Junk Arts Cork, n.d.); though recycling was still uncommon, it seems, from our own childhood and youth perspectives, Junk Art was a precursor to recycling in East Africa. Opportunistic use of newly presented, abundant and functional materials also played a part. Whatever it was, we can safely say that recycling helped generate an artistic genre that thrives on metal and mechanical parts of vehicles and electronic gadgets, among other things. Recycling and repurposing have made inroads into African design, especially plastic and metal containers that are replacing gourds and clay pots. Often the plastic containers are a form of packaging in which cooking oil and other goods are imported to Kenya. Once empty, the containers find their way into second-hand markets and into people's homes. All three of us have witnessed the replacement of palms with plastic strapping and clay water pots with the infinitely lighter cooking oil containers for carrying water. We have former students who now make at least a part of their living from paper mache goods from recycled newspapers.

The new 3Rs: Range, repertoire and resilience, in design education

Building on the two earlier incarnations of the Three Rs, we authors, using design methodology (Wikipedia, n.d.), have ideated and created a model that we now can explain to other designers and other educators. We developed the concept of Range, Repertoire and resilience without reference to any theoretical framework or grounding in anyone else's research. We believe that this is one of the things that designers are supposed to do in spite of our embedment in an academia that over-values the so-called 'hard sciences and STEM subjects (Pido, et al., 2019). By **Range** we mean all the materials, tools and processes available to the designer in creating an outcome. Within the full range, especially of skills, each designer, craftsperson, or hobbyist can and does develop a personal **Repertoire**, a menu or playbill so to speak that they have mastered or dabbled with and can try to mobilise. **Resilience**, to us, means the ability to pivot, to adjust to changed circumstances with relative ease and speed in getting the job done.

That design education in East Africa often starts as art education in primary and secondary schools gives us a skills foundation that can be augmented and increased in detail and range as our students develop. In Kenya's primary and secondary schools, children learn drafting and crafting skills; the lessons are imparted in Art education, including life, still life and Instrumental Drawing. In addition, schoolchildren learn Craft and Sculpture, where they acquire skills of forming objects from different so-called art materials. It is important to note that 'school' portrays Art as a subject that stands timidly and alone yet it is bold and has connections with Biology, Physics, Chemistry and other school subjects (Ongachi, et al., 2013). It is also clear that the European views on artistic expression and communication seem to drive Art education in Kenya schools and beyond (Olweny Mark, 2020). The school's views of Art as a subject without connections to other school subjects and leaving Art as a European-style intellectual engagement tend to deprive Kenya of the full development and benefit of the 3Rs.

In some schools, with gendered settings, some children learn skills of construction and formation of objects in woodwork and metalwork classes while others learn handwork and sewing skills. None of these skill sets is even marginally considered significant criteria for admission to university education. Students also spend more time learning construction methods and related skills instead of studying and gaining a clear understanding of the materials and tools in metalwork and woodwork. Lack of adequate materials and tools (Otati, 2013) undermines the development of the 3Rs and the overall pattern of undergraduate design education. Home science is the other subject where school children learn textile and clothing skills like crochet, knitting and needlework. However, for reasons connected to indigenous cultures and global misogyny, students mistake Home Science to be a subject for girls, never boys. Boys tend to think learning particular skills will make them feminine, or they feel they have to hide their interest in these skills for fear of social ostracism. Girls on the other hand show a proclivity to shy away from learning technical topics. Even when they have a cursory interest in participating in these design activities, the influence from society to conform to female expectations has often held them back.

Undergraduate design students and other creative people tend to be poor in mathematics. Their computational skills are usually very weak. But nearly all students are interested in learning digital technology especially things close to design; there is little doubt that this plays a significant role in the mastery of digital technology and the programs that design professionals use in their day-to-day work. From our experience sitting on admission committees, it is clear that only a few students joining undergraduate design programs offer Physics and Chemistry in secondary school. It is not fully clear why this happens; but many schools do not offer science because mounting science subjects are expensive and many parents cannot afford them. Besides, there is the odd feeling that design does not require science or art possibly because of the belief that a good computer is all a student needs to become a designer.

All the factors described above, coupled with limited physical resources at the university level make it difficult to teach undergraduate design using a wide range of technologies. Many Kenya universities are cash-strapped and unable to support their programs. This is the case because governments but do few good things about universities. Consequently, many of the universities lack studio spaces, libraries, as well as computers and other pieces of equipment for design education and training. Without a broad range of technologies it is difficult to see students develop and possess a wide skills Repertoire. Besides, some university administrators still think that technical and hands-on training is not intellectually fit for university education; a university registrar recently told one of the authors that he does not consider industry-based learning to be the equivalent of an academic term.

Resilience is not easy to build among students who believe that they have ‘arrived’ and that the technologies now available to them will always be there. Since the 1960s we have been observing people, in class and out, who believe that they have moved beyond a technological/skills level that can or must now be relegated to their past as they climb the socio-economic ladder. We have repeatedly observed people who find it difficult or impossible to carry water once they have an indoor tap in their homes. We work with people who have very sophisticated electric sewing machines but do not know how to operate a treadle machine.

Living in both rural and urban areas in Kenya, we know that when the electricity goes off, we have to adjust by changing our work focus or by resorting to tools and processes that do not require ‘power’. We still blithely believe that milk comes in a packet or a tin and that chicken is something in a plastic tray with a cellophane wrapper. Comparing ourselves with urban dwellers in more ‘developed’ countries, we feel empowered by our awareness that there is another set of skills still lurking in our past and that we can mobilise those skills. Most of our students do not know that. Few if any have ever drawn an ellipse by hand. Even fewer can plot a pattern in a grid by hand. Rendering an image of a cat (example) means going to the internet and searching for such an image. Freehand and observational drawing are becoming things of the past.

The Technological Perspective and 4I American philosopher John Dewey said, “If we teach today’s students as we taught yesterday’s, we rob them of tomorrow”. As the fourth industrial revolution (4IR) becomes imminent, educators must re-think education and how to prepare the next generation to take advantage of the plethora of opportunities to overcome the challenges enabled by ever-increasing technological change (Marr, 2019). The role of design programmes could assume even greater meaning in readying students to be innovative active participants in the design profession by interrogating the capacity for their curricula to adequately prepare students for the Fourth industrial age (4IR).

Faculties of Design are uniquely placed to deconstruct design student learning outcomes. The future will place new demands on practitioners and digital literacy will be a requisite skill. Yet, design programmes on the African continent, have limited digital integration and are barely keeping abreast with emergent issues facing learners in the third industrial age. It is against this backdrop that we contend the time may be ripe for a new design thinking, an approach that finds utility in edifying students on a range of technologies and establishing a sufficient repertoire of skills to build resilience that can effectively navigate the fourth industrial revolution (4IR).

The Situation This section examines the implications of the current mode of design instruction on future productivity for a 4IR workplace. We consider strategies derived from psychomotor skills, the context of social interaction and visual-spatial learning styles, as well as home-grown approaches that are personalised, targeted and localised. Our position emphasises the importance of congruence between the range of design materials, tools and practices, the repertoire of skills of practising designers and their capacity to adapt to a new digital age. The overarching aim is to improve learning outcomes among Design students for future professional practice.

The pushback against the technology giants over data breaches affecting users was far too common. Design technology being used to track users, breach privacy, and the massive collection and monetisation of personal data, has done much damage to the design industry. Unfortunately, much of this is done with the active participation of designers who were just applying the ‘best practices‘ of our field. The design work at these technology firms follows a ‘human-centred process’ that purports to ‘improve the user experience’.

A large number of technology services we celebrate as disruptive have significant negative structural impacts. Africa depends on Western design technology without developing her own indigenous knowledge (Pido, 2018). This dependency status has enormous challenges since some of these western technologies are not congenial with the African environment (Abanyam, Lumun, 2013).

Let us look at two examples. Airbnb (Air Bed and Breakfast), is a technology platform that lets property owners rent out their spaces to travellers looking for a place to stay. Travellers can rent a space for multiple people to share, a shared space with private rooms, or the entire property for themselves. The Airbnb product helps make accessing accommodation easy, enjoyable, and safe. However, Airbnb also skews housing affordability in many cities. It facilitates mass tourism with many negative impacts on local communities. Many African countries have called for legislation to level the playing field and ensure that rules and regulations are equally valid for all market players.

Uber is based on a technology where those who drive and deliver can connect with riders, eaters, and restaurants. In cities where Uber is available on the continent, one can use the

Uber app to request a ride. The service is very popular. However, Uber considers its drivers ‘partners’ rather than employees to maximise flexibility and to avoid paying them employee benefits. On its face, their service appears to be socially beneficial to all stakeholders, but Uber drivers in Nairobi and other towns repeatedly went on strike (2019) because of what they described as low wages and poor working conditions. The result has been for Uber to drive away traditional taxi business operators, which has impacted drivers’ subsistence.

We recognise the role of human-centred design especially when measured with the traditional metrics of ease-of-use, time-to-task, efficiency, productivity, reduced wait times, and even ‘delight’. When designers make things more convenient for users, products easier to buy for customers, and customer service more frictionless, there is almost always a business behind the scenes, profiting from the user-data. When something is being bought, there is almost invariably a direct or an indirect component of extraction, exploitation or emissions to it. This is unavoidable in the system of industrial capitalism, for it is a system that is fundamentally unsustainable (Pasanen, 2019). Design activities in their traditionally role are subservient to business considerations.

Identification of range to establish repertoire and resilience

The fourth industrial revolution is emerging out of the third, and is considered to be more advanced and widespread than the previous revolutions because of the frenzy of its development and the disruptiveness of its technologies. Design can positively change the way modern people live, at the same time adversely affecting the sociocultural and environmental conditions in which they live. According to Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum and author of The fourth industrial revolution, the new age is differentiated by the speed of technological breakthroughs, the pervasiveness of scope and the tremendous impact of new systems. If the first three industrial revolutions brought us the steam engine, electricity, and global communication, the fourth revolution merges the digital, physical and biological. This trajectory is destined to result in the concurrence between man and machine.

Some have described the convergence of these exponential technologies as providing a Singularity (Kurzweil, 2005), which may not change what we are doing, but will likely change us. This poses a unique challenge to Designers that building products, for a future in which the barriers between man and machine are eliminated, will be tantamount to redesigning the human condition.

Repertoire

The fourth industrial revolution often is described as the result of an integration and compounding effects of multiple “exponential technologies”, such as artificial intelligence, biotechnologies, and nanomaterials. When these digital exponential technologies are combined, the combination multiplies the pace of change (Peters, 2017) and challenge some of our fundamental assumptions of what it means to be human, and the conditions of our relationship with the natural world. How should design education respond to this new human condition?

With the evolution of online instruction and expanding uses of artificial intelligence, new guidelines are needed to provide a theoretical basis for digital pedagogy. Some have called the old models of teaching Anthropocentric Humanism, and the new types of digital education

‘Critical Posthumanism’. These approaches stress that digital education is more than a purely technical concern, as it changes the dynamics of space and creates new types of learning cultures that challenge our notions of what it means to be human (Bayne & Jandric, 2017).

These humanistic concerns are inseparable from Design education, and a new 4IR curriculum may be needed to reduce the divisions between the humanities and fields of science, technology, engineering and math (STEM) to create a more integrated “system” of education that can explore the newly emerging conceptions of self and identity within the 4IR, including discussions of autonomy vs social determinism.

Resilience

More than ever, higher education in the 4IR age must develop capacities not just for analysing but also for breaking down the Design problem into its constituent parts. It must, instead, emphasise the interconnections between each scientific problem across global scales, and interrelations between physical, chemical, biological and economic dimensions of a problem. The educational experience of all students should culminate in the integration of knowledge into some meaningful whole. This is the notion of trans-disciplinarity as described by Petrie (1992). He suggested that it transcended disciplinary boundaries, exhibiting the most potential to respond to new demands and imperatives. To achieve this experience, the curricula would require multidisciplinary thinking and integration across all areas of design and academia. This kind of thinking is critical to addressing environmentally sustainable actions at local, regional, and continental levels over short, medium, and intergenerational timescales. Design education would need to have the same “lateral rigor” across disciplines, as the “vertical rigour” within, the discipline.

In addition to this more inclusive approach, the rapid pace of change within the 4IR will require rapid expansion of existing initiatives in design placement for upskilling beyond their initial qualification and employers' immediate skills needs, because that is what the 4IR labour market will need and demand from graduates. Within design education, we will need to educate and re-educate students to help develop resilience in the use of today’s most rapidly emerging technologies. To facilitate faculty in keeping their knowledge current, more active and creative forms of faculty development will be needed to maintain institutions within a fast-paced workplace of the future. At the same time we must be reminded of Shakespeare referring to the ‘best-laid plans of mice and men’ and take into account what will happen when all our cyber tools are shut down by failure of electrical grids, what our production will be when all the global water runs out. What will happen when a future pandemic takes out half of us instead of 1 in 500.

Summary and conclusions

We have tried to explain what we mean by Range, Repertoire and Resilience, first by describing the background of the term Three Rs and then by detailing our definitions and experiences that led us to come up with The New three Rs. We recognise that there are probably many other Rs and other letters but we would like to leave those to other scholars and maintain our simple if not simplistic motif here.

It is against this backdrop that this paper contends that the time is ripe for the advent of indigenised design approaches to learning. By this, we mean making all the materials, tools, ad processes we now have our own by modifying them to suit African needs, aesthetics and priorities. Such an approach would find its concrete expression in the edification of learners on the range of possible technologies to establish the stock of twenty-first-century skills Designers need to build resilience and effectively navigate their future work-life. It almost certainly means the indigenisation of objects and concepts that originated outside of Africa but have been adopted and incorporated into African culture. As an example, we can point to a student who showed us a composite picture of several common objects of everyday life in Kenya – a chair, a backpack, a TV, a cell phone. He was lamenting that none of them is 'African'. We pointed out that these are familiar objects to nearly all Kenyans and are, therefore 'African'.

Thinking Afro-centrically and De-colonially, we must acknowledge that the very first industrial revolution happened when our remote ancestors in East and Southern Africa extended their cutting edge beyond their teeth, out of their mouths and into their hands by banging rocks together to create tools. At around the same time our ancestors learned how to make and control fire, yet another revolutionary innovation that astronomically increased our chances of survival as individuals and a species. We live where it happened so why are we still thinking Euro-centrically? As we face the so called fourth industrial revolution head on, design educators in Africa should be standing our cultural ground and insisting on recognition of the blatant fact that there were two industrial revolutions in Eastern and Southern Africa many millennia before the 1 to 4 that are recognised in our post-colonial world.

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SESSION 5: Doing things differently in fashion

Social media facilitates custom-made apparel design decisions: The future for business smart fashion designers

Elizabeth Kempen, *University of South Africa*
Mariette Strydom, *University of South Africa*
Rejoice Tobias-Mamima, *University of South Africa*

Abstract

Fashion design entrepreneurs (FDEs) are compelled to embrace digitalisation to create a competitive advantage and provide the Web 2.0 (participative and social web) smart customer with the service they require. The purpose of this research was to determine how social media facilitates custom-made apparel design decisions in the FDE context. This study sets out to apply the third-generation activity theory to show the role social media plays in the activity system's result between a customer and FDE during the design process. Qualitative data from three independent exploratory studies conducted in Gauteng, South Africa, were used. The study participants for each study were purposefully selected, either as customers of custom-made apparel designers or custom-made apparel designers of SMEs. Content analysis of social media-related extracts from transcribed data was used to identify the technological and semiotic elements of the mediating activities within the customer (subject) and designer (subject) activity systems. Findings suggest that social media as technology, for both activity systems, acts as an inspirational, marketing, distance bridging and design-process tool through the semiotic use of messaging and pictures. Through social media technology, comments and pictures facilitate the semiotic use of social media in each of these tools. Between the two activity systems, the design process facilitates the introduction, design development, or agreement and design progress or completion phases of the process, using comments and pictures as semiotic elements of communication. Through mobile phones, design communication between the activity systems is supported within the fashion community considering social media policy and regulations. Social media is a valuable tool through which the customer and FDE can engage in the design process in an emerging context. The success of the FDE may be reliant on the use of social media and better advocacy of the entrepreneurial business context within design education. FDEs need to understand the importance of the dialectics between creative design and creative business management to ensure the future of fashion designers in an emerging context such as South Africa.

Keywords: Activity theory, emerging economy, entrepreneurship, fashion design, fashion design education, social media

Introduction

Social media offers fashion design entrepreneurs (FDEs) the opportunity to reach new and existing customers (Çiçek, 2018). As consumers have become empowered through smartphones (Duggal & Jain, 2019), entrepreneurs can capitalise on social media in innovative ways to initiate and manage a business (Çiçek, 2018; Khajeheian, 2013). Social media platforms have become an important part of marketing for businesses of all sizes (Hudson, 2020). But Ngoasong (2018) and Jagongo and Kinyua (2013) found very few entrepreneurs in emerging economies using social media optimally. Social media is useful in customer communication (Camilleri, 2019), marketing initiatives (Kim, 2021; Hudson, 2020), crowdfunding opportunities (Olanrewaju, et al., 2020) and assisting women entrepreneurs with networking to grow their business in an emerging context (Cesaroni, Demartini & Paoloni, 2017). Although creativity and innovativeness are important skills for an entrepreneur (Chandra, Tomitsch & Large, 2020), the value of utilising innovative digital technologies, such as social media, may still be lacking and more so within the FDE context. Little research has been conducted on the role social media plays in the design decisions between the customer and FDEs. The purpose of this study is, therefore, to determine how social media facilitates custom-made apparel design decisions in small fashion design entrepreneurial contexts and why FDEs should be aware of the value social media brings to a small entrepreneurial business context.

Literature

The role of design education in fashion design entrepreneurship

Increasing unemployment is challenging fashion design students (FDSs) to become FDEs (Lang & Liu, 2019), whereby they actively manage their business decisions (Meyer & Norman, 2020) with an entrepreneurial mindset (Fernandes, 2019). Including entrepreneurship in a fashion design curriculum is crucial in establishing students' entrepreneurial competency (Duggal & Jain, 2019; Hodges, et al., 2016) and preparing FDSs to start and manage their own fashion design businesses (Fernandes, 2019). To become an entrepreneur, an FDS must merge creative design processes with business practices (Ghajargar & Bardzell, 2019; Aakko & Niinimäki, 2018). Design education is not about entrepreneurship, although fashion design education institutions have the responsibility (Marniati & Witcjaksono, 2020) to provide opportunities for students to transition between being a creative person and starting a fashion design business (Mills, 2012). To become successful, an FDE requires the necessary knowledge, skills and abilities to manage and develop a fashion design business that can address and recognise current demands (Lang & Liu, 2019; Yu, Yuizono & Kim, 2019). Business and entrepreneurship modules are included in some international (Lang & Liu, 2019; Yezhova, Pashkevich & Manoilenko, 2018) and South African fashion design programmes. The concern is, however, whether design education has kept up with twenty-first-century demands (Meyer & Norman, 2020; Ozkaynak & Ust, 2012) brought about through social media.

Technological innovation in design education

Digital technology advancement is currently challenging fashion design education (Marniati & Wibawa, 2019), as it has become an integral part of the fashion industry (Sun & Zhao, 2018). Evolving into connecting individuals to industries has enabled the fashion industry to communicate with their customers (Ahmad, Salman & Ashiq, 2015; Halel, Ozuem & Lancaster, 2018). As fashion consumers are more digitally connected (Zhao, Davis & Copeland, 2018), FDEs are running a risk if they are not active on social media (Duggal & Jain, 2019; Bilal, Ahmed

& Shahzad, 2014). FDEs must reach their customers through the media that customers actively use (Indrupathi & Henari, 2012). Although much attention has been placed on social media as a marketing tool (Tripathi, 2019), its value as a communication tool should not be overlooked (Sehar, Ashraf & Azam, 2019) by fashion design education. Its value manifests as customer information sharing medium (Sultana, 2018), managed through social networking sites, for example, WhatsApp, Facebook and Instagram (Tripathi, 2019), offering FDEs the opportunity to communicate design decisions to the customer.

Theoretical perspective

Activity theory (AT), commonly known as cultural-historical activity theory (Batiibwe, 2019), is a theoretical framework for analysing and understanding human interaction and subsequent activities with technology as tools and artefacts (Hashim & Jones 2007). An activity system is a collective of activities undertaken by actors (Foot, 2014). The activity is linked to various actions with a specific purpose (Katsuhiro, 2006), thus reflecting on what people do (Gretschel, Ramugondo & Galvaan, 2015). Activities use tools to achieve a particular outcome (Sannino & Engeström, 2018). Activities represent six components of the activity system (diagram A in Figure 1). Three components (subject, object, and tools) represent the top structure of the activity system. The *subject* is the actions of people involved in the activity (Trust, 2017), the *object* is the purpose of the action towards solving a problem, and the *tool* is the mediating device (Hashim & Jones 2007) used by the subject to achieve the *outcome*, which is the physical or mental product of the activity system (Trust, 2017; Gretschel, Ramugondo & Galvaan, 2015; Foot, 2014; Koszalka & Wu, 2005). In the context of this study, social media platforms are the design communication tool, the object is the ordered custom-designed garment, and the subject is the customer who requires the garment. The bottom structure of the activity system includes the remaining three components (community, rule and division of labour), highlighting the influence of other factors on the outcome of the activity (Engeström 2001). The *community* of significant others includes people who have a common interest in the same object (Trust, 2017), such as social influencers. The relation between the subject and the community is mediated by the *rule* component (Foot, 2014) that regulates the subject's actions. Rules include explicit and implicit regulations, norms, conventions, and standards that constrain actions (Sannino & Engeström, 2018). Finally, the *division of labour* component indicates what is being done by whom towards the object (such as the designer or tailor). The reciprocal relationships between these components contribute to a better understanding of the activity system, resulting in the value of AT (Foot, 2014).

Engeström's (2001) third-generation AT model introduces two interacting activity systems (Bakhurst, 2009), describing how one activity system can connect with another activity system through all the components (Gretschel, Ramugondo & Galvaan, 2015). In this instance, two activity systems engage through Object 1 (ordered custom-made garment). The customer's activity system, labelled A in Figure 1, moves to a collectively meaningful activity system in Object 2A (customer's ideas and design requirements). The second activity system (labelled C in Figure 1) is that of the FDE, from whom the customer commissions a custom-made garment. The designer brings another activity system to the collective engagement, resulting in Object 2C (designer's alternative ideas and recommendations). Object 3 (labelled B in Figure 1) is the shared and jointly constructed outcome (completed garment), resulting in a collaboratively designed outfit (Engeström 2001). The interaction between the two activity systems (A and C in Figure 1) results in the designed garment, as outcome/Object 3 (B in Figure 1). It is proposed that the activity systems are mediated through social media as a design communication tool, used by both activity systems to generate ideas, make design decisions, and conclude the design activity. The strength of AT is thus the focus on the relations and activities between actors (subjects) and the technological artefacts (Kaptelinin, Kuutti & Bannon 1995).

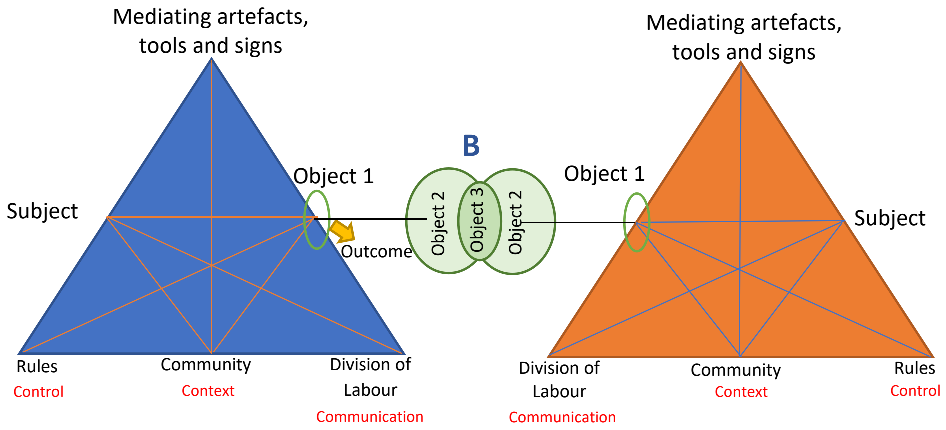

Figure 1: Third generation AT (Engeström (2001); Sharples, Taylor and Vavoula (2005), amended)

Drawing on Sharples, Taylor and Vavoula's (2005) reworking of Engeström's (2001) model, activity is separated into the semiotic layer (include the actions to promote an objective) and the technological layer (engagement with technology) added to each of the AT components. Sharples, Taylor and Vavoula (2005) suggest that these layers are not separate but fused to form a broader category of technology, which acts as a tool to assist people in addressing problems in context and to come to a new understanding. Sharples, Taylor and Vavoula (2005) further substitute Engeström's (2001) rule component with control (rights and permission afforded by the technology), community with context (access to mobile devices), and division of labour with communication (a form of conversation and the way conversation space is shared between parties), to show the dialectical relationship and interactions between technology and semiotics, indicated in red in Figure 1.

Methodology

Data from three independent exploratory-descriptive qualitative (EDQ) studies, conducted in Gauteng, South Africa, were used for this research. EDQ studies aim to explore and describe the experiences of participants (Hunter, McCallum & Howes, 2018) through their thoughts and expressions (Gundumogula, 2020) to gain insight into the phenomenon (Jain, 2021). Study 1 was a case study conducted through personal interviews with 13 custom-made apparel designers within an incubation hub context. Study 2 consisted of 11 mini focus group discussions held with 31 customers of designers of custom-made apparel. Neither study 1 nor 2 specifically elicited data on social media usage, but it emerged from the participant conversations. Study 3 determined, in more depth, custom-made apparel customers' social media use through eight online personal interviews with customers of custom-made designers. To ensure relevant information is provided for each of the studies, participants were purposefully selected according to set inclusion criteria (Andrade, 2021; Luciani, et al., 2019).

Synchronous face-to-face interviews, eliciting personalised engagement (Jain, 2021), were used for studies 1 (personal interviews) and 2 (mini focus groups). Study 3 was conducted in 2020 by using convenient real-time synchronous online interviews while geographically separate (Krouwel, Jolly & Greenfield, 2019; Gill & Baillie, 2018). Semi-structured interviews, allowing for probing questions to elicit more detail (Lune & Berg, 2017), were applied across all three studies. In all these studies, data saturation was reached through thick (quantity) and rich (quality) data (Fusch & Ness, 2015). Conceptual depth resulted in an understanding of and insight into the data (Nelson, 2017), and no new useful information relative to the study objectives (Quest, Namey & Chen, 2020) were identified.

Qualitative content analysis was performed inductively on all interview and focus group transcriptions to allow for an interpretative and meaning-orientated approach to the analysis (Morgan, 2019). This analysis was performed on social media-related extracts from the transcribed data in which the technological and semiotic elements of the activities were identified. Trustworthiness criteria were applied as follows to ensure the quality of the research (Lincoln & Guba 1986); dependability was addressed through a logical, traceable and documented research process (Moon, et al., 2016); credibility was ensured through pilot testing of the interview guide and seasoned researchers conducting the interviews (Forero, et al., 2018); transferability was acquired through the detailed description of the research methodology adopted in each study and confirmability through keeping an audit trail (Forero, et al., 2018).

Before the studies commenced, ethical clearance was obtained from the Health Research Ethics Committee at the College of Agriculture and Environmental Sciences (Ethics numbers: 2016/CAES/005; 2018/CAES/144).

Findings and discussion

Social media is used for four purposes between customers and FDE activity systems: as *a distance-bridging tool, an inspirational tool, a marketing tool, and a design-process tool*.

Social media as a distance-bridging tool is used to shorten the distance between the customer and the FDE: As "the designer that I use is based in Lesotho, social media is the easiest way for me to communicate with her". The convenience of social media is attractive to customers: It is a "convenient mode between myself and her", as "it's easier for us to communicate via social media than for me to be travelling to Pretoria". FDEs use social media on their mobile phones to facilitate the sourcing of raw materials: It enables them to send pictures and confirm prices and suitability of available fabrics, as they can "choose fabric, go to the shop and shoot, WhatsApp [you and] tell you what I want". They can "send the pictures of [fabrics and say], this one looks very nice and costs this much. And [the client] give you a go-ahead on which one they would want". In this way, the customer has an input in the selection of fabric, without being in the fabric shop.

The social media used as inspirational tools are predominantly Facebook and WhatsApp. "When I see a design that I like, I will ", or I "even see it on social media" or "take pictures from social media" or "look at Pinterest for ideas" to use in future designs. In this instance, pictures form the semiotics during the use of social media. FDEs confirmed that they use their mobile phones to access new ideas and inspiration: "I also go to the internet to look at patterns ... No, I'm using my phone ... I google", and "…we are aware of trends ... I think Instagram is it now ... I like Pinterest as well". Clients also communicate with their designers through Facebook ("I will send some of the requests through … Facebook to her"), WhatsApp, which "is the most easily accessible one", or Instagram.

Social media as a marketing tool is used by FDEs who have a Facebook presence. Prospective customers can see "them on Facebook, … it's an ongoing thing", as customers recognise that "designers use (Facebook) to promote their clothing". FDEs confirmed that, "Even on

Facebook, … ja, I do put my things" and "We do have a Facebook page". Customers also noticed that some designers post completed designs on Facebook "just to see the interest or the likes or dislikes of other people" as an indication of what the designer can create. This confirms Hudson's (2020) view that social media is the new "word-of-mouth". In these instances, the semiotics emanate through design pictures. Social media is not only attracting customers who look for "some of the designers … on Facebook", but it is also used to find and follow fashion designers "for ideas", as customers prefer to "check online" and go "with those who are online now". Semiotics become linguistically effective as customers follow FDEs by "notice(ing) when someone recommends someone; I check the comments", because "if people have positive comments about them, then I use them … when people say they ask them to design something, they actually gave them the good results, that's what I look for". An intricate evaluation of the Facebook designer profile is made by some customers, who "don't just go with any designer … I check the style" and "actually, check the background for them (sic) … Are they doing modern things, are they doing things that can suit me". Through pictures, the semiotics assists in deciding on which designer to use.

Social media as a design-process tool is used during three different design phases in the customer and FDE activity systems: the introductory phase, the design development and agreement phase, and the design progress and completion phase.

During the *introductory phase*, the design request is initiated by the customer: "when you have an idea that you want something", social media is used "to start the conversation". This includes "ask(ing) them if they're available … are they going to be able to do it within the specific time" and "how long is it going to take for her to complete what I want", which then leads to the customer and FDE "agree(ing)" over social media, as "all of that happens on social media". However, introductory semiotics not only emerge through language but also through pictures, "when I see a design that I like…I will take the design and start a conversation with my designer, to ask if she'd be able to make it". Therefore, the initial consultation to commission a custom-made garment is often facilitated through social media. FDEs may also initiate this phase, using social media technology, in which case "the designer as well, will see something nice and say, would you like to have something like this". In both activity systems, the semiotic element emerges through language and pictures to start the design process.

Design development results from the introduction to which the FDE responds, through the use of social media, by "share(ing) ideas … they think might work or might not work". Subsequently, customer's body measurements are confirmed by "send(ing) the measurements on WhatApp" or, where measurements are on record, "you can just send your pictures like a facing front, back, sideways and ... send those pictures through the WhatsApp", or "measure that [the longer length of the garment] and send it". The semiotics of measurement includes pictures or language.

The customer and FDE continue developing the exactness of the design through social media by "deliberating … confirming the fabric … maybe sending a design sketch, or maybe sharing a pic with him that I want him to do in a certain way". Alternatives are communicated between the customer and the FDE through social media. FDEs state that they "just give advice" and "try and give suggestions", for example, "how about taking this piece and adding this one … alternating this, with this", or point out the effect of the design selection to the customer, for example, "that lace is too soft for that kind of material … it will overpower the dress", or "you want this kind of a dress … it will suit [you], if we do it like this". During this phase, material selection decisions, including the price of the material, are made; the FDE will "use WhatsApp …. to show me with a video [which] materials are available. This is the one that I'm getting". Or "she will take pictures of several colours … and then she will send [it] through WhatsApp". The client will then ask, "Tell me which one do you like most". And, when a decision is made, "Send the price of the material". The design development process reaches finalisation when the final design is "share(d) for me to approve or disapprove", followed by "invoice(ing) you via social media … before they create the [design]". Then "the paying of deposits and sending the proof of payment through social media" commences. Therefore, the semiotics of this phase is an interplay of decisions taken through pictures and language to finalise the design between the customer and the FDE.

During the design progress and completion phase, the FDEs use social media to communicate progress by messaging: "Just wanted to update you on how far she is". And "Send me pictures to see" or "This is where I'm at the moment" or "Immediately after she does something, she will say OK, this [is] what I've done, see how it looks like ... Are you happy with what you see?" Design progress may also indicate that "I [the designer] am not sure that the dress would be ready by Friday". or "The time for fitting " Garment fitting and collection may be the only physical contact taking place during the design activities, as "collection obviously has to be in person". Regular fittings may not be necessary, as "I don't have to go and fit … I just go knowing that it will be perfect" because "they [the designer] normally write the measurements down, and they keep them". Some FDEs do not require physical fit and can judge fit through pictures of the customer, thereby determining "whether she can stick to the measurement that she has …. or maybe to decrease or increase the measurements". Semiotic engagement results from language or pictures sent between the customer and FDE.

Discussion

Based on the findings and the proposed activity system illustrated in Figure 1, we have constructed a two-way activity system to describe the use of social media as a design communication tool between the customer and the FDE. The proposed activity system for each subject suggests that social media platforms play a role in the configuration, as it acts as a distance bridging, inspirational, marketing and design-process tool during the engagement between the customer and FDEs (Figure 2). Social media mediates the design activities between the two systems, for the custom-made object becomes the outcome. During the design process, design ideas and alternatives are brought from both systems by each subject (FDE and customer) to be considered for the final design. Through social media mediation, the designed object or outcome (Object 3B in Figure 2) is achieved between the two collaborating activity systems, using language and pictures as semiotics.

As all components of the AT are interlinked, social media further mediates communication within both activity systems through comments on posts and picture sharing as semiotics between customers and the FDE continue. Context is achieved through mobile phone interactions between the customer and the FDE, including engagements with the fashion design community, accessed through Facebook comments, which depict the semiotics of the context and authenticates the designer, and control is the technological interaction between both systems that are governed by social media rules about the platform (WhatsApp, Facebook, Instagram) that are used to access comments and posts by the designers which include social rules at a semiotic level. Social media, thus, is a core tool within the activity systems of both customer and FDE through which all AT components are interlinked.

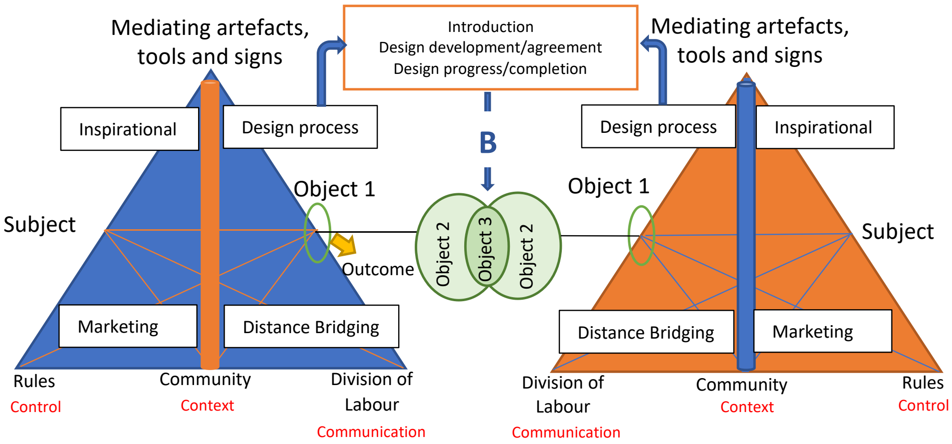

Figure 2: Proposed AT of customer and FDE through social media as design communication tool

Conclusion

The purpose of this research was to determine how social media facilitates custom-made apparel design decisions in the FDE context. The evidence suggests that, although social media is usually considered a marketing tool, FDEs, in an emerging market context, use this tool to communicate design ideas and alternatives, fulfilling an important role across all components of the activity system for both customers and FDEs. It is therefore important that the influence of social media on the design process should not be overlooked in a design education curriculum, as it can contribute towards efficient customer service for start-up entrepreneurs in an emerging economy. This research has contributed through AT to show how social media is used and how the design process is managed through social media. Further research is needed to understand the effect of social media fully on fashion designer profiles and its role in establishing South African fashion designers in an emerging context.

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Masking-up with 4IR fashion design education: A retrospective analysis

Kimberly Bediako, *University of Johannesburg*
Tinyiko Baloyi, *University of Johannesburg*
Neshane Harvey, *University of Johannesburg*

Abstract

For decades, studio-based pedagogy, grounded in socially-engaged, constructivist learning spaces dominated design education (Crowther 2013; Shreeve, 2015). However, the global pandemic forced design education to align with the fourth industrial revolution (4IR) and move towards interactive digital technologies and online teaching and learning methodologies. Positioned in the space of 4IR, the move to digital technologies is required to digitally streamline and integrate human-centred opportunities for inclusivity guided by technological advancements (Chuo 2019, pp. 107).

Globally, fashion design education had to rapidly move practice-based teaching and learning from the studio to digital spaces. Although this move presents challenges in its own right, for first-year fashion design students with minimal vocational teaching and learning exposure, pedagogical questions emerged in terms of: 1) how can practice-based teaching and learning move to remote platforms; 2) how can learning outcomes transform; 3) how can theory integrate with practice; 4) what interactive digital technologies and teaching and learning methodologies can be applied to ensure students remain engaged; and 5) how do educators interact with students? Given the novelty of shifting practice-based teaching and learning to digital spaces, the lack of scholarship posed a research problem in guiding and addressing these pedagogical questions.

Embedded in these pedagogical questions and research problems, this paper serves a three-fold aim. The first aim is to contextualise a COVID-19 mask project, which was designed for implementation with first-year fashion design students with the purpose of integrating and applying theory-based knowledge on human-centred design to co-design, prototype and make a wearable COVID-19 mask in response to user needs. This COVID-19 mask project culminated in a digital design journal as the assessment instrument. The second aim is to draw on selected first-year students' digital design journals to contextualise and juxtapose past scenarios with the COVID-19 mask project. Against the backdrop of reflection-on-action, the third aim is to reflect on challenges, educators' lived experiences and their retrospective analysis.

To achieve these aims, the methodology employed comprised collecting artefacts in the form of selected students' digital design journals as empirical evidence for contextualised narration. In the same light, retrospective analysis is drawn from the educators' reflection-on-action. From an Afrikan lens, in relation to accessible digital resources and unilingual communication, the findings reveal that students may have experienced challenges but that, on the other hand, a hidden curriculum, for example, the development of independence and self-directed innovation, emerged. In the same light, students are digital natives and therefore the digital design journal is a way *forward for fashion design education. As such, this paper aligns with and contributes to the conference focus on design education within the context of Afrika and 4IR digital technologies.*

Keywords: 4IR, digital technologies, fashion design education, online teaching

Introduction

For decades, design education predominately grounded itself in studio-based pedagogy. Crowther (2013, pp. 19) argues that studio-based pedagogy is a constructivist approach. Studio-based pedagogy is student-centred in that educators become facilitators who walk around conversing with students, posing questions to facilitate decision-making, contemplate alternate design opportunities and think about a course of design action (Shreeve, 2015, pp. 85-88).

However, in March 2020, the world found itself in the midst of a COVID-19 pandemic (World Health Organization, 2021), which prompted design education to align with the fourth industrial revolution (4IR) thus requiring a shift to interactive digital technology and online teaching and learning approaches. Moving to digital technologies is essential to digitally streamline and integrate human-centred inclusivity guided by technology breakthroughs in 4IR (Chuo, 2019; Xing, Marwala & Marwala, 2018).

Globally, fashion design education had to move rapidly to practice-based studio teaching and learning to digital spaces via, for example, video conferencing tools and digital learning management systems such as Blackboard (Bb) and Fronter, which provide access to learning materials (Kini-Singh, 2020; Unwin, et al., 2010). The rapid curriculum changes for online offerings notably focused on moving information to online platforms but not necessarily to remote pedagogy (Crawford, et al., 2020, pp. 10). This move presents challenges for first-year fashion design students with minimal vocational teaching and learning exposure. Hence, pedagogical questions emerged in terms of: 1) how can practice-based teaching and learning move to remote platforms; 2) how can learning outcomes transform; 3) how can theory integrate with practice; 4) what interactive digital technologies and teaching and learning methodologies can be applied to ensure students remain engaged; and 5) how do educators interact with students? However, given the novelty of shifting practice-based teaching and learning to digital spaces, the lack of scholarship posed a research problem in guiding and addressing these pedagogical questions.

Embedded in these pedagogical questions and research problem, this paper serves a three-fold aim. The first aim is to contextualise a COVID-19 mask project, which was designed for execution with first-year fashion design students. The second aim is to draw on selected first-year students' digital design journals to contextualise and juxtapose past scenarios with the COVID-19 mask project. Against the backdrop of reflection-on-action, the third aim is to reflect on challenges, educators' lived experiences and their retrospective analysis.

Literature review

Constructivist learning space

In opposition to orthodox university lecture or classroom settings, which hones on information deliverance and transference, constructivist, studio-based pedagogy is widely accepted as being student-centred (Brandt, et al., 2013; Cennamo, et al., 2011; Taylor, 2009). Hence, the studio is a socially-engaged, constructive and cultural learning environment and a workshop

(Crowther, 2013; Lawson & Dorst, 2009; Muratovski, 2016; Tovey, 2015). In this learning environment, students interact with peers thus fostering an ethos of socially-engaged learning experiences, critique and imparting design ideas (Lawson & Dorst, 2009; Tovey, 2015). Facilitator and peer access construct prospects for student learning via conversation, demonstration and design critique (Brocato, 2009, pp. 141). With design critiques, students pose design ideas and prototypes to facilitators and peers in support of reflection, knowledge acquisition and learning about and to design (Brandt et al., 2013; Kuhn, 2001). The global COVID-19 pandemic challenged the constructivist learning space in fashion design education.

Remote teaching and learning opportunities and challenges

The COVID-19 global pandemic impacted on many elements of modern society, including education, resulting in a transformation of human life (Benito, et al., 2021, pp. 52). Globally, tertiary education students experienced varying levels of on-campus access ranging from complete closure, during high-risk pandemic spread, to a combination of on-campus and remote learning (Benito, et al., 2021, pp. 52). Friedman and Escano (2020, pp. 27) claim that art education, particularly in fashion design, have characteristics suitable for remote learning due to substantial reliance on visual demonstration and the fact that, traditions of teaching online art and design processes exist. However, the transition to fully online and blended learning has not been smooth and has thus been described as 'emergency' and 'lighter distance' environments (Suhartini, et al., 2020, pp. 654). Although opportunities exist for educators to apply online teaching and learning to guide, mentor, and encourage students to experiment with technology, the benefit seems to be reserved for the select few who have access to digital resources. As such, structural inequalities in terms of socio-economic status, race, and resource access are evident (Suhartini, et al., 2020, pp. 654). The digital divide is a concept used to characterise the disparity between those who have Information and Communication Technology access and those who do not (Gudmundsdottir, 2010, pp. 3).

In Afrika, although the use of computers and the internet for teaching and learning is still in its infancy, sub-Saharan Afrika has one of the fastest-growing mobile phone subscription rates worldwide and the use of mobile phones to support learning in resource-challenged educational environments has gained momentum (Isaacs, Roberts & Spencer-Smith, 2019, pp. 1). The use of language apps, virtual tutoring, video conferencing tools and digital learning management systems such as Bb and Fronter to provide access to teaching and learning materials coupled with open-source software such as Moodle, KEWL.Nextgen and Sakai/Vula are evident (Kini-Singh, 2020; Unwin, et al., 2010). A recent study found that digital teaching and learning can enhance learning experiences for both educators and students alike, particularly in situations where peer learning and collaboration are encouraged but uncertainty exists (Rambe & Chipunza, 2013, pp. 331). Although this might be the situation within the South African context, the digital divide reveals a divide between those who can and those who cannot access local content, websites and language. Students with English, as a home language, are at an advantage since most content is presented in English (Gudmundsdottir, 2010, pp. 10). The language challenge may possibly present a challenge in terms of 4IR interactive digital technologies.

4IR and interactive digital technologies

4IR requires industries to digitise or digitally streamline operations to create or realise a fully integrated system (Chuo, 2019, pp. 107). Characterised by merging digital, biological, and physical worlds, 4IR has introduced new technologies such as artificial intelligence (AI) (Ndung'u & Signé, 2020, pp. 61). AI refers to replicating human intelligence in machines and technology to apply traits of the human mind in learning and problem-solving (Frankenfield, 2021). Examples of AI technologies that individuals interact with include, for example, smartphone assistance such as Siri on Apple iPhone devices or Alexa, developed by Amazon, and email spam filters (Built In, 2021). The differentiation of new 4IR technologies, compared to previous industrial revolutions, focuses on how such technological developments can best assist users of such technologies, as well as consideration in terms of the level of interaction and user engagement. 4IR is thus synonymous with innovation and creating digital technologies that integrate human-centred opportunities that are socially inclusive (Xing, Marwala, I & Marwala, T, 2018, pp. 187).

Interactive digital technology or media refers to various approaches people use to process and share information (Dhir, 2021). Examples of interactive technologies include social media, WhatsApp, virtual reality and smartphone applications (Dhir, 2021). Many sectors, including higher education (HE), incorporate interactive digital technologies in disseminating and teaching curricula. Literature highlights that “the use of the internet and dependency on digital gadgets has transformed the learning and knowledge sharing approaches” implemented in the HE sector (Habib, et al., 2021, pp. 518). As most sectors begin to digitise and streamline practices and systems to 4IR processes, an integrated and digitally-driven structure becomes instrumental in learning activities (Dhir, 2021).

Contextualising the COVID-19 mask project

To move to remote pedagogy, the authors considered five pedagogical questions to guide the design of the COVID-19 mask project, namely 1) how can practice-based teaching and learning move to remote platforms; 2) how can learning outcomes transform; 3) how can theory integrate with practice; 4) what interactive digital technologies and teaching and learning methodologies can be applied to ensure students remain engaged; and 5) how do educators interact with students? Against this backdrop, this section responds to the first aim, to contextualise the COVID-19 mask project.

The COVID-19 mask project was designed for execution with first-year fashion design students over a duration of seven weeks at the commencement of the second semester. The mask project was designed to integrate a theory and practice-based module by way of remote pedagogies. The theory-based module consisted of two units, namely, basic research and human-centred design (HCD). These units were important to incorporate and inform the practice-based module. The practice-based module consisted of three constituents, namely, design, patternmaking and garment construction (the ‘making’ aspects).

As such, the overall aim of the mask project was to integrate and apply theory-based knowledge about the HCD principles and basic research to co-design, prototype and make a wearable COVID-19 mask in response to real-world user needs and problems. To engage with co-design activities, the authors drew on Harvey and Smal’s (2021, pp. 33) framework known as *The Generative Tool* comprising seven activity modes namely 1) needs, goals, preferences and context of design use (what to design), 2) define design criteria and constraints (requirements), 3) idea (brainstorming), 4) action plan, 5) concept, 6) prototype, and 7) product. In other words, the activities associated with research, design processes and, finally, product development.

However, the authors were mindful that these first-year students were only exposed to seven weeks of first-semester, contact teaching, and learning. Hence, they had limited vocational exposure to the usual studio-based pedagogy and socially-engaged, constructivist learning space. Therefore, learning outcomes transformed in four fundamental ways.

Firstly, in a contact teaching and learning situation, to achieve learning outcomes, activity tasks were designed in a way to adopt a role-playing strategy where one student assumed a user role and another that of designer, culminating in a two-member co-design team. For the mask project, students were required to select a real-world user such as a family member or friend, to form part of the co-design team.

Secondly, the first and second modes in *The Generative Tool*, namely to identify needs, goals, preferences and context of design in order to define design criteria and constraints, required empirical conversations. Contact theory allowed opportunity to design activity tasks in a way that students could practice the art of conversation and probing were essential to gather empirical information, user feedback and engagement in a co-design process. However, remote pedagogy removed this socially-engaged learning experience in that, to gather and analyse empirical information to define design criteria and constraints, a qualitative open-ended questionnaire was designed for students to apply as a research instrument, as opposed to conversations. The rationale for this particular research instrument considered that some students may be living alone or even in self-isolation.

Thirdly, in contact teaching, the practice-based studios are equipped with discipline-specific tools, equipment and specialised machinery to accommodate for human-size prototyping and product development. However, remote pedagogy could not accommodate this situation. Therefore, the tangible product of a mask. In addition, the authors acknowledged that in a remote learning situation, students may not have access to specialised machinery. For this reason, the outcome and activity tasks were flexible to accommodate for hand-sewing techniques or the application of discipline-specific machinery depending on students' unique situations. Similarly, the mask project design activities required experimentation with fabrication techniques such as fabric dyeing but regulations meant that students may not be in a position to purchase materials. Therefore, experimentation required the use of natural dyeing techniques that were easily available at home. Likewise, recycled materials were required to make the mask.

Fourthly, the authors questioned how students would submit a tangible product and document the design process activities against the backdrop of *The Generative Tool*. Previously, design process activities were documented in a hard-copy design journal and tangible products were physically submitted on campus. To accommodate this, a digital design journal template was generated to align with *The Generative Tool.* As such, students were required to document the design and product development process and user feedback by applying computer-aided design (CAD) software packages. To support engagement with activity tasks and develop a digital design journal, for each of the seven activity modes presented in *The Generative Tool*, detailed step-by-step guidelines were posted on Bb with hyperlinks directing students to online video tutorials. To obtain and document user feedback, depending on individual situations, students could apply any preferred communication tools such as face-to-face or virtual conversations or digital applications.

The mask project culminated in the submission of a digital design journal as the summative assessment instrument. For both theory and practice-based modules, teaching and learning materials were offered via Bb. Remote teaching methodologies included hyperlinked video tutorials, pre-recorded, compressed audio recordings used in conjunction with PowerPoint slide decks, which were converted to PDF format as a means to reduce student data costs. The authors were of the view that students may well be 'digital natives' and prefer interactive learning materials to remain engaged as opposed to only textual. In the same light, regular Bb collaboration sessions were held to ensure constant interaction between students and educators, as well as for the purpose of formative assessment. Bb discussion forums were set up to support learning-on-the-go question and answer opportunities. As a further support mechanism to interact and remain engaged, WhatsApp and email tools were implemented as additional communication strategies. The summative assessment digital design journal was submitted via a portal created on Bb.

Methodology

The methodology employed secondary data collection in the form of artefacts comprising selected students' digital design journals. Artefacts include, for example, documents, photographic and film materials, objects and drawings (Banks 2009; Flick, 2018; Silverman, 2014). Prosser (2011, pp. 479) states that visual images are employed for comprehensive empirical purposes to structurally link visuals and contextualisation. As such, in this research endeavour, selected students' digital design journals were not analysed but rather used as comprehensive evidence to support contextual narration in order to juxtapose past scenarios with pedagogic reflection on the COVID-19 mask project. Aligned to the third aim of this paper, the educators' retrospective analysis is drawn from reflection-on-action.

Ethical considerations were observed by requesting ethical consent from the Department Higher Degrees Committee to use selected students' digital journals in this paper. In addition, student confidentiality and anonymity are ensured by eliminating any personal information such as names, surnames, and student numbers. For that reason, when citing the work of selected students, non-gender-specific pseudonyms (Eden and Morgan) are used.

Findings

Digital design journal: juxtaposing past practice with the COVID-19 mask project

In response to the second aim, this section draws on selected first-year students' digital design journals to contextualise and juxtapose past scenarios with the COVID-19 mask project. From retrospective analysis, three fundamental juxtapositions emerged.

Firstly, in the past, students captured research conversations, data analysis, design and product development process activities and user feedback in hard-copy design journals. However, through educator reflections, students engaged with the design journal in an unorganised manner whereby documentation occurred in various notebooks or paper-sheets and prior to summative submission, students would attempt to cut, paste and collate disorderly material into a hard-copy design journal. In the same light, although in the past, activity tasks required that hard-copy design journals be structured to align with *The Generative Tool*, on submission, it was confusing for educators to decipher which activities corresponded to which of the seven activity modes in *The Generative Tool*. With the design and implementation of a digital design journal template, most students excelled in producing well-organised, coherent and well-planned digital design journals that demonstrated design thinking, action, reflection and iterative cycles of refinements. In addition, students were found to be 'digital natives' and applied software packages to compile the digital design journal, which seems to have eradicated the challenge of last-minute attempts to cut, paste and collate a hard-copy design journal.

Secondly, in the past, research, by way of conversations, was documented via field notes, analysed in a systematic manner and recorded in hard-copy design journals. Although rich in information and data analysis strategies, the move to digital design journals showed deeper rigour and engagement with research in a planned and systematic manner that led to design criteria and constraints. Figure 1 is a graphical image of the research analysis stemming from the data collected from the respective user regarding the problems and proposed solutions in terms of comfort, practicality, fit, environment or context of design use, and style of the COVID-19 mask. Data analysis continued, as shown in Figure 2, to develop a set of design criteria and constraints emanating from the research. These design criteria and constraints acted as a framework for designing the COVID-19 mask.

From a third aspect, although hard-copy design journals demonstrated engagement with experimentation and exploration, the digital design journals revealed deeper participation, on the part of some students, with brainstorming, experimentation and exploration of multiple design solutions to best align with user-generated design criteria and constraints. In the same light, digital design journals included detailed photographs as a strategy for documentation. Some students surpassed expectations in applying innovative digital applications to obtain user feedback and capture such feedback in digital design journals. The possibility exists that because students were engaging with design process activities remotely, those students who took the initiative might have had more time for experimentation and exploration. Figure 3 represents concept stage activities that include detailed sketching activities with supporting narratives to demonstrate thinking, motivation, and action. In the same light, given the emphasis on user participation, Figure 3 shows user feedback to support refinement. Figure 4 depicts experimental fabric dyeing techniques as part of the concept stage activities. As such, Figure 4 demonstrates the practical, experimental testing process before product development.

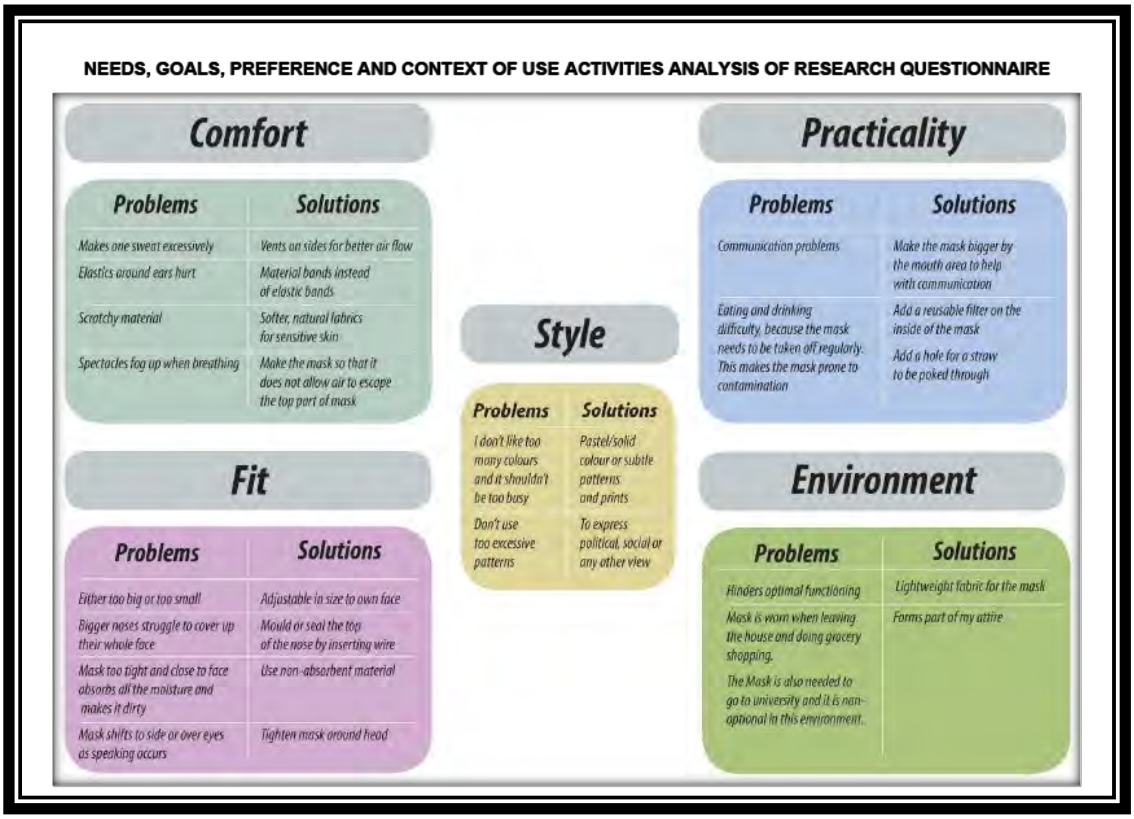

Figure 1: Analysis of research. Developed by Eden (2020)

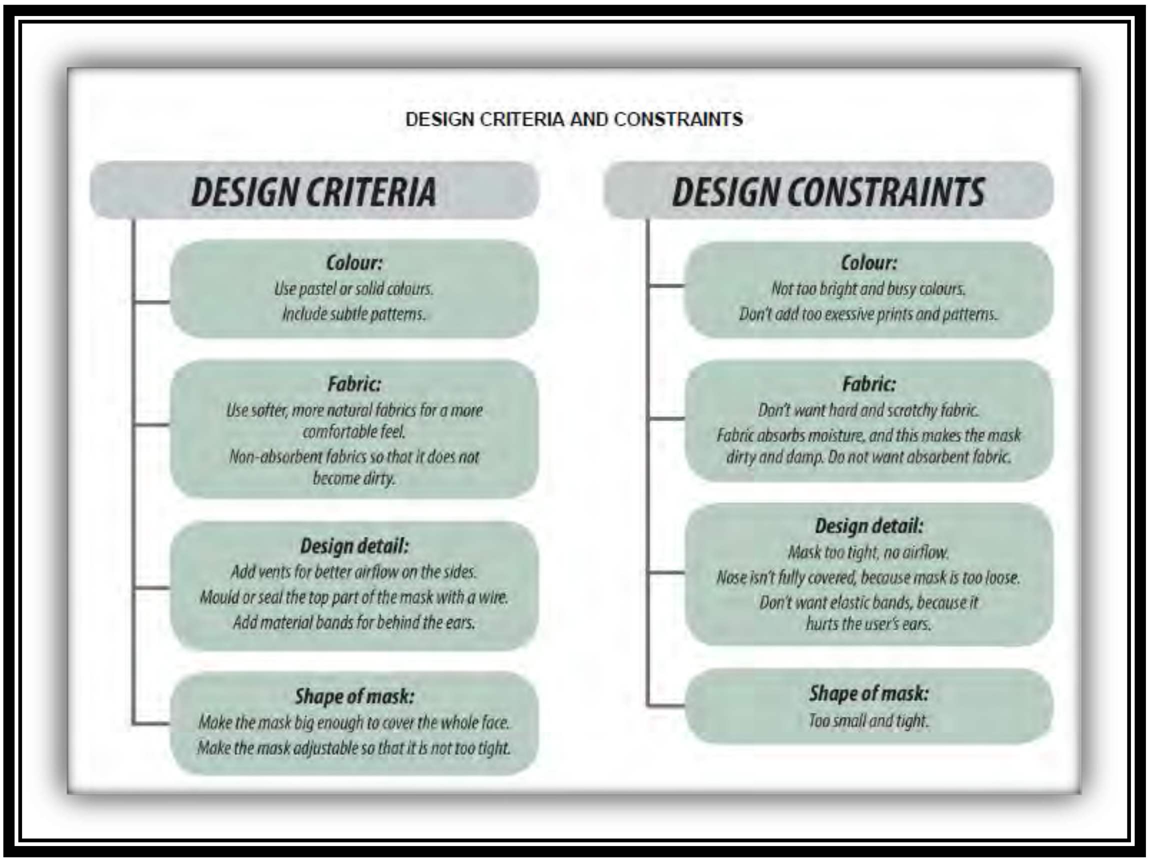

Figure 2: Design criteria and constrains emerging from research analysis: Developed by Eden (2020)

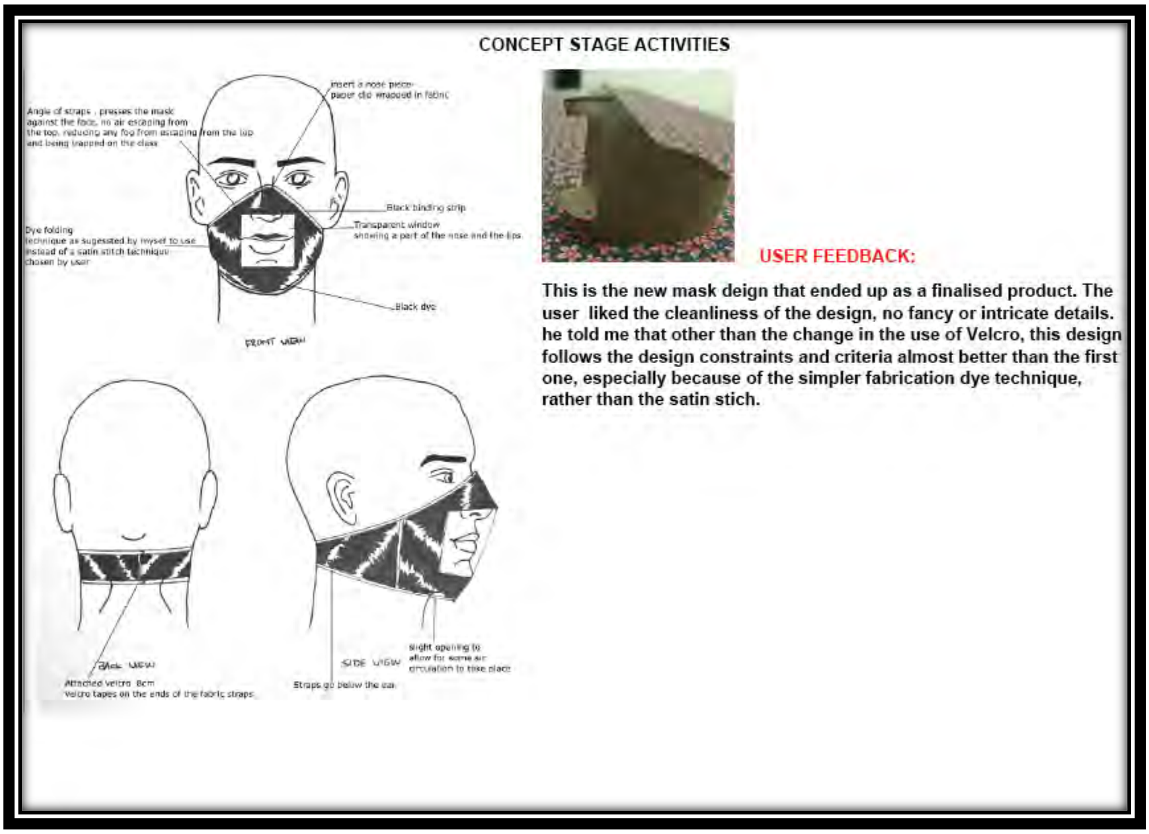

Figure 3: Concept stage. Developed by Morgan (2020)

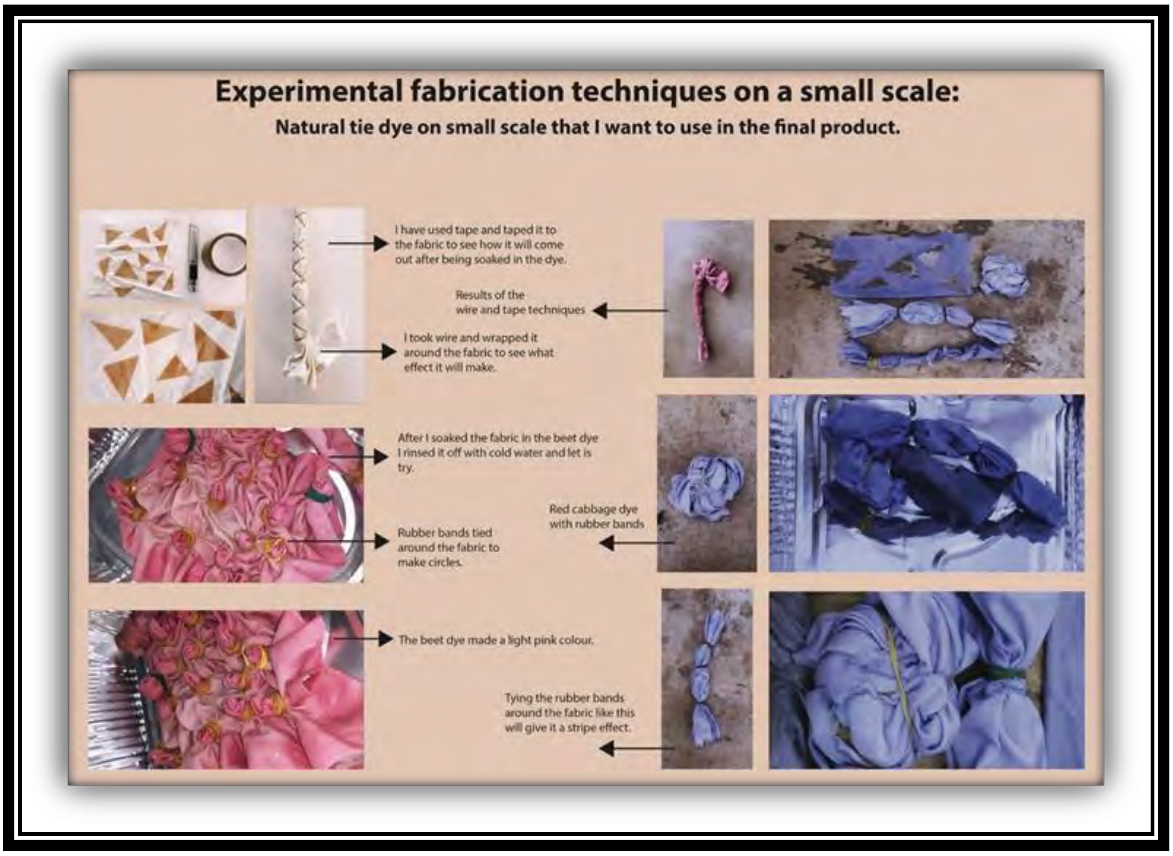

Figure 4: Experimentation. Developed by Eden (2020)

Educators' retrospective analysis

Against the backdrop of reflection-on-action, this section links to the third aim and narrates the challenges, the educators' lived experiences, and their retrospective analysis.

The online teaching experience is vastly different from the conventional, studio-based approach, which posed limitations for educator-student interactions. The challenge experienced with the 'making' aspects in terms of patternmaking and garment construction is that students' individualised designs raised difficulties in addressing each student's distinctive design specifications to assist with divergent various construction methods. The educator-generated video tutorials consisting of construction methods relating to four general designs for a three-layer mask and three fastening methods. However, students presented specific queries relating to their masks, and addressing all student queries electronically was challenging. Often, some students did not follow through with electronic formative feedback but some took the opportunity to interact and gain meaningful feedback.

The importance for students to be self-driven, motivated, and experimental became evident in an online environment. Usually, in a studio-based setting, students are encouraged to experiment with a variety of fabric manipulation techniques with provided materials, workspace, and guidance to do so. However, with remote learning, some students did not experiment with a variety of fabrication techniques. Instead, they chose what appeared to be the easiest or simplest fabrication technique. On the other hand, for some students, a hidden curriculum of, for example, independence, motivation, and self-directed innovation emerged under remote conditions. In such situations, the experience was extremely rich and outcomes innovative.

Unilingual communication posed another challenge. The studio space provided frequent opportunities to communicate with students via Afrikan languages but in a digital environment, this was not an easily accessible communication strategy because the English language dominates the internet. Likewise, of South Africa's eleven official languages, English is the only available language on Bb and also the language used to prepare student learning materials. The haste with which migration to digital learning occurred did not allow sufficient time to be more inclusive in using Afrikan languages which may have disadvantaged some students.

Challenges around computer-aided design

Still linking to the third aim, this section narrates on the challenges, the educators' lived experiences and their retrospective analysis pertaining to CAD.

The digital design journal required that students use any accessible CAD software packages, such as Adobe Creative Suite or open-source software. Although the licenced Adobe Creative Suite was accessible in departmental computer studios, national lockdown regulations coupled with institutional phased-in student reintegration plans posed challenges for on-campus access. Off-campus access to licenced software became temporarily available during the course of the year but these first-year students had no exposure to CAD software. As such, educators and students pursued alternative, open-source software packages such as Inkscape and Gimp for more accessible access. Although these alternative software packages solved the problem of temporary inaccessibility to CAD resources in departmental computer studios, students had to be remotely taught how to use open-source CAD software packages. Online video tutorials were created and shared with students for remote, independent learning and practice. In the same light, educators were required to fully understand the open-source CAD packages, from a technical aspect, due to student technical-related queries about the software. Learning and using alternative software packages required more preparation, as well as educators and students first understanding the software before beginning with the project which impacted on the time allocated for activity tasks.

Software compatibility with laptops, desktops, and hand-held devices was another challenge that required investigation through online tutorials or guidance found in website forums. Challenges regarding student experiences emerged as some students did not have remote access to laptops or desktops; hence CAD compatibility on phone devices posed challenges. To accommodate such challenges, students could apply hand-drawings, photograph them and insert them into the digital design journal. However, students could produce digital design journals through availability and access to open-source CAD packages and various other access methods.

Conclusion

This paper shows that despite the swift move to remote methodologies, the design and implementation of the COVID-19 mask project to integrate theory and practice-based modules at a first-year level is possible. However, it required educators to be responsive and consider the diversified, Afrikan student body, critical thinking, transformation of learning outcomes and application of interactive digital technologies to ensure students remain engaged. Educators cannot expect students to deliver historical learning outcomes and offer conventional teaching and learning methodologies in a unique Afrikan remote environment.

From an Afrikan lens, the findings reveal challenges in terms of unilingual communication which may have disadvantaged some students. Although English is the official language of instruction, the recommendation is further research to explore the barriers to Afrikan languages in a remote teaching and learning environment.

In addition, students are certainly ‘digital natives’ and therefore the digital design journal is a way forward for fashion design education. Then again, in relation to accessible digital resources, although the findings reveal challenges, educators and students alike demonstrated dexterity and adaptability in applying open-source software to compile digital design journals. The situation of open-source software access changed from the commencement of the 2021 academic year with remote accessibility to off-campus, licensed software packages. However, further research is required in two areas. The first is the feasibility and functionality of licensed software packages in comparison to open-source. The second is to explore the challenges of accessing licensed software packages for off-campus use.

Although student challenges are real, educators’ retrospective analysis allowed for a hidden curriculum, for example, independence, motivation and self-directed innovation, to emerge among some students. This paper did not set out to measure these aspects. Hence, the recommendation is to explore and measure this hidden curriculum as further research.

Despite the lack of research and innovation associated with repositioning practice-based teaching and learning within digital spaces, this paper makes an original contribution to 4IR scholarship of teaching and learning in fashion design education. As such, this paper aligns and contributes to the conference focus on design education within the context of Afrika and 4IR digital technologies.

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Exploring manual and digital pattern design methodologies towards the development of the design education offering

Annelize Scheepers, *Stadio*

Abstract

This paper considers the importance of preserving 'hand-skills' in fashion design education for students to acquire the ability to visualise the shape, proportion and fit of a garment instead of relying solely on a computer. In addition, the apparel industry requirement for patternmakers to be familiar with digital patternmaking technology to speed up the efficiency of the patternmaking component of the manufacturing process is of equal importance. Both techniques are examined and compared in the research.

The connection between manual patternmaking and computerised technology when constructing patterns for the fashion industry is explored through means of qualitative research and purposive sampling for this paper.

The theoretical framework that underpins the study is the System Theory, which also guided the methodology used in this study. The Inputs, as part of the system theory, include both computer-generated patternmaking and manual patternmaking systems to produce outputs in the form of garments. The transformation of a garment, during construction, is part of a system and usually requires an expert machinist. The output of a system for garment construction usually includes a mock garment that guides the evaluation of fit. The creativity and functionality in the physical fit, aesthetic fit and functional fit of both the digital and manual results are assessed.

The findings from this study reveal the important role of manual patternmaking, in combination with the digital capabilities that the industry requires from pattern designers. It is evident from the findings that alternative education approaches in fashion design courses should be considered. Such an alternative approach may involve consideration around, training time and the potential for inter or multi approaches by including both: manual and digital patternmaking techniques. Computerised pattern design approaches are an indispensable instrument to keep pace with the advances in the garment industry, but this research proves that it is necessary for the future generation, in a world of technology, to learn manual patternmaking skills in order to preserve a high standard of technical knowledge.

Applying both manual and digital patternmaking approaches to pattern design courses advance the continuation of manual skills, yet, includes a collective learning setting where students are involved in the progression of a career-orientated learning experience, preparing them for the technological world that they are about to enter.

Keywords: aesthetic fit, digital patternmaking, functional fit, manual patternmaking, pattern-design, physical fit

Introduction

Mechanised textile manufacturing launched the textile and clothing industry into the first wave of mass production and led the way into the first industrial revolution (Boydell, 2010). As the South African fashion industry negotiates the fourth industrial revolution, it is evident that South Africa is underprepared (Campbell, 2017). However, digitally rendered patterns are already well established in the fashion manufacturing process and significantly accelerate output rate (Datta & Seal, 2018). Equally important, is manual patternmaking in the development of fundamental pattern design skills (Schenk, 2007). This paper considers the comparative outcome of digitally rendered patterns to manually crafted patterns taking into consideration the complexity of the design, grade-ability of the pattern, timekeeping, the quality and accuracy of the finished patterns, the truthfulness to the original design and a comparison of the fit in the sample garment.

The value in comparing pattern design methodologies is to inform possible future study directions in patternmaking. The benefits of a multi-method approach are well worth exploring to give learners an all-inclusive outcome in the area. Strong design is initiated through a sound knowledge of pattern cutting in combination with a good understanding of body measurements, shape, proportion, and silhouette. A combination of technical and creative skills merged with theoretical approaches is applied during the pattern design process. The competence to visualise and realise an end product necessitates the development of the before mentioned skills. For an experienced practitioner, this comprehension is fundamentally learnt through repetition and observation (Pritchard, 2013). For a student, practising patternmaking principles, the comprehension and competence to visualise and realise a successful end product is yet to be achieved as they are in the learning phase of repetition and observation. The objective for tertiary institutes is to prepare the student for industry (Schenk, 2007). Undoubtedly the fourth industrial revolution asks for more than traditional educating approaches (Selingo, 2018).

It is also important to understand the preservation of 'hand-skills' in fashion design education and the influence of manual patternmaking on a student's ability to visualise the shape, proportion, and fit of a garment instead of relying solely on a computer (Pritchard, 2013). In addition, the apparel industry requirement for patternmakers to be familiar with digital patternmaking technology to speed up the efficiency of the patternmaking component of the manufacturing process is of equal importance. Published research on the comparisons between manual patternmaking (Joseph-Armstrong, 2006 & Nakamichi, 2010 & Nakamichi, 2011) and digitally rendered patterns (Stott, 2012) is rare, but regardless of the infrequency in documentation, the advantages of the investigation lie in the considerations and bearing of computerisation on pattern creation as this is significant for the prospects of manufacturing standards.

In particular, Dr Pam Schenk (2007), a key writer in the field of 'hand-skills' in design, extensively researched paper-based design, and through her findings provides various reasons for the significance drawing plays in concept development. She explains that: "the consistent and overwhelming finding of [her] work is that drawing remains at the very centre of the creative and developmental process of design". Suitable techniques and regular drawing preserve 'visual literacy', the capacity to improve ideas, and observational skills. Drawing also generates an awareness of an essential perception and comprehension of scale and organisation (Schenk, 2007). For this reason, conventional manually crafted patterns could play a significant role in design development. Manual patternmaking allows for the realisation and development of new design ideas on paper while simultaneously refining the means of visualising a design when three-dimensional shapes are created on a figure form by means of pinning pattern pieces together on the form. A specialist patternmaker's methods will regularly include knowledge that is not easily verbalised but fundamentally acquired through experience and observation (Brown & Duguid, 1998).

Fasanella on the other hand, works as a manual patternmaker and a digital patternmaker, her opinion is that: “People are losing sight of the difference between preferences, available tools, and skills” (Fasanella, 2012). She explains that both methods have their advantages and can be equally efficient. Fasanella (2012) also states that pattern making is a time-consuming process and can proportionately exhaust time whether being done digitally or physically. Computer-aided design (CAD) does however reduce the time needed on slight pattern alterations and styling modifications. CAD also “facilitates the ease of offshoring product development” (Fasanella, 2012). However, digital patternmaking could also possibly be a disadvantage for clothing manufacturing regarding the maintenance and experience of industry knowledge. She concludes by saying that: the knowledge and skill in patternmaking supersede methodology (Fasanella, 2012).

Literature survey

Dr Pam Schenk (2007) says: “Drawing is about thinking, analysing, exploring and imagining”. Manual pattern construction requires reasoning, technical drawing analysis and the exploration of shape, proportion and silhouette in the process to enable successful outcomes (Schenk, 2007). A parallel could be drawn between drawing and manual patternmaking in the deliberation and interpretation of information, also the re-interpretation and re-production of the initial design to create a three-dimensional solution (Sennet, 2009). Therefore, it could be debated that digital pattern making prevents self-directed innovation and comprehension of pattern outcomes and the purpose in pattern manipulation actions that are required to construct a particular result (Sennet, 2009). Schenk (2007) concludes by saying that: “It is also important for students to realise that much design software has actually been developed through research into the practice of design. Without the experience of the ‘physical’ world of paper-based drawing, students will struggle to understand many of the tasks that the digital media have been developed to perform”. Flat patternmaking principles, namely dart manipulation, added fullness and contouring as explained by Joseph-Armstrong (2006) are essential to the success of the garment outcome and fit. This is also why the preservation and teaching of hand skills in patternmaking is essential in a technological world amidst the apprehension of the fourth industrial revolution.

Pattern design books are “based on the contributions of great patternmakers of the past and adds to them new innovations and concepts gained through years of experience in the industry and in the classroom. … Comprehensive enough to be a valuable tool now and in the future regardless of fashion trends” (Joseph-Armstrong, 2006).

Although there is an infrequency on the comparisons between manual patternmaking (Joseph-Armstrong, 2006; Nakamichi, 2010; Nakamichi, 2011) and digitally rendered patterns (Stott, 2012), Hodakel (2020) states that “technology [makes] it easier to produce accurate designs that speed up the production process”. Hodakel (2020), explains how computer-aided design can synchronise numerous manufacturing procedures in the clothing industry, especially for patternmaking and grading. Illustrations are digitised, which are then printed by garment plotters. “The use of innovative software enables businesses to keep up with trends and garment development through intelligent platforms” (Hodakel, 2020). Fast fashion is partially realised through digital pattern creation, an irreplaceable tool for improving efficiency and productivity. Software solutions include Lectra, Gerber Accumark, Optitex, Autodesk and Assist (Hodakel, 2020).

Fasanella (2012) works with both patternmaking methods and is of the opinion that they are mutually efficient and that each method has its advantages, but includes that the time spent on pattern alterations is less when using CAD. The interesting point that Fasanella makes is that the drawback in digital patternmaking could remain in the maintenance and proficiency of industry knowledge. This is a similar thought that Helen-Armstrong makes when she talks about the "years of experience in industry" Fasanella (2012) presumes that the comprehension and skill in patternmaking supersede methodology (Fasanella, 2012). Most present patternmakers however, have initially been trained as manual patternmakers making it difficult to determine the result of the developmental process when paper-based-patternmaking is excluded.

To resolve this dilemma, this paper addresses the question: What is the outcome when comparing digitally rendered patterns to manually crafted patterns while including the assessment of the garment, complexity of the design, grade-ability of the pattern, timekeeping, the quality and accuracy of the finished patterns, the truthfulness to the original design and a comparison of the fit in the garment? Shin (2016) evaluates the complex concept of garment fit through the lens of three measures: Physical fit, Aesthetic fit and Functional fit.

Physical fit is described as "features of fit that are physically perceived in terms of the relationship between clothing and body, such as tightness and length" (Shin, 2013: 44). In earlier studies, Shin found that customer inclinations contrast in opinion when considering the tightness of clothing fit. Supplementary to the tightness of fit, the length of garments also needs consideration as taller people favour clothing that is long enough for their limbs, while shorter customers select pieces where the length of the garment is appropriate for their body height. In consequence, customers evaluate a good physical fit by the extent to which they have had difficulty in past experiences concerning appropriate physical fit for their figure and height (Shin, 2016).

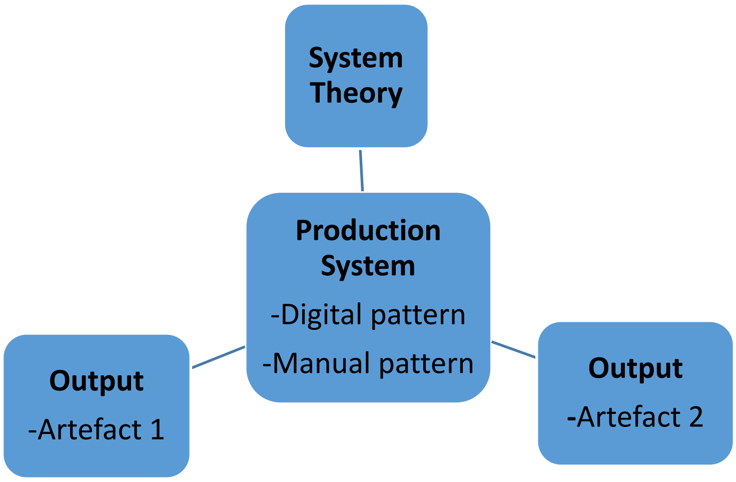
Aesthetic fit is explained as "features of fit that are visually perceived and assessed when looking at an individual's dressed body, such as overall appearance related to the body and attractiveness" (Shin, 2013, p. 44). Consumers assessed aesthetic features of fit based on how the clothing looked when wearing the piece, whether the garment displayed positive features and concealed imperfections. Shin stated that examining only physical fit limits the consumers' insight of fit because the customers' observations include other elements, such as personal style, current fashion trends, and personal impressions of their own figure (Shin, 2016).

Functional fit signifies "features of fit that are perceived when the dressed body is moving for activities, related to restriction or lack of restriction of movement" (Shin, 2013, p. 44). A garment that fits well allows the wearer to move comfortably while performing activities and also to move easily in the clothing itself. "Depending on the activities in question and personal preferences, different levels of functional fit may be preferred at different times" (Shin, 2016).

In the data collection phase of this study, the researcher relied on these fit measures and qualitative findings to assist in the assessment of the pattern and garment outcomes.

Research method

Clothing production and planning can be represented through 'System Theories' and patternmaking as a part of the production system that connects patternmaking and manufacturing technology (von Bertalanffy, 1969). The research method, therefore, includes manual and digital patternmaking processes and the sample construction of both patterns by an expert tailor. The transformation process results in the output of pattern and garment comparisons.



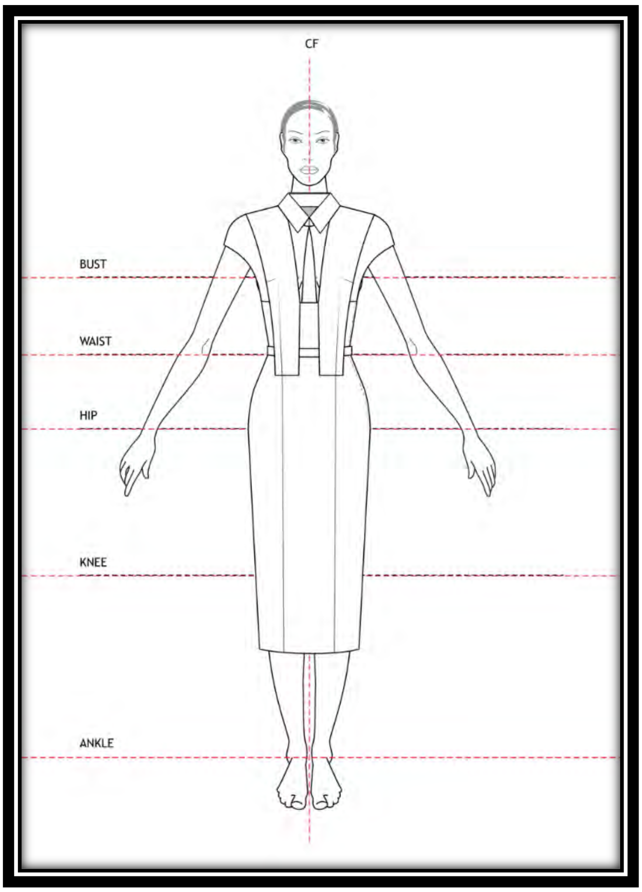
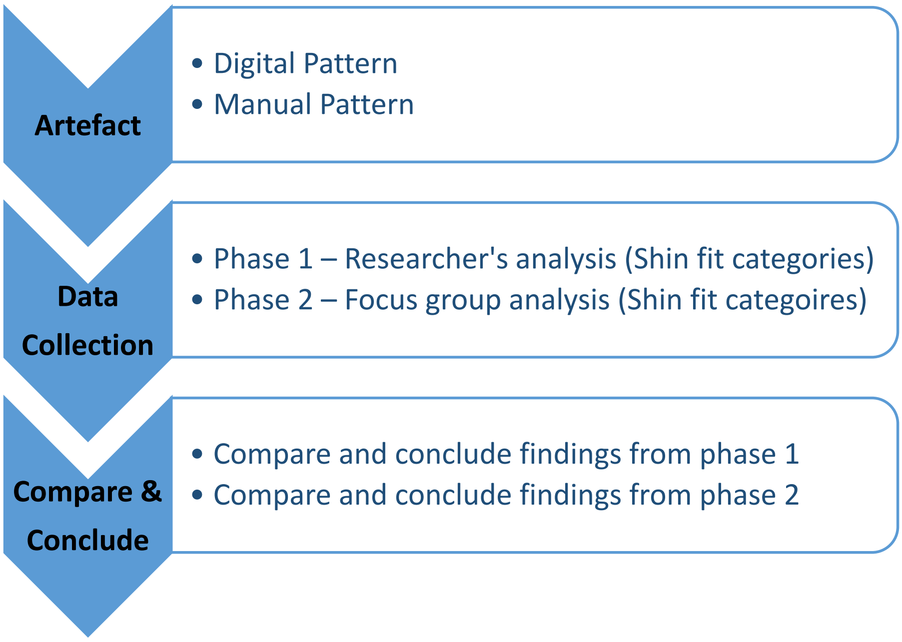


Figure 1: Front view, technical drawing

The technical drawings supplied to the pattern makers were based on current trends and the patternmaking principles as per the recordings and investigations of Joseph-Armstrong (2006). These visuals include the silhouette, proportion, and fit of the design. A pencil skirt design is based on a garment that closely echoes the basic hip silhouette. This design permits measuring the 'fit' of the skirt part with the slightest inconsistencies. Comparisons between the patterns and samples to inform the research were outlined in assessment templates evaluating the silhouette, proportions and fit of the sample dresses.

Purposive sampling in terms of selecting patternmakers for this project was crucial as the skillset of the patternmaker is not compared, but the different methods in patternmaking. The patternmakers were chosen based on their competency and experience in their field of expertise. These two patternmakers drafted the manual and digital patterns respectively for the same dress design. Sample construction garments of both patterns were made.



Qualitative data collection emerged in content consideration and artefact evaluation comparing the difference in manual and digital pattern fit. Visual analysis of the artefact samples was performed to interpret participants perception of fit based on the measures as described by Shin. The overall assessment of samples was concluded through the opinions of an focus group. The focus group made up of five industry experts, an international model, a fashion photographer, a make-up artist, a designer and design assistant, gave their opinion during an interview on the fit of the sample dresses. To gain deeper insight on the subject of fit, the researcher posted photos of the two samples on Instagram and asked individuals to comment on the fit. The methodology concluded and informed critical comparisons of digital and handmade patternmaking methods to support the study.

Data collection criteria were simplified through an operational table that redeems all the objective issues in the study based on the fit measured as explained by Shin.

Table 1: Scheepers. 2020. Operationalisation table of the objectives. South-Africa

Objectives	Measurement tool	Justification
Compare and analyse the Physical fit against the garment proportions of both the mock-up samples respectively.	The fit in garment features that are physically perceived such as length and tightness will be measured under the heading of Physical fit (Shin, 2016).	Records of the actual measurement differences that influence the Physical fit in a garment
Compare and analyse the Aesthetic fit against the garment silhouette of both the mock-up samples respectively.	Aesthetic fit will measure the attractiveness of how the garment clothes the figure (Shin, 2013: 44).	To compare and analyse the Aesthetic fit against the garment silhouette of both the mock-up as recorded by Shin (2016)
Compare and analyse the Functional fit, of both the mock-up samples respectively.	Functional fit signifies and is synonym with the comfort of movement in a garment (Shin, 2013: 44). "Thus, for a garment to meet the needs and desires of the consumer, body measurements, comfort and ease preferences must be translated into [pattern] measurements" (LaBat, 1987: cited in Pritchard, 2013).	Comprehensive appraisals on the creativity and the functionality deemed suitable for the fit of the garments presented.

Artefact evidence

Sample dress – **Manuel pattern** photographic evidence (close-up)

Figure 2: Front view, mock-up sample, close-up photo of the manually crafted pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Digital pattern** photographic evidence (close-up)

Figure 3: Front view, mock-up sample, close-up photo, of the digitally rendered pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Manuel pattern** photographic evidence (front)

Figure 4: Front view, mock-up sample, full-length photo, of the manually crafted pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Digital pattern** photographic evidence (front)

Figure 5: Front view, mock-up sample, full-length photo, of the digitally rendered pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Manuel pattern** photographic evidence (back)

Figure 6: Back view, mock-up sample, full-length photo, of the manually crafted pattern. South Africa (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Sample dress – **Digital pattern** photographic evidence (back)

Figure 7: Back view, mock-up sample, full-length photo, of the digitally rendered pattern. South Africa. (Photographer: Burger, 2020. Photographed by Burger, South Africa, 2020.)

Discussion of results

The images below highlight proportional differences between the original technical drawing and the made-up samples of the digital and manual patterns. Horizontal balance lines in red mark the similarities and differences between the technical drawing and the different samples. The greater majority of the proportions in both outcomes are creatively and functionally suitable within the proposed sample with a skilled approach evident that underpins proportional awareness.

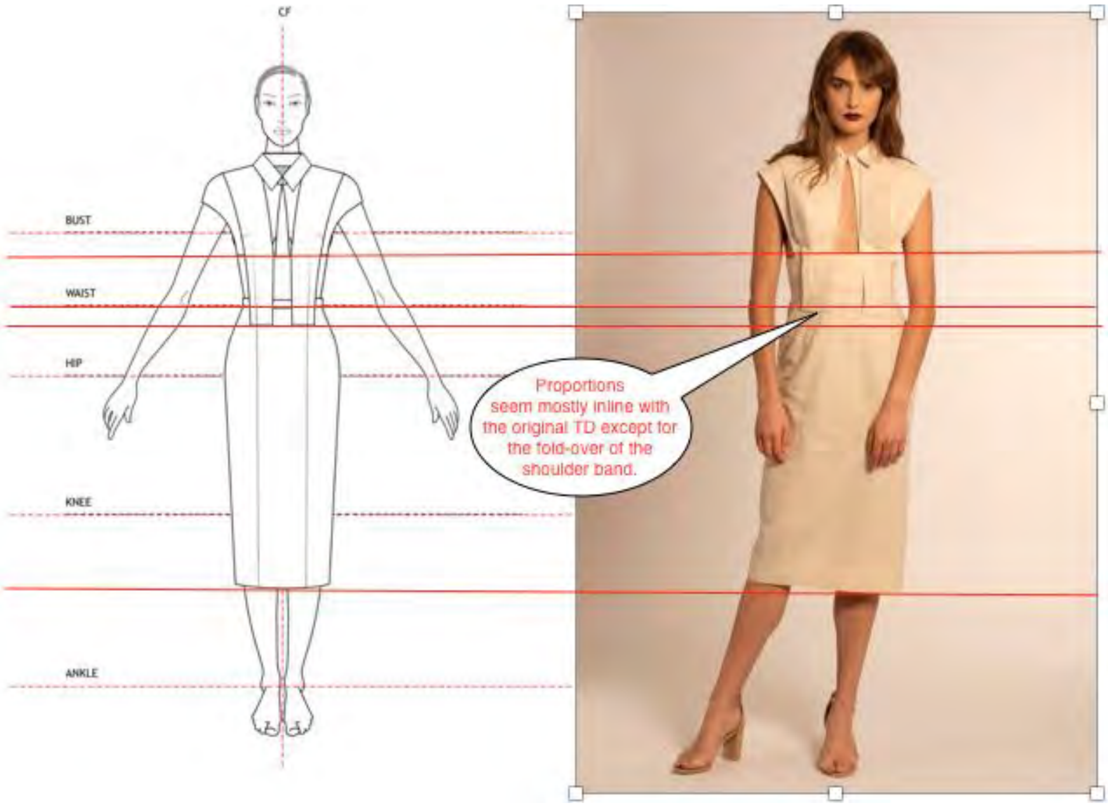


Figure 8: Front, technical drawing and manual pattern mock-up sample comparison. South Africa (Scheepers, 2020)

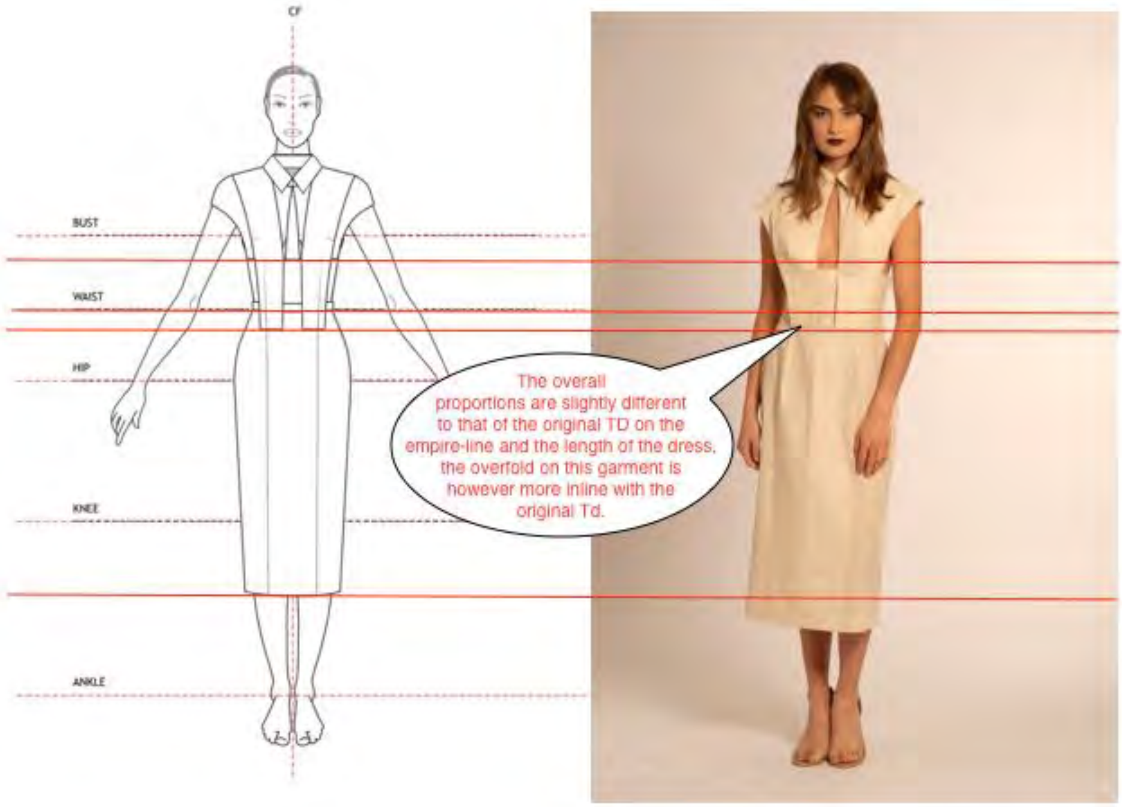


Figure 9: Front, technical drawing and digital pattern mock-up sample comparison. South Africa (Scheepers, 2020)

Proportionately the front panel fold-over at the waist of the sample, made from the manual pattern, is not relevant according to the specifications of the supplied design. The fold-over done by the digital patternmaker is more suitable in this perspective.

The proportions, including the hem length, empire line and the back-panel seam of the sample made from the digital pattern are, however not relevant according to the specifications of the supplied design. An appraisal of the back view can be seen in Figure 10 and Figure 11. The major differences between the technical drawing and both the pattern outcomes are that the technical drawing requires seven pleats in the centre back inset. The manual pattern maker included six pleats. The balance line for the seventh pleat is indicated but not actually manipulated into a pleat. The digital patternmaker included eight pleats in the inset, where four pleats are created on the first side from the centre back and mirrored onto the opposite side.

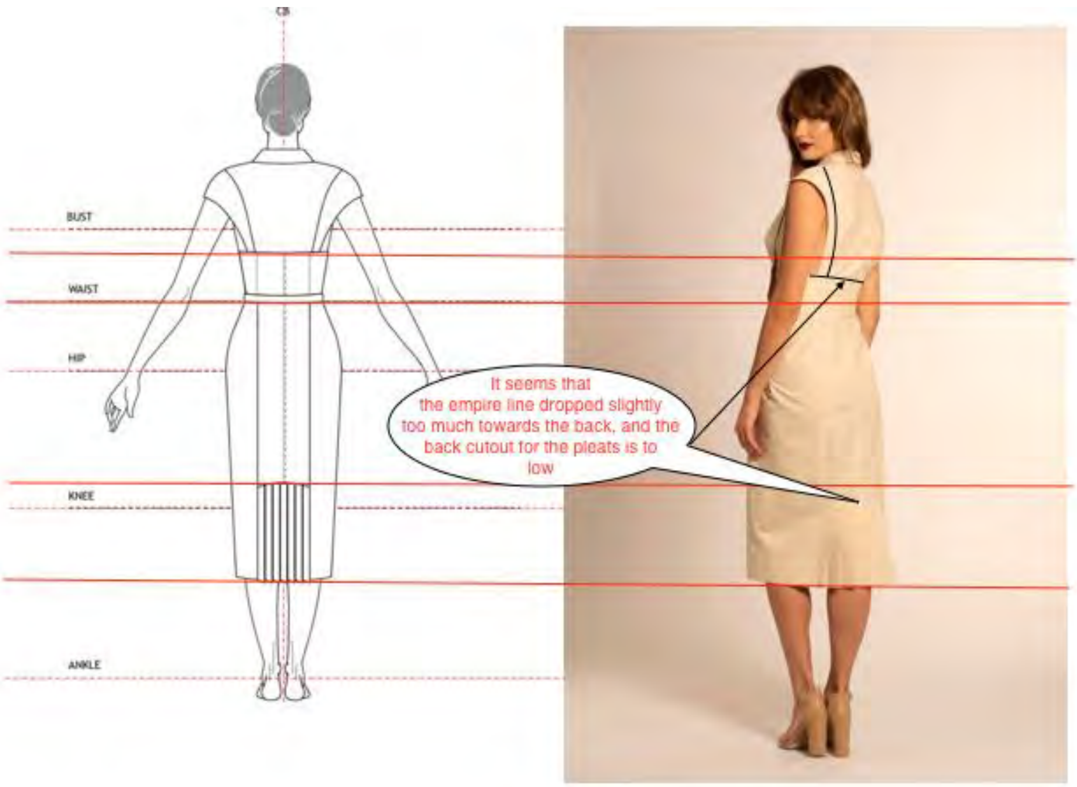


Figure 10: Back, technical drawing and manual pattern mock-up sample comparison. South Africa (Scheepers, 2020)

Through the research, it became clear that Shin (2016) made well-defined observations on customer inclinations and their contrasting opinions when contemplating the tension and looseness of the fit in clothing items. Supplementary to the tightness of how the garment fits, the proportions and length of the skirt were also considered by the focus group. In consequence, it could also be assumed that individuals evaluated the physical fit of the dress by the extent to which they have had difficulty in past experiences concerning appropriate physical fit for their own height and figure (Shin, 2016).

The focus group of industry experts mostly voted in favour of the manual pattern sample dress. The overwhelming comment on the dress made from the manual pattern was that the dress seemed tailor-made. Comments from the panel on the dress made from the digital pattern were that the dress seemed too long and also seemed too big for the model as the skirt did not echo the hip shape snuggly. The public vote on Instagram, with a small percentage of 20% also indicates that they favour the fit of the mock-up made from the manual pattern. This marginal difference in judgement on the physical fit of the garment stresses the research of Shin (2016).

The focus group assessed the aesthetic fit features of the mock-up made from the digitised pattern as mass-produced and flat. Once more, the individual observations from the Instagram vote include other elements and an equally divided opinion was shared. Some appreciated the looser fit and proportions, and also appreciated the commercial value that the garment (made from the digitally rendered pattern) displayed. Functional fit relates to the ease of movement when wearing a garment" (Shin, 2013: 44). Both dresses fit well and allow the wearer to move comfortably in the garment. The professional model did, however, prefer the fit of the mock-up made from the digital pattern on the torso area.

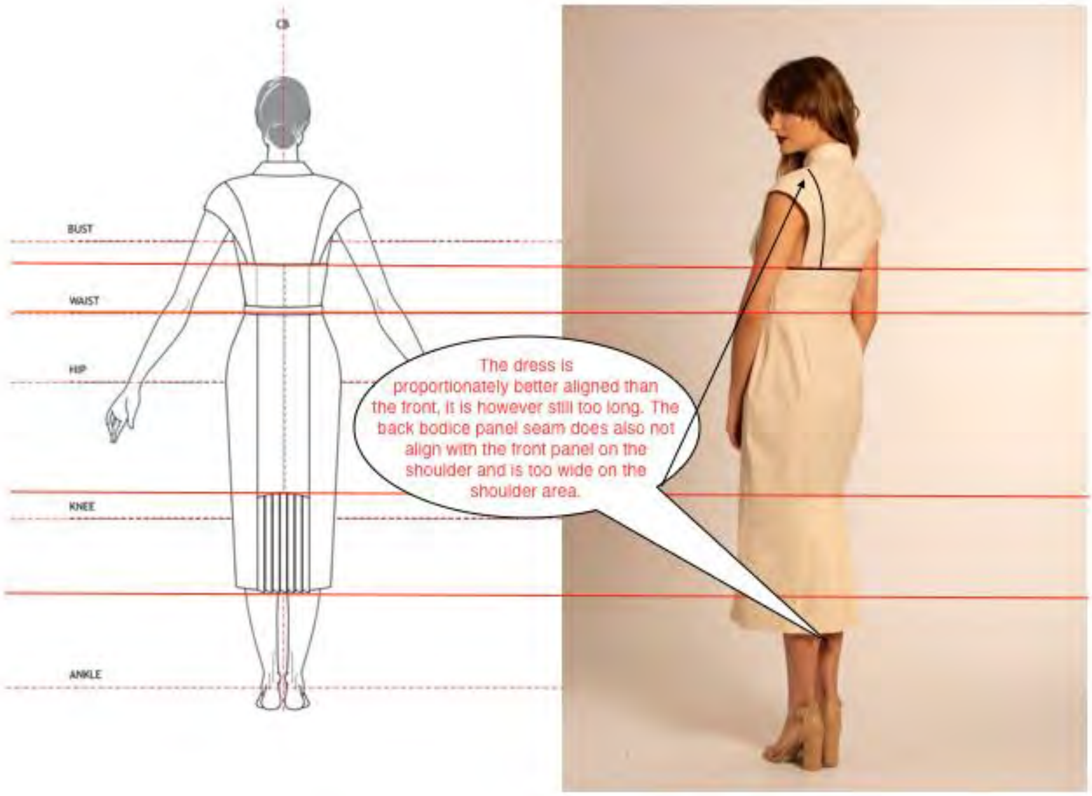


Figure 11: Back, technical drawing and digital pattern mock-up sample comparison, South Africa (Scheepers, 2020)

The difference in the interpretation of the silhouette and proportion was highlighted by gathering data and comparing the dissimilarities in garment measurements. In this case, most of the measurements, when comparing the two methods closely align. Obvious differences in proportion interpretation were in the variation of the measurement on the collar, the length of the skirt and the number of pleats in the CB inset. These differences highlight the deliberation regarding the importance of the patternmaker having the proficiency to visualise the three-dimensional outcome from the illustrated two-dimensional drawing. As both the pattern makers were highly skilled professionals, and the outcome on both garments were successful, the differences do not necessarily point out the inability to visualise, but rather strengthen the position of the two patternmakers in their fields.

The significance of traditional patternmaking skills being maintained remains in the undertaking of the process. Self-directed creativity and comprehension are developed through technical drawing analysis while assessing the shape, proportion and silhouette when manipulating patterns (Schenk, 2007). Although three-dimensional views of a design can be obtained through digital technology, the digitisation process does not necessitate a similar exploration in the silhouette, proportion and fit of the item.

During general public evaluations of the pattern outcomes, it was clear that the innovation and functionality in the ‘Physical fit’, ‘Aesthetic fit’ and ‘Functional fit’ (Shin, 2013: 44), of both results, were equally accepted on a commercial platform. Personal views from the audience did nonetheless indicate the need for customisation in a tailor-made piece when sharing their sentiments on the fit sequels.

The skill application of both participants proved understanding far beyond fundamental patternmaking. It was nevertheless remarkable that the outcome of the digitised pattern proved to have a higher commercial value in terms of a ready-to-wear appeal as viewed by a marginal percentage of participants. The argument to this statement does remain that readymade garments do not fit every individual figure perfectly. A great advantage of digital technology is that the digitised pattern is much quicker and easier to grade into different sizes and that the speed of pattern alterations and delivery globally, is much faster. The quality and accuracy of the finished patterns in both cases were excellent and seem to be reliant on the skill and punctuality of the patternmaker and not so much the chosen method. The findings and data analysis does suggest the preservation of 'hand-skills' in order to preserve patternmaking perceptive, but vividly prove the prerequisites of new technologies in a global fast-fashion market. The need for both old and new methods of patternmaking is not displaced and remain possible study directions for young designers.

Conclusions

Current product offerings of fashion institutes incorporate learning to establish an in-depth comprehension of manual pattern making. With the loom of a fourth industrial revolution, it seems essential that higher education adjust classic teaching modules. Within the current digital era, deliberation on whether a far-reaching grasp in the craft of manual pattern making will be required in the future, is mandatory. The question remains whether the art of manual patternmaking will be preserved if digitised programmes assist the patternmaking process.

The Literature review includes relevant research that assisted in the exploration of patternmaking methods. Dr Pam Schenk (2007) stresses the importance of maintaining 'hand-skills' in fashion design education in order for students to acquire the ability to visualise the shape, proportion and fit of a garment. Fasanella (2012) recognises the advantages of each patternmaking method, but includes that the downside of digital patternmaking could remain in the preservation and proficiency of industry knowledge.

Qualitative data collection for this study transpired through content analysis and artefact evaluation. These findings do, however, inform the adaptation of both manual and digitised pattern design modules on a tertiary level to enable a more wholesome multi-method approach in preparing fashion design students for the industry. Collectively, incorporating both digital and manual pattern learning experiences, where undergraduates are instantaneously involved in the advancement of career dedicated learning, will hopefully instruct an education beyond a reliance on just technology for current students.

It is not debatable that technological skills are indispensable for the future of garment manufacturing in the fashion industry. There are frequent new developments in technology, patternmaking systems are regularly updated, and three-dimensional body scanning is available to aid in digitally rendered patternmaking and design (Pritchard, 2013), and even though Chinese factories are leading the global supply of manufactured garments by standard, price and speed, the possibility of factories and clothing manufacture to be re-introduced locally is possible. Such an initiation could inspire future generations to acquire manual patternmaking skills and this could also be re-established as an integral part of fashion design training.

This means that with the approach of a fourth industrial revolution, higher education will need to adjust classic modules while preserving industry knowledge. Teaching pattern design curriculums will require reconsiderations that include training in technology, and the accommodation of both manual and computer-assisted methods for this field. Regarding training of technical skills in pattern making and the upholding of these skills, multi-method approaches, and apprenticeship schemes are possibilities. From the evidence gained throughout this research alternative ideas for training future patternmakers could include a collective learning setting. A multi-method approach where students are involved in the progression of a career-orientated learning experience, including digital grading short courses and manual pattern training, will prepare them for the technological world that they are about to enter, yet preserve hand-skills. When teaching digital patternmaking or grading, it would however, require a lecturer who is educated and knowledgeable with traditional manual patternmaking principles to uphold interpretation of silhouette and proportion. Training on a technological programme also requires class time, and the necessary equipment in order to put together a valuable and accredited course in higher education. Course development commands practice, experience and time. Without that, the recommendations remain theory only.

Another multi-method approach is to divide the course into two pathways. Commercial design studies that allow students to focus on digital pattern making, the creation of tech-packs and requirements that feed into the manufacturing side of fashion. Contrary to that a more classic pathway could include manual patternmaking and tailormade garment construction. With overlapping courses in these pathways, the students could at times work together, yet follow a specialised course. Students could respectively enrich the other's proficiencies, mimicking the industrial world of fashion, as well as couture fashion. Collaborations between the streams, with focused teamwork tasks between designers, patternmakers, and machinists will lift the standards of all the speciality fields involved.

More research to answer the new question that has emerged during the research process includes:

- Researching global manufacturers that mass produce in comparison with specialised designers globally in order to interview pattern cutters and analyse patternmaking methods aligned to different industry requirements. This will further explore training opportunities in the field of pattern design; and
- Exploring the skills of pattern designers in South Africa with greater depth, by carrying out larger practical studies locally, and investigating further into practical and technological pattern needs locally.

Disclaimer

I, Annelize Scheepers, declare that this paper, which I hereby submit to DEFSA for publication, is my own work. This paper is derived from a study in 2020, where pattern design methodologies were compared to inform the design education offering on a tertiary level.

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

I think (sustainably) there 4IR: Exploring design thinking through a first principle approach in fashion praxis

Diandra Haupt, *Stadio*

Abstract

As fashion is becoming increasingly more inclusive of environmentally friendly fibres and sustainable textile solutions, consideration needs to be given to other applications of sustainable strategies within fashion design praxis (Gwilt & Rissanen, 2011, p. 57). Concepts such as design for sustainability, which centres on cutting waste, upcycling and fibre recycling strategies have become commonplace within the industry. A greater focus needs to be placed on developing new ways of clothing construction processes (Fletcher & Grose, 2012, p. 48). In order to address the wasteful nature of the conventional and linear fashion design and production process, designers need to adapt and cultivate new thinking processes that directly affect the phases they most actively participate in.

Through the lens of sustainability, Industry 4.0 falls behind in what is both possible and societally desirable (Ulrich & Gronau, 2020, pp. 110). The internet of things, artificial intelligence (AI) and big data analytics are at the forefront of the fourth industrial revolution (4IR), which has in effect neglected a more holistic and therefore sustainable approach (less technologically centred) towards human, technology and organisational processes (Ulrich & Gronau 2020, pp. 110). Looking at areas such as digital technology solutions and circular economy solutions and the relationship between the two, 4IR has the potential to align the United Nation's goals on sustainable development, while still supporting continued digital transformation within industries (Hoosain, Paul & Ramakrishna 2020, pp. 11). In order to cultivate this holistic approach consideration needs to be given to investigative processes in practice and how the relationship between the digital and sustainable can be aligned.

This paper emanates from a MA Design study that is nearing completion. The study uses a practice-led research framework with investigative methods such as, the think-aloud method and reflection cycles in order to apply a first principle design approach within fashion praxis. This first principle approach aims to address the limitations of the current linear design and production process, allowing for the implementation of sustainable strategies at the start of the design process by means of a design from principle approach (a set of principles that has been synthesised from the UN's sustainability goals, as well as various approaches to design thinking). This paper reflects on the potential of 4IR to be inclusive within this first principle design approach by reflecting on the value of a first principle approach and the potential of incorporating 4IR to advance the adoption of sustainable strategies. The concept of integrating the circular economy and 4IR emerging innovations offers the opportunity for creative and positive impact towards sustainability through aligned thinking (Hoosain, Paul & Ramakrishna 2020, pp. 14).

Keywords: *Aligned thinking, circular economy, fashion praxis, first principle, design approach*

Introduction

This paper aims to look at a first principle design approach within fashion praxis, which emanates from a current MA Design study that is nearing completion. This paper reflects on the inclusivity that the first principle design approach offers to align 4IR with sustainable thinking. Situated within fashion design praxis this first principle approach, addresses the limitations of the current linear design and production process. The focus of the first principle approach is to design from a set of principles that have been synthesised from investigating design thinking and aligning this to the UN's sustainability goals. Looking at the relationship between digital technology and sustainable strategies, 4IR could offer a means to further these goals alongside a creative and positive impact towards suitability (Ulrich & Gronau*, 2020, p*. 109).

Sustainable opportunities within the design process

The integration of sustainable strategies within the traditional fashion design process has not often been examined (Gwilt & Rissanen, 2011, p. 57), conventionally designers have viewed the concept of sustainability as an 'afterthought' to their fashion design praxis (Gwilt and Rissanen 201, p. 14). This poses a challenge and opportunity for the design and production team to integrate strategies that can influence the design and production process right from the start (Gwilt & Rissanen, 2011, p. 57). Gwilt (2012, p. 59) refers to Lawson (2006) who suggests that the traditional design process should be investigated and challenged, as designers need to be more inclined to adapt to a changing future industry (Gwilt, 2012, p. 59). According to Hoosain, et al. (2020, p. 109) 4IR could offer a means to align the goals of sustainable development with continued digital transformation, however, there should be a focus on how research and practice can implement this alignment and sustainability aspects can gain more influence in 4IR (Hoosain, Paul & Ramakrishna, 2020, p. 110).

The fashion design and production process, according to Gwilt (2012, p. 39), can be systematised as a sequential series of activities and phases that is evident within various sectors of the fashion industry. These activities and phases have been well documented through various educational texts, thus indicating a generic design process. This process consists of five distinct phases; the research and analysis phase; synthesis phase, selection phase; manufacturing phase and distribution phase. Within each of these phases, there are specific activities and tasks and the responsibility of each fall to a specific member of staff, department or facility involved within this process. The divisions of these duties, as outlined by Gwilt (2012, p. 40), are dependent on the production; and hence company scale, the larger the company, the less reach the designer has. The influence of the fashion designer across these phases' also changes accordingly, their duties within a larger setting, becoming more well defined and restricted to the starting phases of this linear process (Gwilt, 2012, p. 40).

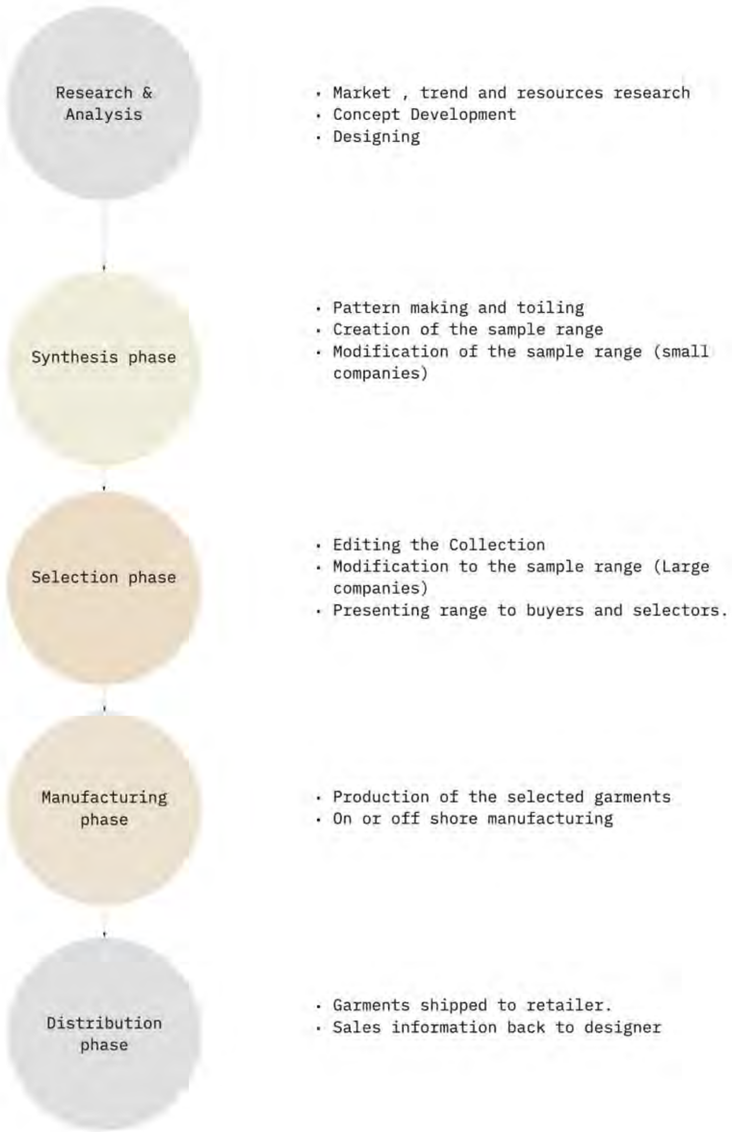

Figure 1: Five phases of design and production (Gwilt, 2011, p. 61)

The design of sustainable fashion necessitates that we garner more knowledge about; and show more support for sustainable systems of production (Fletcher, 2008, p. 4). There is no quick fix to the complex issues this presents and therefore no easy solution to attain the perfect garment, which is able to function within the sphere of sustainability (Fletcher, 2008, p. 42). Rather addressing these problems requires a combination of ‘creativity, mindfulness and information about the processes’ approaching the problems from a life cycle point of view (Fletcher, 2008, p. 42). An opportunity lies in re-evaluating the design process, investigating alternative methods of design and production, and challenging the conventions of this process (Gwilt, 2012, p. 12). The wasteful nature of the fashion system is a direct result of the conventional design process (McQuillan, 2011, p. 85). Hierarchical processes within this linear design system entails design, pattern cutting, construction and production, which has substantial wasteful side effects. To change the wasteful nature of the conventional fashion design and production process, designers should adapt and cultivate new thinking processes that directly affect the phases they most actively participate in.

Designing from first principles

Designing from first principles can be seen as a means of generating good or successful designs and is often commended for achieving creative designs (Cross, 2006, p. 54). The difficulty that this approach to design poses is identifying what the first principles might be in any given design situation, whether artificial or natural (Cross, 2006, p. 54). According to Dorst (2006, p. 24) consideration needs to be given to what the end solution of the design needs to achieve, the freedom lies in how one gets to the solution. This is supported by Cross (2008, p. 76) who suggest that one should consider the conceptual boundary that is used to define the function of the product as a way to create impactful designs.

Any meaningful understanding of design is centred around the concept of designing from first principles (Cross, 2006, p. 54). It stands to argue that designing takes place by identifying requirements or desired functions, and the form of the structures taking shape based on these established requirements. The function of a product that needs to be designed, should not be seen as a static concept, but is rather something that develops and evolves during the course of the design process (Cross, 2006, p. 54). Cross (2008, p. 78) looks at a similar approach to design through the function analysis method, where the purpose of the method is to concentrate on what needs to be achieved by a new design and not how it needs to be achieved.

First principles and sustainability

Sustainability can be viewed as the concept that underpins the process of sustaining current resources, which are limited, in order to ensure future generations are able to maintain favourable living conditions and meet their needs for said resources (Bervar & Bertoncelj, 2016, p. 243). This definition is supported by various scholars, as well as the Brundtland Report (UN, World Commission on Environment and Development 1987, p. 43). The definition for sustainable development, which is used interchangeably with sustainability, presupposes the importance of development rather than focusing on implementing strategies that maintain current conditions (McKenzie, 2004, p. 2). Sustainable development can further be assessed through the intersection of three interrelated concepts, economic, social and environmental systems (Barbier & Burgess, 2017, p. 3).

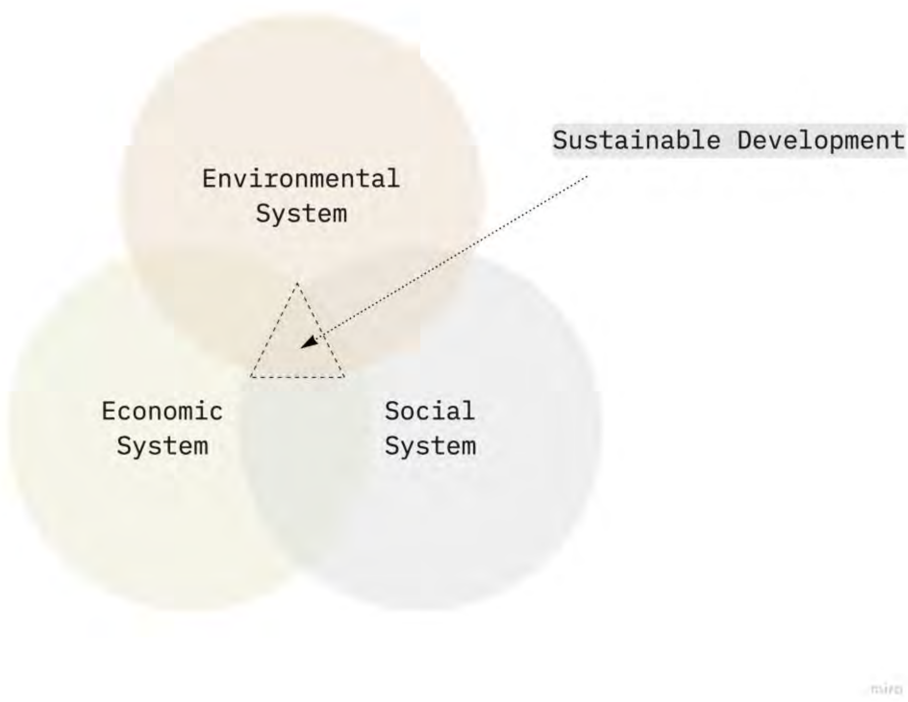

Figure 2: Diagram adapted from Barbier & Burgess, 2017, p. 4

Barber and Burgess (2017, p. 2) state that the objective of sustainable development is a continuous trade-off between these systems by means of an adaptive process. This is supported by Vreja & Balan (2020, p. 1108) that state the three areas of action need to tackle simultaneously, as neglecting one of the pillars will lead to the unfulfillment of the sustainability goal. For example, focusing on only economic growth while neglecting environmental concerns can create additional cost to counteract the environmental impacts, thus resulting in the economic benefits becoming null and void (Vreja & Balan, 2020, p. 1108). There is no clear guidance as to how this adaptive process would need to navigate the tradeoffs between the economic, social, and environmental systems (Barbier and Marandya, 2012, p. 38). However, they need to be balanced, focus on improving one system, while neglecting the others will not result in a sustainable outcome (Barbier and Burgess, 2017, p. 5). This adaptive system, however, shows sustainable development to be at the intersection of the three interlinked systems and their goals (Barbier and Burgess 2017, p. 3).

The UN Sustainable Development Goals (2015) are 17 goals that are interlinked, with the purpose to achieve sustainable development. During the development of the SDGs, the three pillars were explicitly embedded within the formulation of said goals (Purvis, Mao & Robinson, 2017, p. 672). The UN agenda highlights the interlinked and integrated nature of the SDGs that is vital to the success of sustainable development (Barbier & Burgess, 2017, p. 2). The SDGs form a blueprint for a more sustainable future and look at the major global issues we face (Ulrich & Gronau, 2020, *p*. 1). By using the 17 SDGs that are underpinned by the pillars of sustainability, the first principle design approach is situated within a framework that is informed by core sustainability goals, that become the identifying requirements or desired functions of the design (Cross 2006, p. 54). As Gwilt (2012, p. 20) suggests, the designer needs to consider the intended purpose of the garment and establish the sustainable strategies at the start of the design process. The first principle design approach allows the designer to consider the key sustainability requirements or characteristic that the design needs to align to, which directs the final structure or outcome of the design.

4IR and sustainability

The concept of the circular economy is an alternative to our current linear and conventional concept of "take, make, and dispose" (Hoosain, Paul & Ramakrishna, 2020, p. 7). Ideals such as "designing out waste and emissions", "keeping goods and materials in operation", and "regenerating natural systems" are all concepts that underpin a circular economy. Bringing together 4IR digital technologies and the circular economy concept will allow for global growth through sustainable practices and ensure that this development is aligned to that of the SDGs (Hoosain, Paul & Ramakrishna, 2020, p. 7).

This alignment might most strongly be seen in the economic and environmental pillars of sustainability, 4IR is reflected in areas such as productivity, as well as a more pressing concern for the environment, through the development of eco-friendly technologies and practices (Vreja & Balan, 2020, p. 1112). With regards to the social dimension of sustainability and 4IR, we look at the ability to improve the life of individuals through aspects such as high-end devices and goods or even unprecedented ways of communicating, labour protection, or the need for social identity (Vreja & Balan, 2020, p. 1112). Industry 4.0 has the potential to inform sustainability goals through the application of intelligent digital technologies and optimisation of products and resources (Ulrich & Gronau, 2020, p. 115). A stronger focus should be placed on investigating how Industry 4.0 can contribute to the realisation of the United Nation's sustainability goals beyond that of energy efficiency and working conditions (Ulrich & Gronau, 2020, p. 115).

The World Economic Forum has characterised the fourth industrial revolution as a period in time where the lines between physical, digital, and biological fields are being blurred (Adelowotan, 2021, p. 41). 4IR provides not only an opportunity to advance the UN'S sustainability goals further through the alignment of digital technology with sustainability but also provides a means for the African continent to reinvent skills, labour, and production practices (Adelowotan, 2021, p. 41). According to Adelowotan (2021, p. 42) Africa will have one of the largest workforces globally, a workforce that will need to be equipped with the relevant skills on digital and technological innovations. These digital technologies will also encourage entrepreneurs to develop products and models that will directly affect this workforce and the economy (Adelowotan, 2021, p. 42).

The first principle approach within fashion design praxis allows for 4IR to be included within the design process, the framework, which is informed by the UN sustainability goals allows for 4IR practices to be easily aligned. As discussed by (Hoosain, et al., 2020, p. 7) 4IR, that is aligned to the UN's sustainability goals will allow for global growth as well sustainable development. This might offer an opportunity for fashion praxis to better achieve a sustainable outcome and advance the first principle approach through the inclusion of 4IR. Technologies such as AI, for example, can act as an enabler towards a transition to a circular economy, as well as advance processes that are aimed at solving human problems identified in the UN's Sustainability goals (Hoosain, Paul & Ramakrishna, 2020, p. 12). By designing from a set of principles and aligning this principle approach to 4IR technologies, the goal to achieve a sustainable outcome within the fashion process, could be advanced.

Practice-led application of the emerging design approach

Within the sphere of practice-led research, it has become a pressing concern to develop sustainable strategies through design (Spalwa-Neyman, 2013, p. 2). Terry (2018, p 1) states that Wicked Problems are problems that are "systems problems" that require new problem-solving approaches as they exist within large social systems. A new "design-led approach" is therefore required to confront these complex wicked problems we are faced with during the twenty-first century (Terry, 2018, p. 1). The MA study that informs the first principle design approach makes use of a practice-led research approach or rather as coined by Terry (2008:1) design-led approach where the research "primarily leads to the new understanding of the design practice itself" (Muratovski, 2016, p. 11).

Candy (2006, p. 3) describes practice-led research as "a process that is concerned with the nature of practice and leads to new knowledge that has operational significance for that practice". Smith and Dean (2009, p. 7) refer to practice-led research knowledge value lying in both the work of art (artefact) as a form of research, as well as the documentation of the process of creating the artefact. This is further supported by Cross (cited in Farber & Makela, 2010, pp. 11-12) that the knowledge of design that can be found within people, processes, and artefacts, can be gained through not only the process of design, and making, but also through the reflection on these processes. Makela (2007, p. 158) suggest that the artifact, as an object produced through the research process, becomes a method of "collecting and preserving information and understanding".

Design-led research within a qualitative paradigm, is defined by process rather than output (Muratovski, 2016, p. 36). During the process of applying the first principle framework, the most important finding from the process of design-led research, was the challenge the new approach posed to traditional thinking, as well as the conventional design process. During the prototyping phase of the study the practitioner-researcher investigated the outcome of the first principle design approach, through the application of zero waste patternmaking. The challenge lay in discarding traditional linear design processes and adapting to a purely principle focused approach. Aesthetic components of the garment design, such as a defined apparel category, as well as a set design blueprint (in terms of proportion, shape, and garment details) became a secondary element that was influenced by what the intended purpose/function of the garment was, as it aligned to the selected first principles.

Within practice led research, the researcher forms an integral part of the research, actively participating in the epistemological process and not merely becoming an observer. The new knowledge is therefore created through the researcher's interaction with the research process, which becomes explorative and self-reflective. Candy (2006, p. 3) suggests that it is not necessary to include an artefact within practice-led research, the MA study, that informs the first principle design approach, aims to apply the newly synthesised design-process to the development of a series of artefacts or rather prototypes by employing the practice of Zero Waste pattern making. The prototypes are created to aid in the reflection process of the study; therefore, the new knowledge creation lies solely in the process, with the prototype aiding in the reflection of the process.

The first principle design approach places emphasis on the garment's alignment to the developed first principle framework more than the aesthetic outcome thereof. The practitioner-researcher's role during the process was to identify the specific principles that they would align to their design and hence starting their design process from this blueprint. The outcome of the design is therefore dependent on how the aesthetic elements of the garment work in support of this blueprint. This is contradictory to the traditional linear approach where the outcome of the design is used as the starting blueprint for the design process. Sustainable design within fashion praxis should be informed by a life cycle point of view that will create impactful designs that consider the conceptual boundary of the product to define its function (that of sustainability).

Conclusion

This paper aims to reflect on the development and exploration of a first principle design approach which has the potential to include 4IR technologies to advance the adoption of sustainable strategies at the start of the design process. The first principle design approach which emanates from a first principle framework, advocates for design to take place by identifying requirements and desired function that guide the form of the design outcome. By means of synthesising a first principle framework, based on the UN's sustainability goals, the desired requirements are informed by the three pillars of sustainability, economic, environmental and social sustainability.

Although there is no quick fix to the complex issue we face with regards to sustainable design, an opportunity lies in re-evaluating the design process. According to Gwilt (2012, p. 12), challenging the conventions of the fashion design process and investigating alternative methods of design might open up a means of achieving alternative methods of design and production, that challenges the wasteful nature of the conventional design process (McQuillan, 2011, p. 85).4IR could offer a means to align this synthesised first principle framework to that of global growth, through investigating intelligent digital technologies, that can assist in further aligning design processes to that of the SDGs. The nature of designing from first principles, that of championing a conceptual framework as a starting point, allows for the inclusivity of 4IR to be incorporated within the first principle design approach as an integrated aspect of the final design outcome.

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SESSION 6: 4IR for design education

Design Education Forum of Southern Africa

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Use of automation and artificial intelligence as a sub-set of knowledge management domain in architectural organisations in South Africa

Francine van Tonder, *Tshwane University of Technology*
Pantaleo Rwelamila, *University of South Africa*

Abstract

The purpose of this paper is to publish research findings on the use of automation and artificial intelligence as a sub-set of knowledge management domains in architectural organisations in South Africa. Automation and artificial intelligence are two aspects that the fourth industrial revolution deals with, and automation may drastically change the way humans work.

For this paper, research data was collected by means of a qualitative research study. Consisting of 14 semi-structured interviews. The paper presents a discussion and research on the use of automation and artificial intelligence in the service architectural organisations provide.

The research findings indicate that automation and artificial intelligence may, in the near future, have an impact on this service provision, even if the use of automation and artificial intelligence is currently not commonly used. These research findings are useful and important in education as these findings are new and may practically affect future curricula; to meet industry needs and changes pertaining to the fourth industrial revolution, and to remain relevant and provide appropriate skill enabled graduates.

Keywords: Architectural organisations, artificial intelligence, automation, fourth industrial revolution, knowledge management

Introduction

This paper emanates from a Master of Business Leadership (MBL) research report completed by one of the authors of this paper and supervised by the other author of this paper. Data and analysis referred to within this paper, comes from and is included within, this submitted but unpublished MBL dissertation.

When referring to Architects and architectural organisations confusion may arise. This paper includes a study focused on built environment Architects and architectural organisations. Architectural organisations employ Architects, Architectural Technologists, and Architectural Draughts people, most of whom enter the workforce after graduating from design higher learning institutions, specifically schools of Architecture, Planning, and Interior Design. These employees and shareholders execute Architectural Projects as set out according to the South

African Council for the Architectural Profession (SACAP) Board Notice 91 (2020), Stages of Work for Architectural Projects.[34]

This paper presents research findings of semi-structured interviews on the use of automation and AI in the service architectural organisations provide. These research findings are useful and important in education as these findings are new and may practically affect future curricula in schools of Architecture, Planning, and Interior Design. These future curricula developments may be necessary to meet industry needs and changes pertaining to the fourth industrial revolution, so that schools of Architecture, Planning, and Interior Design can remain relevant and provide appropriate skill-enabled graduates.

For this paper, it is important to know what definition each term refers to. The term knowledge management (KM) refers to the action of managing knowledge (Aggestam, 2006; Grover & Froese, 2016). This KM action can be further elaborated upon as the acquisition, creation, sharing, and transfer of information (Pinho, Rego & e Cunha, 2012). Once KM has support from an information technology system, it is referred to as a knowledge management system or knowledge management systems (KMs). Organisations, such as architectural organisations, may use KMS for the capture, storage, retrieval, and usage of knowledge within that organisation (Sivasubramanian, 2016). The most common KMS used by architectural organisations are computer-aided draughting (CAD) software enabled building information modelling (BIM).

For lack of space and brevity other seminar sources on theory and practice of knowledge management have not been reported on. These are found elsewhere with Afolayan, White and Mason-Jones (2016), Barrat (2013), Desouza (2002), Ghahramani (2015), Gorry (2014), Omotayo (2015), and Schapire (2008).

A knowledge worker (KW) is a person whose job involves handling or using information. A KW has knowledge of a subject matter and is employed in a field where they use this knowledge (Serrat, 2017). A KW gains greater knowledge power (KP) when they receive appropriate knowledge resources. KMS may assist an architectural organisation KW employee to enhance their KP above and beyond the KP they already have due their qualification and experience. KP refer to the control of unique information (Burnes, 2014), usually information that is necessary for decision making. Therefore, enhanced KP improves the effectiveness of architectural organisation KW employees.

Architectural organisations, in their execution of built environment projects, deal with big data. Big data refers to the analysis and handling of massive datasets (Mashey, 1997). Data sets that may be analysed by performing a procedure of calculating or determining something by mathematical or logical methods. This is done with the aim of revealing patterns, associations, and trends. These patterns, associations, and trends may be automated and inform artificial intelligence (AI) to predict the most probable next step, thereby supporting architectural organisation KW employees or possibly even, eliminating, augmenting, or changing the work roles of some architectural organisation KW employees.

AI refers to the solving of complex problems by means of intelligence exhibited by an artificial entity (Borana, 2016). AI deals with innovations and developments relating to computers and machines having human-like intelligence, which is characterised by cognitive abilities, learning, adaptability, and decision-making capabilities (Chen, Chen & Lin, 2020). As

[34] The South African Council for the Architectural Profession (SACAP) Stages of Work for Architectural Projects consist of: 1: Inception. 2: Concept and viability. 3: Design development. 4: Documentation and procurement. 5: Construction. 6: Close out (SACAP Board Notice 91, 2020).

Automation and AI are two aspects that the fourth industrial revolution (4IR) deals with, it is therefore important to discuss the 4IR.

The 4IR is upon us (World Economic Forum, 2016) and the impact of the 4IR on worker displacement, as well as encouraging new strategies for empowering job transitions, from declining to emerging roles, have accelerated since 2016 (World Economic Forum, 2018, World Economic Forum, 2020). Many industries are already (Kim, 2019, McKinsey, 2017), and most industries may in future (Kim, 2019; World Economic Forum, 2016; Frey & Osborne, 2013), be affected by the 4IR. This includes architecture and the construction industry (Frey & Osborne, 2013). The 4IR deals with digitisation (Hirschi, 2018; Schwab, 2016) and automation enabled by advances in robotics, AI, and machine learning (McKinsey, 2017). Automation may drastically change the way humans work (McKinsey, 2017; Frey & Osborne, 2013).

These drastic changes in the way humans work, associated with automation, which may affect architectural organisation KW employees consist of: Online globalised crowdsourcing of high-skilled but repetitive work processes, a rise in time limited, project-based contracts (World Economic Forum, 2016) expanded use of contractors for task-specialised work (World Economic Forum, 2020), and the use of remote staffing and decentralisation of operations (World Economic Forum, 2018, World Economic Forum, 2020). Furthermore, employees may be required to have a much higher level of technology literacy than in the past, greater problem-solving skills, and broader general understanding of the work processes of their organisation (World Economic Forum, 2016).

The World Economic Forum (2020) state that there is a need for tangible evidence and reliable information from the frontlines of this change. The authors of this paper were placed in a position to observe the dynamics of architectural organisations and to ask the participants to the study to reflect on the latest employment, skills, and human capital investment trends in their industry. It is therefore important to list and discuss these industry changes and emerging industry needs regarding automation and AI.

Research methods

There is limited, to no research on the industry changes and emerging industry needs regarding automation and AI for architectural organisations in South Africa. Likewise, there is limited, to no research available on how these organisations may adapt to the 4IR. To address this limitation of available research this paper presents a discussion and research on the use of automation and AI in the service architectural organisations provide.

A qualitative research approach

A qualitative research study, consisting of semi-structured interviews, was employed as a method of inquiry into the status and practices of architectural organisations. A qualitative research approach was chosen for this study as the kind of information used for this paper deals with the specific phenomenon (Blumberg, Cooper & Schindler, 2014) of KM, automation, and AI in architectural organisations.

Population and sample framework

The population and sample framework interviewed consisted of architectural organisation KW employees, shareholders, and schools of Architecture, Planning, and Interior Design Senior Lecturers. In 2019 when the research data was submitted the population of Professional Senior Architectural Technologists and Professional Architects in Gauteng consisted of 2458 professionals of which 1642 are Professional Architects (SACAP, 2017). From this population a sample unit of 14 participants was selected consisting of participants who fit an identified criterion.

The criteria list requirements such as years of experience whereas a participant must have a minimum of 10 years' experience in an architectural organisation or school of Architecture, Planning, and/ or Interior Design; a position of seniority in their organisation; and an interest in KM, automation and AI. This study therefore targeted and approached middle management participants, who hold positions such as team leaders, team managers, and associates. The study also targeted owners, leaders, and directors of architectural organisations who make decisions on the day-to-day running of the architectural organisation as a business. Furthermore, experienced Senior Lecturers at schools of Architecture, Planning, and Interior Design have been included.

Sample units

Sample units are the units, or in the case of individual participants, the participants, as chosen by the sampling selection (Diamantopoulos & Schlegelmilch, 2000). The sample units consisted of 14 qualified participants who showed an interest to be interviewed and who fit the criteria of the sampling selection. The demographic was made up of the four identified sub-population or strata groups, namely:

- Group 1 Directors/company owners, 5/14 participants or 36% of the study;
- Group 2 Associates/team leaders, 3/14 participants or 21% of the study;
- Group 3 Architectural institute leaders, 3/14 participants or 21% of the study; and
- Group 4 Schools of architecture, planning, and interior design senior lecturers, 3/14 participants or 21% of the study.

Sample unit gender

At least one participant in each group was female. There are far fewer female architectural professionals than male architectural professionals in South Africa (SACAP, 2017). A decision was made to include 36% female participants, as this was an above average female representation of the profession. Thereby an attempt toward gender parity was made without misrepresenting the current unequal state of the profession.

The research instrument

According to Leedy and Ormrod (2015), a criterion of a phenomenological study is that participants must all have direct experience with the phenomenon being studied. In this case KM, automation, and AI in architectural organisations. Leedy and Ormrod (2015) go on to state that the exploratory methods of a phenomenological study lend itself almost exclusively to lengthy interviews consisting of one to two hours. For these interviews a small sample of participants consisting of five to 25 individuals, is arguably applicable. For this research, interviews were conducted with one participant at a time.

It is noteworthy that the research presented in this paper originates from a larger business study that collected data on the topics of KM, automation, and AI in South African architectural organisations, as project-based organisations. Questions on automation and AI were concluding questions to the interviews. It was thought applicable to enquire about automation and AI as automation and AI are sub-sets of KM. The data collected on AI and automation was thought significant enough by the author to share in a publication.

There were eleven questions in total. Question 10 and 11 receptively being (van Tonder, 2019, pp. 114):

> *10) Do you automate any of your service provision?*
>
> *11) Do you think that it is possible to automate architecture and use artificial intelligence to provide the service or part of the service that architectural organisations currently provide?*

Research results

The research findings indicate that automation and AI may, in the near future, have an impact on the service that architectural organisations in South Africa provide. However, it is important to note that automation and AI is currently not commonly used. Furthermore, the research findings indicate that KM and KMS may be the vessel for architectural organisations to weather the storm of the 4IR. A revolution that is eminent and therefore architectural organisations may consider adapting, to retain a competitive advantage. Likewise, schools of Architecture, Planning, and Interior Design may find these research findings useful and important in education as these findings are new and may practically affect future curricula.

Data was collected and captured appropriately for data analyses. The results are presented in categories of themes.

Automation

The participants in the study were asked if they or the architectural organisation they are involved with automating any of their service provision. Five of the 14 participants or 36% of the study stated 'yes', two participants or 14% of the study stated 'no,' and seven participants or 50% of the study were unsure. Figure 1 below shows the results (van Tonder, 2019).

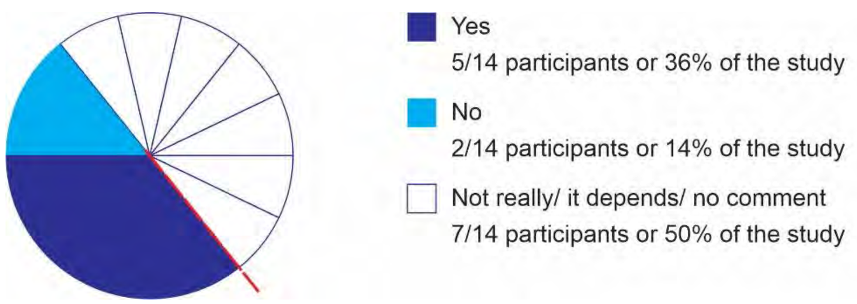

Figure 1: Architectural organisations automation of service provision chart

KW employees spend a notable amount of time on administrative work, such as timesheets, contracts, and invoices. Automation could indicate a saving on allocated work hours as repetitive tasks may be minimised. However, one participant who is a director of a small architectural organisation explained that the cost of automation to perform a task such as an invoice, is not justifiable as they only produced one to three invoices a month and therefore do those manually. The work hours for that specific task are still cheaper than the initial cost of automation (van Tonder, 2019).

Of the 14 participants, one of the five participants who answered 'yes' is a director of a small architectural organisation. They stated that they extensively use CAD software that enabled

BIM to capture as much knowledge from previous projects as possible for use on future projects. They stated that they preferred producing or drawing a piece of information only once. Of all the participants, this was the only participant who did not consult other KW employees to enable KM as they used their CAD software enabled BIM as a knowledge management system (van Tonder, 2019).

One participant, a school of Architecture, Planning, and/or Interior Design Senior Lecturer stated, regarding CAD software enabled BIM as KMS, that the onus is on the schools to provide an education to students and that the onus is on industry to provide training to recently graduated candidates. Therefore, even though CAD software enabled BIM is part of the coursework the emphasis is not on training.

Automating architecture

Participants were asked if they thought it possible to automate architecture. Eight of the 14 participants or 57% of the study stated 'yes', it is possible, five participants or 36% of the study stated 'no' it is not possible, and one participant or 7% of the study had no comment (van Tonder, 2019). Figure 2 below show the results.

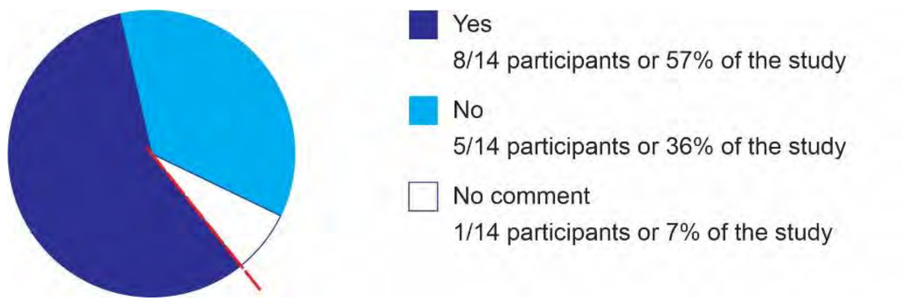

Figure 2: Possibility to automate architecture chart

According to Grover and Froese (2016) the construction industry shows low levels of productivity because the same errors occur from project to project. Automation as part of KM and KMS mitigate these mistakes and reduce the cost thereof from project to project. Therefore, it is interesting to know to what extent architectural organisations use the automation of architecture in the service they provide.

It is noteworthy that some participants stated that Microsoft Excel, and Microsoft Outlook calendar are information technology tools that they perceive to be the automation of architecture, even though it is not (van Tonder, 2019). One participant stated that automation of architecture for them would be when the CAD software they work on has the intelligence to know which SACAP Stage of Work for Architectural Projects a specific project is at, and thereby log the hours they work on the project, on the CAD software, automatically onto the timesheet. It is therefore deduced that the participants had a different understanding of what automating architecture may entail (van Tonder, 2019).

Cognisance may be taken of the way this question was posed in the interviews. The question, 'Do you think that it is possible to automate architecture and use AI to provide the service or part of the service that architectural organisations currently provide?' was read as a whole, and then broken down and asked in two parts. The first part of the response to the question was tallied separately from the second part. The first part being 'Do you think that it is possible to automate architecture to provide the service or part of the service that architectural organisations currently provide'. The second part of the question was 'Do you think that it is possible to use artificial intelligence to provide the service or part of the service that architectural organisations currently provide?' (van Tonder, 2019). Therefore, the results to the question of automating architecture pertain to automation providing the service or part of the service that architectural organisations currently provide, and not automating architecture as a whole and thereby replacing, augmenting, or complementing, the professional service that Architects provide in its completeness.

It was unclear if any of the participants or the architectural organisations they are involved with, have made any real advancement in automating architecture. Four participants, all from the same large-sized architectural organisation, mentioned a research and development initiative explored over the past two years by their organisation, towards automating architecture for Stage 2 of the SACAP Stages of Work for Architectural Projects. However, one participant believed that the project came to a halt and was unsuccessful. The remaining three believed the project was necessary, showed great potential, but were unsure whether it would prove successful. Unfortunately, none of the participants worked directly with, was involved in, or contributed to, this research and development project (van Tonder, 2019).

One participant, a school of Architecture, Planning, and/or Interior Design Senior Lecturer stated regarding the automation of architecture that a knowledge repository of say generic construction and building details is detrimental to the learning and discovery of students, who are tasked with designing their own details. The participant agreed that in practice information should not be regenerated at a cost, if it is not necessary, but that during education discovery is an important process deterred by having generic information at hand.

Artificial intelligence

There is limited information on AI in architectural organisations. Therefore, participants were asked if they think it possible to use AI to provide the service, or part of the service, that architectural organisations currently provide.

Six of the 14 participants or 43% of the study stated 'yes', it is possible, two participants or 14% of the study stated 'no' it is not possible, and six participants or 43% of the study stated, 'not really', 'it depends', they 'are unsure', or 'no comment'. Arguably only 14% firmly stated 'no' with 43% acknowledging the possibility of AI playing a role in architectural organisations, and a further 43% reluctant to commit to either a 'yes' or a 'no' (van Tonder, 2019). Therefore, it could be argued that 86% of the study already realise that AI may be a future factor for architectural organisations to take into account, as the participants do not immediately dismiss the possibility. Figure 3 below show the results.

Figure 3: Possible for AI to provide the service that architectural organisations provide chart

According to Pannu (2015) AI can perform certain tasks more effectively than a human being can. KM, automation, and AI may contribute to reducing the work hours or KW employee resources, currently allocated to the service provision that architectural organisations provide.

Thereby providing a strategic advantage to architectural organisations by enhancing effectiveness (van Tonder, 2019).

It is important to note that the impact of AI in architectural organisations is currently unmeasurable as AI is not yet an innovation that is used in architectural organisations. AI in architectural organisations is currently only in the beginning stages of conceptualisation and development, or currently architectural organisations are only speculating the possible benefits of AI.

automation and AI could be a significant strategic advantage for architectural organisations and the driving force behind the required business survival sustainability for architectural organisations in South Africa. As a paradox, the reason automation and AI as an innovation is nearly unexplored, is that such research and development is costly. Due to low or no profit margins for architectural organisations, there are limited or no funds to spend on research and development. Schools of Architecture, Planning, and Interior Design may play a role by providing some of the necessary research and development.

The use of automation and AI may also come at the cost of a loss of employment for some KW employees. As South Africa deprecates to more than 16 million people who are unemployed (Statistics South Africa, 2019) an innovation that may come at the cost of jobs may be socially and morally irresponsible.

Changes for knowledge worker employees

Participants were asked if they think the successful automation of architecture would cost architectural organisation KW employees their employment. Two participants or 14% of the study said 'yes', that automation of architecture would probably cost some people their jobs. A further two participants or 14% of the study maintained that the automation of architecture is not possible. The remaining 10 participants or 71% of the study answered 'no', architectural organisation KW employees would not lose their jobs, their jobs may change or evolve and that new job descriptions in architectural organisations would emerge (van Tonder, 2019). Figure 4 below show the results.

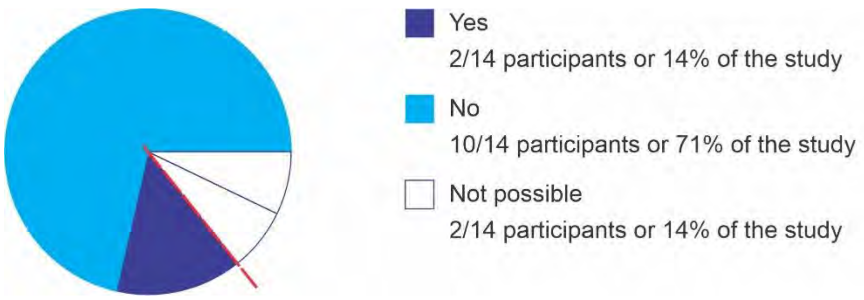

Figure 4: Architectural organisation knowledge worker employee job security vs architecture automation chart

71% of the participants argue that a change for KW employees is underway because of automation. Only 14% of the participants stated there may be a loss of employment for KW employees should the automation of architecture ever prove successful. The data shows that the impact on job security may be minimal, which is an argument towards, and for, the use of automation (van Tonder, 2019). These findings are interesting as they align with the drastic changes in the way humans work, associated with automation, which may affect architectural organisation KW employees, previously listed from the World Economic Forum (2016, 2018, 2020).

It is suggested that schools of Architecture, Planning, and Interior Design investigate and identify what these changes in the job description may be, how jobs in architectural organisations may change and evolve, as this may impact the future curricula development of schools of Architecture, Planning, and Interior Design. As the effectiveness of architectural organisations KW employees may become the greatest force that determines the profitability of the industry, it is recommended by this paper that graduates from schools of Architecture, Planning, and Interior Design should be informed on topics of KM, automation, AI, and the 4IR, as these topics may have a substantial effect on the industry in the near future.

Conclusion

The purpose of this paper is to contribute to the body of existing research by publishing research findings on automation and AI and how this may, in the near future, have an impact on the service provision that architectural organisations provide. The research findings are useful and important in education and may practically affect future curricula, as it shows that most of the participants agree that automation and AI is not yet commonly used by architectural organisations in South Africa. Therefore, it is argued that there is still time to prepare; so that schools of Architecture, Planning, and Interior Design may meet industry needs and changes pertaining to automation, AI, and the 4IR, and thereby remain relevant and provide appropriate skill enabled graduates.

As a summary the following salient points are noted:

- Drastic changes associated with automation may affect the way architectural organisation KW employees work, and may also affect their job descriptions to change and evolve to include emerging roles;
- Due to automation, graduates may enter the workforce in different ways than what was previously the norm. As opposed to full time, centralised operations, and salaried employment, graduates may be employed on time limited, project-based contracts that comprise decentralised operations;
- Schools of architecture, planning, and interior design may have the opportunity to provide post-exit-level training to graduates, to enhance technology literacy, problem-solving skills, and a broader general understanding of the work processes of architectural organisations; and
- Schools of architecture, planning, and interior design may have the opportunity to provide some of the research and development requirements for KM, KMS, automation, and AI to give advancements towards automating architecture, that may possibly contribute build environmental solutions towards addressing the current global ecological breakdown.

Future research questions emerge because of this study:

- Should schools of Architecture, Planning, and Interior Design contribute to the research and development requirements of KM, KMS, automation, and AI?
- What would advancements in automating architecture look like, and what may it require from schools of Architecture, Planning, and Interior Design?
- How are KM and KMS used by schools of Architecture, Planning, and Interior Design amidst the COVID-19 pandemic?

- Could automation, AI and the 4IR aid schools of Architecture, Planning, and Interior Design, as well as architectural organisations, to address the current global ecological breakdown better?

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Developing an educational strategy for emerging technology in design: A case study of the FabLab at FADA, UJ

Denver Hendricks, *University of Johannesburg*

Abstract

Emerging technology is developing at an exponential rate and has a direct impact on design education. This boom in innovation has been dubbed the fourth industrial revolution (4IR). This economic initiative was framed at the 2015 World Economic Forum by Klaus Schwab and has been echoed since 2016 by South African politicians as a government and education policy transformation catalyst to South Africa's struggling economy. Academic scholars are critical about these objectives against the face of high unemployment, poor education and developing foundational skills in South Africa. Educators are confronted with very little support to address this technological development, often leaving design educators with scepticism. Emerging technology can often fall in the realm of being 'hype' and having 'unrealistic expectations' that limit teaching and learning methods facilitated in studios and lecture halls.

Fabrication laboratories are emerging globally as growing sites of innovation and are hands-on creative spaces of production in art, science and engineering that offer exposure to solving real-life problems. In addition, they are being implemented in educational institutions from primary schools up to tertiary education and used to drive pedagogies of the future by teaching twenty-first century content skills and content in emerging technology. Emerging technology offers a wide range of opportunities to enhance education and prepare learners for industries of the future that form part of 4IR.

This paper argues that fabrication laboratories pose a practical and contemporary learning space in addition to the existing current design studios and lecturer halls to aid in the integration of technology into the design curriculum. The author established and currently coordinates a fabrication laboratory at the Faculty of Art Design and Architecture (FADA) at the University of Johannesburg. This paper will discuss the implementation and operations of this Fabrication Laboratory through qualitative data such as the author observations along with feedback from lecturers who are using the FabLab to understand the impact the FADA FabLab has made on design pedagogy. The frequency of use, the types of engagements from lecturers and learners, the average time the learner spent in the FabLab and the types of projects they worked on will be unpacked.

Keywords: *Curriculum, emerging Technology, FabLab, innovation*

Introduction

Fabrication Laboratories are fast becoming alternative democratic innovative educational spaces for learners from primary schools through to tertiary institutions. Fabrication Laboratories are at the centre of emerging technology (ET) in education spaces. They have several benefiting factors such as; contributions to STEM learning (Kajamaa, Kumpulainen and Olkinuora, 2020, p. 372), promoting economic growth and entrepreneurship (Stacey, 2014, p. 222; Schwab, 2016 , p. 32) and, enhancing preparation for learners in the workplace and they expose learners to real-world problems (Dousay, 2015, p. 199). Although Fabrication Laboratories are not only about the latest technology, they are also a space of experimentation and they bring together a culture of shared and self-learning through technology-driven platforms. They foster "collaborative, open and inclusive forms of innovation; decentralised manufacturing; and democratic access to digital fabrication technologies" (Hielscher, 2017, p. 52). Education technology is a term used by academics to describe the type of learning and research associated with ET in the broader knowledge society. Since the first laboratory was established by the Massachusetts Institute of Technology's (MIT) Interdisciplinary Centre for Bits and Atoms course, fabrication laboratories have developed into grassroots facilities for 'makers' known as 'Maker Labs' (Stacey, 2014, p. 221; Hielscher, 2017, p. 51). These Laboratories are pitched for entrepreneurs to fill a gap in society to offer services for the design and production of objects, parts and elements. Hielscher (2017, p. 51) had identified 440 Fabrication Laboratories across 60 countries.

Emerging technology (ET) in education

Technology has always had a profound effect on education in general. The last three decades saw the ubiquitous use of the simple calculator, overhead projectors, and computers in schools to make teaching and communication methods easier (Amiel and Thomas C Reeves, 2008, p. 29). Information and communication technology (ICT) has been a foundational mode of education for decades as technological tools to support, enhance and optimise educational networks. Adding to this, the introduction of the internet in education has widened access to learners and has normalised many emerging technologies. Tarling and Ng'ambi (2016, p. 562) recognise "ET's may be used to achieve deep and meaningful learning experiences " Academic scholars agree that technology enhances education (Song, 2020, p. 687). Amiel and Reeves (2008, p. 32) draw on the understanding of technology "invention, development, and cognitive deployment of tools and other artefacts" having strong links to the philosophical approach to the education of pragmatism. Tarling and Ng'ambi (2016, p. 561) state that educational spaces will transform the ways we educate. This new landscape will be unfamiliar to how the current educators understand them, and that education is no longer limited to the educator, the books or the curriculum.

ET will help educators to re-conceptualise our modalities of knowledge. It will require a design-based approach. Educators will need to consider a sustainable change. Developing new approaches to knowledge needs to be radically shifted as educators "become that of knowledgeable guide-on- the-side who guides learners as they learn how to interact and work with knowledge" (Tarling & Ng'ambi, 2016, p. 561). Tarling and Ngambi's (2016) research laboratory brings forth a need to develop a Teaching Change Framework (TCF) that plots out how teachers change sustainably towards implementing technology. The focus is on the scalable innovative practice of teaching with emerging technologies for wider education impact. This is a noteworthy effort to concentrate on responsible and relevant change towards transformative pedagogies. Tarling and Ng'ambi (2016, p. 562) developed a continuum that builds onto Bloomberg's Taxonomy' (Patricia, 2021) skills-based knowledge for ET which, tracks ICT engagement and learning modes (Tarling & Ng'ambi, 2016, p. 562).

The role of technology has been limited to tools and equipment. Amiel and Reeves (2008, p. 32) argue that this has contributed to the misunderstanding of the role of technology in education and that there is an important value being lost. They state that educators need to take up new practices of understanding ET to what they describe as design-based research in technology. Dousay (2015, p. 145) states that we need to recognise the epistemological benefits and that the approach requires a philosophical intertwining of technology in our teaching approaches.

Many academics have elaborated on the definition of technology. In the frame of the emerging technology debate, we must acknowledge the full spectrum of the term to appreciate its capacity and the impact that it has on design education. Therefore, technology is not an item to be used as a product, tool or piece of equipment but instead a systematic process. Song (2020, p. 687) goes on to describe that "technology is a social and cultural construct that concerns what people do with technologies, how knowledge is constructed and shared among people, and how technology use is contextualised within certain social and cultural environments". Amiel and Reeves (2008, p. 31) expands on the definition that goes beyond hardware "Technology is so much more than hardware. It is a process that involves the complex interactions of human, social, and cultural factors, as well as the technical aspects. Second, it requires new directions in research goals, moving away from traditional predictive methods to long-term collaborations based on development goals". With the current explosion of ET being domesticated, we as educators need to shift our concept of technology and rethink what we need to learn, how we need to learn to achieve new paradigms of design thinking in our curriculums. We need to draw on multiple ET's and curate new modalities of learning. Educators need to engage with a variety of new concepts, their purpose and how it applies to our practice and the curriculums we maintain.

Design education

Design education has been disparaged largely for not aligning with ET and exploiting this as a mechanism to add more value and integration to learners' knowledge-building (Venter & van der Wath, 2014, p. 1; Demirkan, 2016, p. 28). To date, it has relied heavily on the classic design thinking skills of the design fields. Design analytical, observation, design, problem-solving, drawing, communication and business skills have largely held the space for design education. For many decades the transferring of these skills have been the normal practice and remain to be core to the teaching of design thinking. Some mainstream teaching methods could fall into the realm of a repetitive and parrot-fashion manner and fall into the paradigm of transmittances (Tarling & Ng'ambi, 2016:562). Conversely, an education that focuses on twenty-first-century technological education falls into the paradigm of being a transformative education where knowledge is conceptualised and is "generative and transformative" (Tarling & Ng'ambi, 2016, p. 562).

Design education has long been ignored and educators are resistant to engage with technology as it defies what design essentially stands for. Hence the idea of technology has been related to a lens through which we see. It has often been seen as a tool and the use of equipment in our curriculums as an extension of our ability to create and make. This brings to light the fact that most design programmes focus on design thinking skills and content, but not enough weight is placed on ET content and skills. With a new emphasis on our conceptual understanding of content and skills in ET, Dousay (2015, p. 18) argues that they are tightly related, and skills need to be given equal attention as content teaching to ensure that we align with twenty-first-century learning.

ET processes can create a sense of despondency due to novelty and can be “over-hyped and insignificant” (Amiel & Reeves, 2008, p. 29). Alternatively, it could be a lack of support or a sense of overwhelming. Amiel and Reeves (2008:30) frame the relationship to technology by educators as “as a process that has implications for how educational technologists conduct research”. This important observation could be the reason why some educators are reluctant to take up the technology. Venter and Van de What (2014, p. 1) state that “complexity and innovation in spatial design requires a more pronounced link… eventual technical articulation of design” in a paper which discusses the enhanced hands-on learning technological advances in digital fabrication. Venter and van der Wath (2014) are advocates for educators and learners to have a better understanding of industrial processes and materials in the industry. Venter and van der Wath (2014, p. 1) state that “academic environments share a symbiotic relationship with emerging trends that take influence from technological innovations, social conditions and political shifts’

Actively Integrating ET into design education will enhance design-thinking and aspects of design that previously had less focus. The quality of design education can be augmented by exposing learners to new ways of understanding the complex relationships in design. More technology integration can lead to “substantial changes in social organisation, learner-teacher relationship, and a myriad of other factors that cannot be investigated successfully by predictive research” and “schools can become living laborites in which researchers investigate in real-world settings” (Amiel & Reeves, 2008, p. 35).

Technology in education needs to be treated with consideration to harness the potential of technology by redefining and enhancing the “performance as learners work in partnership ... with a technology” (Tarling & Ng’ambi, 2016, p. 561). Technologies tend to date and therefore require a considerable approach to ET. Impactful events like the internet were received with partial acceptance and contained negative impacts until they became pervasive and part of our daily lives. For design educators to facilitate ET, they would need to position themselves in the centre and understand technology. This means that educators would need to take a more pragmatic approach to their research to build an ET curriculum as opposed to the conventional theoretical methodology. Amiel and Reeves (2008, p. 37) state that dominant research can often be based on “impartial, unengaged” methods.

Educators develop an understanding of contemporary practices in the industry. For example, laser-cutting of materials and large-scale 3D printing is becoming more frequently considered as a form of efficient fabrication in building construction. Architects and builders are employing two-dimensional and three-dimensional strategies on construct aspects and at times entire projects. It is important to emphasise the value and importance of the link to ET and the impact on education. “This link must be informed by technological advances in digital fabrication and should include a deeper understanding of industrial manufacturing processes and the embedded nature of materials” (Venter & van der Wath, 2014, p. 1). Closing the gap between ET and education will create a stronger connection between research and real-world problems (Amiel & Reeves, 2008, p. 29)

FADA FabLab as a case study

In 2018, the author established a fabrication laboratory known as the FabLab at the Faculty of Art, Design and Architecture (FADA) at the University of Johannesburg (UJ). In 2021, the R2m fully equipped facility was completed. The FADA FabLab is a collaborative innovative facility located in the faculty. It is a 250sqm space with a glass shopfront facing the FADA atrium. It is open to all the learners and staff of the institution with a special focus on design fabrication learners and research for educators of FADA. FADA consists of nine departments, i.e. Architecture, Arts and Culture, Communication, Fashion, Industrial, Interior, Jewellery, Multimedia and Visual Art. There are 1400 registered learners at FADA in 2021. The FabLab officially opened its doors in January 2021 and has subsequently run for one full academic year. The current staffing is made up of the development coordinator (the author), who is a lecturer in the Architecture department and the FabLab manager. Several sub-facilities make up the FabLab and are the central preparation area. This is area has three large movable tables that are dedicated to the preparation and cleaning of fabricated models, workshops and exhibitions. The FabLab also has a 3D printing station, graphic station, Virtual Reality corner, laser-cutting room, CNC milling room, a secured small workshop with motorised hand tools, a biology laboratory, storage space and an office which has a two-hundred and seventy-degree view of the facility. It is important to note that a series of educator induction was established to generate an ET culture. This began by inviting all department educators to take a guided tour of the FabLab; demonstrating the facility's wide range of offerings and catalyse a discussion on the various applications that the design curriculum can pursue. Educators were encouraged to return to their departments to convene and to consider appropriate ET applications within their design programmes. Most of the faculty engaged and attended these sessions.

This paper focuses on the type of ET engagements in the FabLab. The observations intend to establish the nature of the learner's engagement with the facility. The observations were interpreted and documented. It seeks to establish which learner grouping types are accessing the lab; how they are engaging with space; what their project needs are and how are they are conducting it. Quantitative data was tracked and recorded by the FabLab manager to establish engagement trends. This data is supported by an open-ended questionnaire given to lecturers who engaged with the FabLab. The lecturer feedback establishes the pedagogical value of the FabLab in terms of their learner experience. The paper interprets and reflects on these sources of data.

Findings

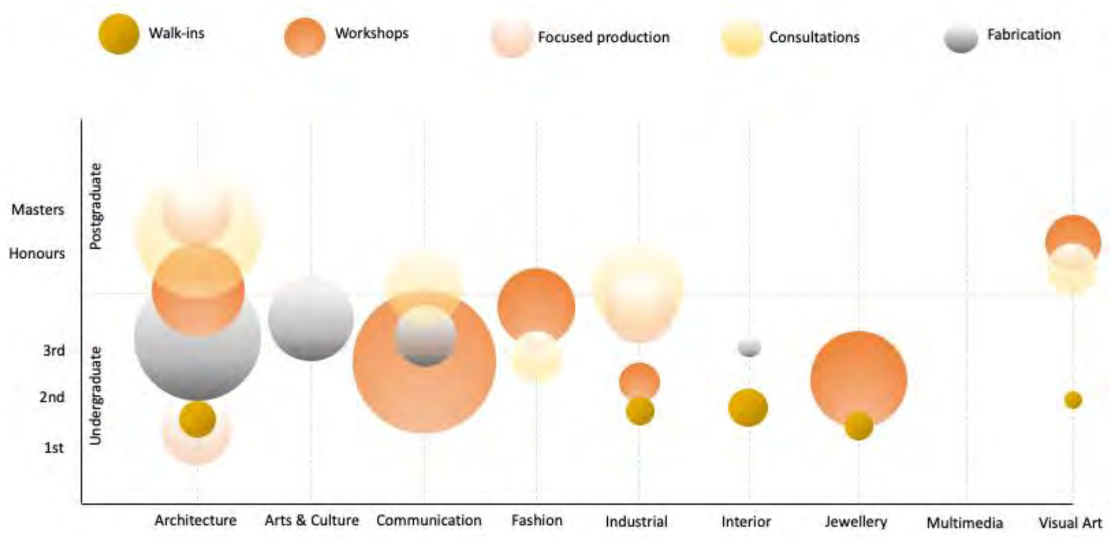

Figure 5: ET engagement with the FabLab

There are five types of ET engagements that were observed.

Firstly, walk-ins: without any prior arrangements, learners walk into the FabLab. There are on average 50 learner walk-ins observed per week with an increase of walk-ins from Tuesday to Thursday, with a constant stream throughout the academic year. These learners are registered in various departments and across all years. However, the majority of walk-ins are undergraduate learners; they make technical enquiries about machine fabrication processes, for example, how to prepare files, which machines are appropriate for certain fabrication processes or the learner purchases fabrication materials. Some learners were not made aware of the FabLab facility, they enter, and walkabout making basic enquiries about the facility.

The second ET engagement with the FabLab is facilitated by the educator with module-specific objectives and outcomes. These engagements were pre-arranged and occupied the format of structured workshops or talks to create awareness of either the facility, 4IR or conducting a specific tutorial. There were 30 formal workshops documented. The most active departments requiring workshops were the Communication, Jewellery Design and Architecture departments. The number of learners in the workshop were between 15 and 45.

The third ET engagement observed in the FabLab was focused on individual production. This group of learners were either worked in the FabLab on practical timber projects for short periods because their briefs required them to use the FabLab for their project- these were predominantly undergraduate learners from the Architecture and Industrial Design Departments, or senior learners conducting parametric modelling on laptops, or senior learners working continuously on a single project which included a combination of machine fabrication and manual work. The latter group of learners developed a stronger pedagogical relationship with the FabLab and the manager.

Consultation is the fourth type of ET engagement. This group of learners were seniors, and they work on one project and are required to invest a significant amount of time to produce the project at a high quality of standard. Their consultation is on average an hour. The FabLab manager is briefed about the project, and he responds by exploring various technical avenues which the learners can pursue. The materials, fabrication methods, modelling, and complexity is thoroughly discussed with possible follow-up consultations to assess and develop the project. There was 200 consultation conducted in 2021 with most of the demographics located in the Architecture, Industrial and Communication Departments.

The fifth and final group of learners include staff and requires little to no physical contact. This group of learners and staff are familiar with the machine fabrication process. There were 530 files received, processed, and fabricated in the FabLab. Most of those files, 355, were architecture senior learner projects, followed by Arts, and Culture, and the Communication Department. The leading machine fabrication was 3D printing. There are two machines; they were printing every day of the working week. The laser cutter and CNC router were producing projects between three to five days per week on average. The drone and the VR headset was booked out minimally for use.

Discussion

The FabLab offers multiple modes of ET engagements for a range of disciplines and year levels. Learners take advantage of that and therefore the lab is preoccupied with all five ET engagements. It forms the matrix of information that enables us to establish the ET engagement patterns.

The broader observation is that although many departments are actively engaging in ET in the FabLab in one form or another, there is a minority group of departments that have low ET engagement. This is attributed to a combination of low programmatic relevance or low educator facilitation and awareness. Learners who are exposed to ET engagements in the FabLab because their educator facilitated the engagement either through workshops or project brief requirements, tend to engage with high motivation. Walk-in learners tell us that there is not enough training and information about working with machine fabrication. In addition, learners responded positively to the workshops, and they are highly engaged. It was also established that senior learners spend more time in the FabLab to conduct intensive medium-term research. They form a stronger pedagogical relationship with the FabLab and the manager. They demonstrated a strong culture of experimentation. Although this is one of the most valuable learning methods in ET, only an insignificant number, four to five, learners are found in this group from the Architecture and Industrial Design Departments primarily in postgraduate programmes. This means that there is no consideration, or desire for, ET yet. With 200 consultations, with most learners being located in the Architecture, Industrial and Communication Design Programmes, this is a clear indicator that postgraduate learners benefit from the technical development discussion of their fabrication methods. Lastly, there is a high volume of fabrication projects received digitally from learners. Printing in 3D is the most common requirement for learners. Learners tend to be implemented laser cutting in fewer volumes and it requires an extensive amount of experimenting. It is more time-consuming.

The FabLab is a neural network of ad-hoc creative activity and most of the workflows in the FabLab require technical assistance because it poses a health and safety risk. Some of the challenges which have surfaced are human resources to expedite the skilled fabrication while consulting learners and dealing with walk-in queries. Trouble-shooting files on the computer before machine fabrication consumes a considerable amount of time. Although a schedule for organised workshops was created for the year, walk-ins and daily machine fabrication are ad-hoc and are challenging to control. The volume of incoming activity is hard to forecast and manage. It has a direct impact on the human resource of the facility.

Four of the educators were requested to provide feedback on their workshop facilitation in the FabLab. The four educators facilitated a structured workshop in the FabLab during the year. The departments were Jewellery (first year), Communication Design (first year), Fashion and Textile Technology (third year) and Architectural Design (third year). Based on a series of questions (Appendix A), the following insights were gained from the lecturers:

- Digital methods are increasing in the respective fields and the lecturers feel that the learner will benefit well and be more prepared for the industry if they are exposed to digital and alternative analogue design methods;
- The projects intend to expose learners to a variety of analogue and fabrication methods.
- Educators have complemented the access to the FabLab and find that the facility is 'extremely" valuable;
- They also complimented that the design of the space structure provides a pedagogical advantage and stimulates and inspired the learners and lecturers.
- Positive feedback was received in regards to exposing learners to new tools, new materials, understanding how materials work and supporting thinking about dimensions in 2D and 3D;
- All lecturers said enquiry based experiential learning does contribute to the way they think about the design curriculum. It makes the curriculum more experimental, opens up learners’ minds and increases production quality;

- The FabLab was able to fill a gap in the teaching and learning of skills that are closely related to making; and
- The lecturers will facilitate a wider range of engagements across their departments and will strive to encourage interdisciplinary interaction across the faculty.

In general, lecturers' responses to the questionnaire can be described as exciting, engaging, and complimentary. A larger study over an extended period will examine the quantitative and qualitative multi-facetted impact of the FabLab as an experiential learning model on learners and educators and their performance, comprehension, teaching methods, assessments to produce a comprehensive and extensive understanding.

Conclusion

In this paper, I argue that ET will not be able to solve problems of education inequality, but by developing new modalities of teaching and research in ET we will be able to solve some of the practical and tangible problems which face our country. Although institutions are competing globally for ratings and apply pressure to increase research quality, especially in 4IR, this should not be the reason for design educators to become despondent towards ET. There is real value in transformative pedagogies that can enhance learners understanding of ET content and skills. It will bring education closer to the industry and foster better relationships with spatial design complexity and technical knowledge. To embrace ET will require leadership and an attitude willing to discover new methods, tools, and approaches to design innovation in curriculums.

Accreditation bodies that endorse core design skills, knowledge, and competencies would have to reconsider qualification outputs with a specific focus on technology-related modules in the curriculum. A new conceptual understanding of modules like Computer-aided Draughting would need to be rethought to include ET methods for skills and content. Aspects of fabrication, parametric design, data and design, algorithms, biomaterials, electronics, virtual reality, and augmented reality are aspects of ET that would need to be redesigned into new pedagogical structures to allow new sub-technologies to emerge and old technology to be phased out. However, we need to maintain the core approaches to ET thinking. Problem-solving skills would take on a new approach with new methods and ideas to solve contemporary design-based technical solutions and institutions would need to nurture educators who are inclined to make these changes and invest in modern infrastructures.

The 4IR is a 'primer' for thinking about ET. Although it is high level, strategic and speaks to the positive impact of our economies, it should not be seen as a mechanism to displace poor education in South Africa. It is undeniable that global economies are in neoliberal contexts and that the intention of countries by nature is to compete economically. The context in which 4IR is being presented does very little for design educators and can be viewed as discouraging. We should consider ET for its relevance, its practical intention. Technology has always been at our disposal, some more convincing than others, and it is up to design educators to make sense of its applications. The beneficiaries are our learners, design educators, the departments, and the faculty. By developing this new knowledge, we can advance our society. If design schools want to aspire to offer the best quality in education, they would need to invest in the infrastructure and develop the culture. Creating innovative spaces and programmes to reflect twenty-first-century skills would need to be on the top of the agenda.

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Appendix A

Questions for the FabLab manager

1. Which departments do you service in the faculty?
2. On average how many students do you engage with per day or week?
3. What is the nature of the engagements with students?

4. What are types of requirements and questions do you receive from students?
5. What kind of staff engagements do you have?
6. What role does the FabLab play in faculty?
7. What is the role scale of the role of the FABLAB in the faculty?
8. How does access to the lab help students with their education?
9. How important is access to a lab manager?
10. What is missing from the pedagogical approach in the FabLab?

Design Education Forum of Southern Africa

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

The influence of the fourth industrial revolution: A multi-discipline approach for design education

Cherisé Walters, *University of Johannesburg*
Emmerentia PM Deminey, *University of Johannesburg*
Amanda Breytenbach, *University of Johannesburg*

Abstract

Klaus Schwab defines the word "revolution" to convey the "abrupt" and "radical" change, which brought about the first, second, third and fourth industrial revolutions. Schwab explains that the fourth industrial revolution (4IR) will transform the way humans communicate, socially connect, function day to day and operate their jobs. The 4IR is not only about technology; its fundamental difference is due to these technologies combining: as a result, the physical, digital and biological spheres overlap.

Leading design firms, like that of Neri Oxman, have combined the physical, digital and biological spheres by using computational design, additive manufacturing, material engineering, and synthetic biology. The design philosophy and scientific approach embedded in Oxman's work explore interrelationships among different spheres made possible by specialised in-house teams. These in-house teams form part of the design team to drive creative and innovative solutions. Through this multi-discipline approach, the fusion of the physical, digital and biological spheres is made possible.

This paper identifies Oxman's approach as a suitable example that meets the requirements of 4IR as described by Schwab. Through the exploration of the collaborative strategies employed by Oxman's in-house teams, this paper proposes a multi-discipline approach appropriate to design education. This paper will address theoretically how Oxman's multi-discipline team achieves the fusion of the spheres and how this could be incorporated into design education in developing a multi-discipline approach in the curriculum, taking into consideration graduate output associated with the 4IR paradigm.

The 4IR and rapidly changing employment skills requirement provide the context of this paper, which is investigated for a richer understanding and how this can impact the future of design education. The 4IR encourages exploring the fusion of the technology spheres, which imparts a collaboration of various disciplines, leading to a continuous multi-discipline domain. While the design industry finds its place within the 4IR, the design education sector's challenge is to produce graduates with creative ideas and relevant skills to function in and contribute to this emerging complex world. Through the exploration of 4IR practices, it is identified that a multi-discipline approach is a differentiating factor for creativity and innovation. Therefore this paper aims to understand how the multi-discipline approach can inform design education to enhance 4IR graduate output expectations in Afrika.

Keywords: Collaboration, design education, design industry, fourth industrial revolution (4IR), graduate output requirements, in-house teams, multi-discipline

Introduction

The 4IR is not only about technology; its fundamental difference is that these technologies combine: as a result, the physical, digital and biological spheres overlap (Schwab, 2016, pp. 1,8). These three spheres are identified in Schwab's (2016, p. 14) book as the technology drivers of the 4IR. The physical sphere refers to tangible technology such as autonomous vehicles, three-dimensional (3D) printing, advanced robotics, and new materials (Schwab, 2016, p. 15). The digital sphere is the internet of things (IoT) that bonds the physical and digital, and it is the association between things, such as products, services and applications, through connected technologies and various platforms that communicate with one another through algorithms, artificial intelligence (AI) and machine learning (ML) (Fox, 2019; Li, Hou & Wu, 2017, p. 627; Schwab, 2016, p. 18). The biological sphere refers to biological exploration, genetic sequencing, synthetic biology and genetic engineering. Examples include clustered regularly interspaced short palindromic repeats (CRISPR) or Material Ecology (Schwab, 2016, p. 21-22; Oxman, 2014, p. 1).

Schwab (2016, p. 10,14-24) indicates that some designers and architects have combined the physical, digital and biological spheres by using computational design, additive manufacturing, material engineering, and synthetic biology. This paper explores Oxman's design approach, demonstrating how the overlapping spheres are integrated into a design project. The paper reflects on work performed by Neri Oxman with a specific focus on the Aguahoja project. Neri Oxman (2019, p. 5) uses the Krebs Cycle of Creativity, which integrates four domains, where disciplines vary, to create innovative solutions that advocate a multi-discipline approach. By combining these domains, the technology megatrends such as computational design, digital fabrication, material science, and synthetic biology are combined, which creates an amalgamation of the spheres in line with the 4IR's fundamental framework.

The collaboration of work and combining multiple disciplines is not new to design education; this form of collaboration is usually multidisciplinarity. A set of disciplines come together to solve a common problem, and once the problem is resolved, the disciplines continue as before (Tolk, 2016, p. 226). The 4IR brings forth another kind of multi-discipline domain where disciplines come together not to solve a problem but to create innovation by blurring the lines of the physical, digital and biological spheres and continue to work together (Schwab, 2016, p. 1,10).

The paper develops an understanding of emerging phenomena in higher education and suggests a multi-discipline approach in this paper to address 4IR graduate output criteria. The exploration of 4IR practices identified that a multi-discipline approach is a differentiating factor for creativity and innovation. Therefore this paper aims to understand how the multi-discipline approach can inform design education to enhance 4IR graduate output expectations in Afrika.

Methodology

The research methodology used for this paper comprises an integrative literature review. Torraco (2005, p. 357) describes this type of literature review to address new and emerging topics which stimulate new thinking. This paper distinctly employs this approach to generate new knowledge for a topic in a state of exploration and discovery.

Torracco (2005, p. 357) explains that using an integrative literature review may lead to an "initial or preliminary conceptualisation of the topic" from which one could extrapolate a new model or framework. Snyder (2019, p. 336) suggests that this approach often requires "creative" data collection methods rather than presenting a review of all published articles. The paper comprises an integrative literature review within the context of the 4IR. Within the 4IR paradigm, Neri Oxman's work is identified and further investigated and explored in an attempt to understand how Oxman developed a multi-discipline approach. Subsequently, the paper extrapolates and suggest a multi-discipline approach for higher design education.

The 4IR and rapidly changing employment skills requirements further contextualise this paper and are investigated to better understand how this can impact design education while exploring a multi-discipline approach. The connection between a 4IR multi-discipline approach and the graduate output requirements is considered essential in postulating strategic drivers for future curriculum or project approaches in design education. In addition, keywords and phrases listed in the Future of Jobs Report 2020 assisted in conducting a critical reflection of South Africa's education's positioning and approach to the 4IR (World Economic Forum, 2020). Klaus Schwab is the founder and Executive Chairman of the World Economic Forum (WEF). The 2020 report, therefore, assisted in guiding our understanding of how a proposed multi-discipline model will positively contribute to how we work, design and think within the 4IR.

Literature review

Fourth industrial revolution

Schwab (2016, p. 3) recognises that several academics and professionals consider the theory of the 4IR to be part of the third industrial revolution. However, three reasons reinforce his view that a fourth and evident revolution is in motion. These three underpinning reasons are velocity, breadth and depth, and systems impact (Schwab, 2016, p. 3).

Schwab (2016, p. 3) explains that the velocity of the 4IR is developing at a rapid rate rather than a linear speed, distinguishing it from previous industrial revolutions, which is the result of a complex interwoven world we live in where new technology keeps on creating further advancements. The breadth and depth of the 4IR is an expansion from the digital revolution or third industrial revolution (Schwab, 2016, p. 3, 7). It merges several technologies forming a unique paradigm shift in individuals, our society, the way businesses run and how economies will function (Schwab, 2016, p. 3). The system's impact of the 4IR is the transformation of whole systems, which influences individuals, societies, industries, companies and countries as a whole (Schwab, 2016, p. 3). Therefore, the velocity, breadth and depth, and systems impact are the underpinning framework supporting the notion that the 4IR is distinct and currently underway.

According to Min Xu, Jeanne M David and Suk Hi Kim (2018, p. 90), this framework brings forth changes in knowledge, power and wealth. With the 4IR bringing changes to individuals, societies, industries, companies, and countries, it is in our best interest to be aware of these changes and take advantage of the knowledge to be learned. Therefore, understanding the framework of the 4IR will help make sense of this paradigm shift and how this knowledge can be used to the advantage of design education.

The 4IR is characterised by the amalgamation of the physical, digital, and biological spheres, which are the technology drivers of this paradigm shift. These technology drivers set the 4IR apart from the previous revolutions (Schwab, 2016, p. 1,8). Schwab (2016, p. 14) further identifies the technology megatrends grouped under the technology drivers. These technology megatrends can be categorised as; physical sphere: autonomous vehicles, 3D printing, advanced robotics and new materials, digital sphere: internet of things (IoT), computational design, connected technologies, various platforms, artificial intelligence (AI) and machine learning (ML), and biological sphere: nanotechnology, biotechnology, synthetic biology and material science (Schwab, 2016, p. 1,10,14-24). New technology is continuously changing and developing; therefore, this list only mentions a few available technologies.

The overlapping of these spheres that happens through the use of the technology megatrends brings forth another type of collaboration, disciplines that are not generally relatable work together and continue to work together but don't blur into each other's domain but share a common body of knowledge. A multi-discipline approach, therefore, emerges through the collaboration and interaction of various project contributors.

Collaboration and a multi-discipline approach

According to Bernard Choi and Anita Pak (2006, pp. 351), a multiple discipline approach aims to undertake multifaceted issues, present various viewpoints, give a comprehensive understanding of these issues with complex solutions, and create frameworks for future usage. There are advantages and disadvantages to using a multiple discipline approach (Choi & Pak 2006, pp. 351). Julie Thompson Klein (2010, p. 16) states that a multiple discipline approach can be used differently and has identified three branches; multidisciplinarity, interdisciplinarity and transdisciplinarity.

Through our research, Andreas Tolk emerged as a seminal author on multiple discipline approaches. Tolk (2016, p. 226) offers insight into the differences among the three identified multiple discipline approaches. Multidisciplinarity portrays the "loosest coupling" of disciplines that come together to solve a common problem that contrasts their accepted/known discipline method (Tolk, 2016, p. 226). This approach requires that each discipline resides independently in their domain but adds their experience to the common problem to be solved in an organised system. This results in various disciplinary methods to support one another but not overlapping. After solving the problem, different disciplines continue with their independent domains uninterruptedly. This approach does not pursue a shared "body of knowledge" except overcoming the common problem (Tolk, 2016, p. 226).

Interdisciplinarity generates a "closer linkage" among contributing disciplines (Tolk, 2016, p. 227). With the execution of interdisciplinary projects, the team that represents various disciplines concentrates on overlapping discipline knowledge. As a result, these domains are blended by recognising these overlapping knowledge areas, creating a new common subset that becomes interlinked domains from all participating disciplines. The focus remains to solve common problems but to create long-lasting bridges that connect the disciplines, which supports the new "body of knowledge" (Tolk, 2016, p. 227).

Transdisciplinarity signifies the "strongest coupling" of disciplines. New disciplines are created within the transdisciplinary teams through "transcending, transgressing, and transforming the contributing disciplines and specialities" (Tolk, 2016, p. 227). The knowledge that results from transdisciplinarity is crossbreed along with all the participating disciplines, not only in common terms but integrated within these contributing disciplines. A new hypothesis needs to be made to explain the stemming "body of knowledge" (Tolk, 2016, p. 227). The amalgamation is "systematic and transparent", all disciplines must agree upon the new knowledge and the common use thereof (Tolk, 2016, p. 227).

The multi-discipline approach advocated for in this paper does not fall within multidisciplinarity, interdisciplinarity and transdisciplinarity methods but derives similar aspects. The multi-discipline approach will be reviewed by focusing on Neri Oxman's Krebs Cycle of Creativity and Aguahoja pavilion.

Neri Oxman

Krebs cycle of creativity: A multi-modal approach

Neri Oxman, designer and architect, is the founder and director of Mediated Matter research group at Media Arts and Sciences at Massachusetts Institute of Technology (MIT) (MIT Media Lab 2020b; Oxman, 2015, p. 101). The research group focuses on Nature Inspired Design and Design Inspired Nature. The research area Material Ecology researches the "intersection of computational design, digital fabrication, materials science and synthetic biology, and applies that knowledge to design across disciplines" (MIT Media Lab 2020b). Neri Oxman hypothesises an anti-discipline approach and proposes the Krebs Cycle of Creativity (KCC) as an alternative approach. Oxman's KCC is an adaptation of the Krebs Cycle, the Rich Gold Matrix and John Maeda's Diagram.

Oxman reflects on John Maeda's diagram, as seen in Figure 2, which was based on the Rich Gold Matrix. Maeda's uses the diagram to define areas of creativity and assigns a specific creative approach and outcome to each quadrant. This diagram depicts that 'Science' is for exploration, 'Engineering' is for invention, 'Design' is for communication, and 'Art' is for expression (Oxman 2016a, p. 2). Similarly, the Rich Gold Matrix, as shown in Figure 1, distinctively boundaries the four quadrants: Science, Engineering, Design, and Art. These diagrams suggest that there are distinct modalities of human creativity that reside in the defined boundaries. Oxman reflects that by confining knowledge to any of the four boundaried domains, one will be "a citizen in one" and "a tourist in another" (Oxman 2016a, p. 2). Oxman, therefore, questions, "How we can become constant travellers within a border-free … intellectual Pangea?" (Oxman 2016a, p. 2).

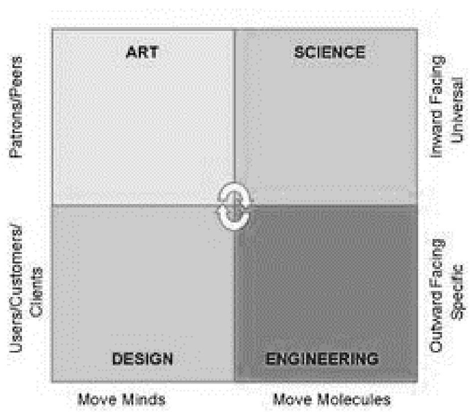

Figure 1: Rich Gold (designer) Rich Gold Matrix (The Rich Gold Matrix 2018)

Figure 2: John Maeda (designer) John Maeda Diagram (Maeda, 2017)

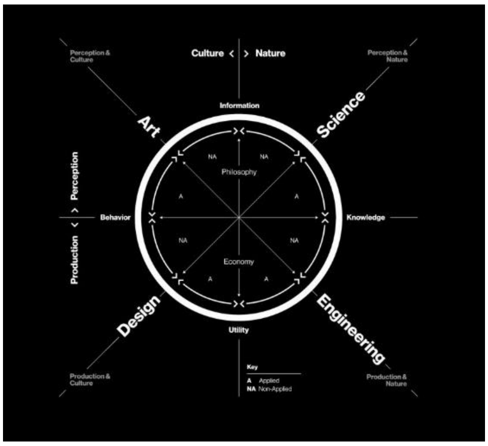

Figure 6: Neri Oxman (designer), Neri Oxman's Krebs Cycle of Creativity (Oxman, 2017)

Oxman refers to biochemistry knowledge focusing on the Krebs Cycle in her quest to offer an alternative approach to ways of being, knowledge generation, investigation and problem-solving. The Krebs Cycle is a chemical process in which energy is harnessed for cellular respiration in the form of Adenosine Triphosphate (ATP). Oxman reflects that ATP can be seen as "a molecular unit of currency for energy transfer" (Oxman 2016a, p. 4). Reflecting on this principle, Oxman proposes that her adaptation, KCC, as seen in Figure 3, is a map that illustrates the perpetuation of creative energy"creative ATP or CreATP" (Oxman 2016a, p. 4).

The KCC positions the four creative approaches as per the Rich Gold Matrix within a circle. However, Oxman (2019, p. 5) suggests that as you travel between and among these quadrants, you "spend currency in the form of intellectual energy", offering an elasticity in exploration not made possible by the Rich Gold Matrix. One can approach, engage, and apply the KCC by observing it as the Clock, the Microscope, the Compass, and the Gyroscope, each offering different opportunities for travelling, exploring and content generation. As a result, discipline residing knowledge in one domain can become the catalyst for discovery in another, which can only be made possible through a multi-discipline approach. Therefore, Oxman (2019, p. 7) argues that "knowledge can no longer be ascribed to, or produced within disciplinary boundaries, but is entirely entangled".

Aguahoja project

Through the design of a multi-discipline team and implementing the KCC in her approach, projects like the Aguahoja are conceived. The project Aguahoja focuses on the use of biopolymers that can be used to counter the effects of climate change and pollutions methane-rich manufacturing process (Oxman, 2020). In theory, to replace plastic goods by using bio-polymers instead. The skin-and-shell of the Aguahoja is completely made up of a bio-polymer which is found in nature from shrimp shells (chitin) and fallen leaves (cellulose), that was robotically fabricated through a 3D printing process (Figure 4) and shaped by water (Figure 5) (Oxman, 2020; Oxman, 2017).

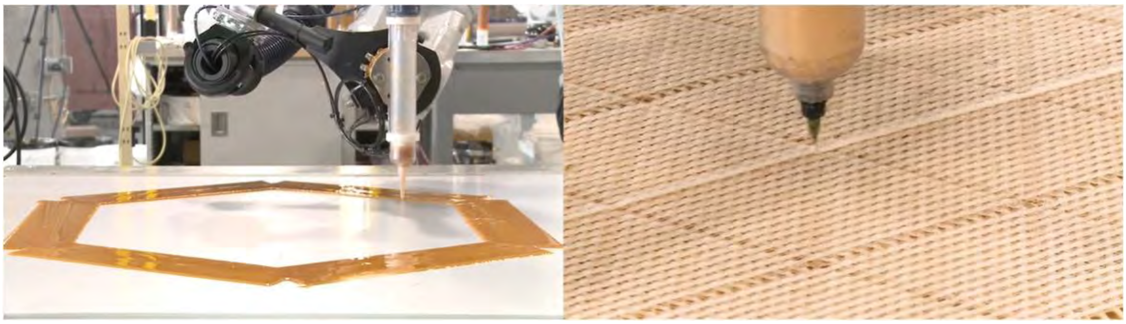

Figure 7: The Mediated Matter group (designer), Aguahoja being 3D printed (MIT Media Lab, 2018)

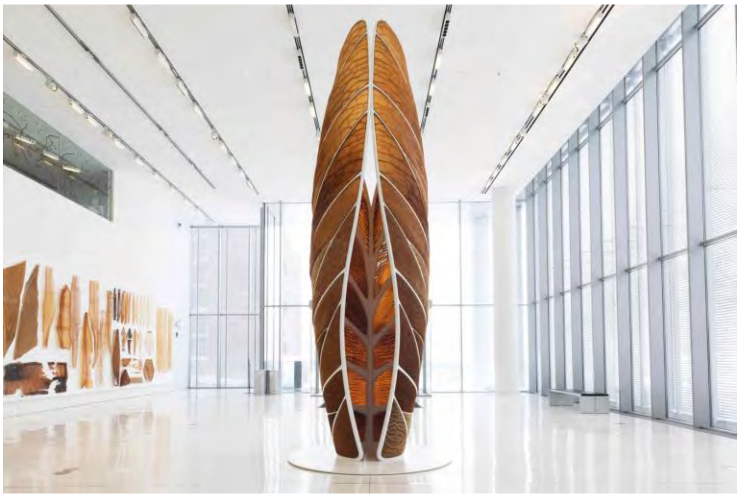

Figure 8: The Mediated Matter group (designer), Aguahoja exhibition (MIT Media Lab, 2018)

The table below has been constructed for the paper to show the disciplines that the various team members represent. This table shows that contributing individuals from the respective science, engineering, art and design domains have specialised knowledge due to their formal training. The Netflix Series *Abstract: The Art of Design*, episode 2 *Neri Oxman: Bio-Architecture* (Sorrentino, Roma & Chowles, 2019) reveals that these individuals do not take up sole residence in their discipline domains. We can observe from this episode that the lab has been constructed to engage collaborative thinking through its interior construction and layout, which encourages a continuous collaborative environment. We further observe that various disciplines gather around a cluster of work desks and critically engage cross-disciplinary thinking in a deep way. One of the team members supports this observation by stating that they "have to do just know about everything" (Sorrentino, Roma & Chowles, 2019). Knowledge no longer resides in a single discipline but is shared and acquired to generate new knowledge for undefined problems.

Table 1 Research team, discipline and department

Research team member	Discipline (degrees)	Department
Jorge Duro-Royo	Structural Design and Construction.	Department of Architecture and Urban Planning
Laia Mogas-Soldevilla	Visual Arts, Architect, Advanced Design and Digital Architecture.	Department of Architecture and Urban Planning

Joshua Van Zak	Chemistry and Systems Biology	Past member of Tangible Media
Yen-Ju (Tim) Tai	Architect	Past member of Mediated Matter Group
Andrea Ling	Designer and Architect	Past member of Mediated Matter Group
Christoph Bader	Information Design and Computer Science	Mediated Matter Group
Nic Lee (Hogan)	Biomedical Engineering, Neuroscience, Media Arts and Sciences	Mediated Matter Group
Barrak Darweesh	Architect and Designer	Past member of Mediated Matter Group
James C. Weaver	Aquatic Biology, Marine Science, Molecular Biology, Chemical Engineering, Physics, and Earth Sciences.	Mediated Matter Group
Nitzan Zilberman	Architect	Department of Architecture and Urban Planning
Neri Oxman	Architect, Designer, Design Computation and Medical Science	Media Arts and Sciences, and Mediated Matter Group.

Source: (table compiled by authors) (Ling, 2021; Linkedin, 2021; Duro-Royo, Mogas-Soldevila & Oxman, 2015; Mediated Matter, 2020a; Mediated Matter, 2020b; Mediated Matter, 2020c; Mediated Matter, 2020d; MIT Architecture, 2019; MIT Media Lab, 2020a; MIT Media Lab, 2020c; Mogas-Soldevila, et al., 2015).

Findings: Design education in an Afrikan context

This section discusses findings identified through the literature review that show the impact of 4IR on design education. A gap in the education sector's approach in the 4IR and an opportunity for the education sector emerges within our discussion. Therefore, in response, the discussion advocates the value of incorporating a multi-discipline approach in a design education curriculum.

Graduate output requirements within 4IR

The 4IR paradigm connection to the graduate output requirements is considered essential in presenting the future graduate output requirements for design education. While the design discipline finds its place within the 4IR, the design education sector's challenge is to produce graduates with creative ideas and skills relevant to this emerging complex world. The 2020 WEF's Future of Jobs report takes into consideration the impact of the "two twin events" (World Economic Forum, 2020, p. 12), being the arrival of the 4IR and the sudden impact of COVID-19 recession across the world.

The WEF data gathered for South African industries identify a list of emerging high demand skills. Among the skills listed, the following activities resonate well with design education activities: analytical thinking and innovation; critical thinking and analysis; complex problem solving; creativity, originality and initiative; and reasoning, problem-solving, and ideation (World Economic Forum, 2020, p. 105). The top three essential emerging skills in high demand in South Africa are creativity, originality and initiative; active learning and learning strategies; and technology design and programming (World Economic Forum, 2020, p. 105).

The emerging high demand skills identified in the report show the inherent strengths of the design curriculum when preparing graduates to take part in the 4IR world of work. The design curriculum focus is, therefore, well positioned to strengthen these emerging skills as strategic drivers in developing an appropriate 4IR approach. The responsibility of design educators is to incorporate these skills within the emerging context of the 4IR.

Actively embrace 4IR in the education system

Rodny-Gumede (2019) reports that diversity, flexibility, and creativity do not reflect South Africa's economy, job market, education system, or societal organisation due to its political past. This identifies the gap in the education sector's approach in the 4IR and an opportunity for the education sector. Current literature suggests that by actively embracing the 4IR, the education system is well-positioned to cultivate innovation and talent (Rodny-Gumede, 2019; Xing & Marwala, 2017, p. 13; Kayembe & Nel, 2019, p. 92).

The impact of COVID-19 and lockdown had a sudden impact on our design of teaching and learning strategies. The incorporation of technology-assisted greatly in the presentation of online classes and distance learning. The incorporation of technology, however, represent one sphere of the 4IR. The design education should actively embrace a more comprehensive and full spectrum of 4IR requirements to prepare graduates for a job environment that requires flexibility, creativity and innovation.

According to John Butler-Adam (2018, p. 1), future jobs have not been envisaged yet with the ever-developing technology, and highly skilled professionals will grow into their positions or be moulded for the needed job through the developing technology they work alongside. Therefore, students would need to learn how to adapt and be flexible in the working industry as their original profession may develop as the technology they use develops.

Include opportunities for multi-discipline collaboration

The KCC and the multi-discipline approach included in Neri Oxman's work provides insight into a revised design approach that stretches beyond design discipline boundaries. The approach further illustrates how the 4IR technology megatrends and overlapping physical, digital and biological spheres, identified by Schwab, is integrated into a design process. Design education can extrapolate valuable lessons from work performed by Neri Oxman, which offers guidance in providing a deeper understanding and richer application of 4IR influences in the design education curriculum and the students' execution of the design process.

Students from various disciplines should be encouraged to use creative and innovative thinking skills to explore problems through overlapping the various spheres. Design students should be guided through collaborative thinking processes and understand that multi-discipline work will expand knowledge and problem-solving. Creative and innovative thinking skills should take place beyond the boundaries of the discipline activities. This approach will require students to become travellers and explorers of knowledge in the fields of science, engineering, art and design. The design team should include a range of participants to inform and represent the complexities associated with our modern world and immediate vernacular context.

Integrating a multi-discipline process in design education will require design educators to include collaborative projects that will bring together a far wider group of participants. The vernacular (Afrika) context cannot be ignored and should be included to address social, economic and environmental factors in the design thinking process. This will allow Engineers, Scientists, Designers and Artists to investigate and explore problems, with the opportunity to generate knowledge. The aim is not to focus on a problem space but rather a solutions space where design students are curious and investigative. Students will become entangled with complex problems and explore solutions beyond disciplinary boundaries.

Conclusion

The paper identifies that the 4IR is not only about the introduction of technology and advancement of technology. As identified by Schwab (2016, p. 1,8), the fundamental difference is the overlapping of physical, digital and biological spheres. The paper explores the work of Neri Oxman and her design team's work to understand how she developed her multi-discipline approach, as expressed in the KCC and included in the execution of her design projects. Oxman's KCC and the emphasis on a multi-discipline approach presents insight into how the design education could understand the thinking and value of a multi-discipline team that contribute to developing design innovations.

The study identified that the design education sector naturally aligns itself with the high-demand emerging skills associated with rapidly changing 4IR. Emerging skills that will require creativity, innovation, and complex thinking are already embedded in design education curricula. The design education sector should understand how to cultivate these high demand skills, actively embrace participation in the 4IR paradigm, and consider introducing alternative teaching and learning strategies to prepare students for the complex 4IR work environment. Design education is consequently well-positioned to address this gap currently identified in this paper. By engaging alternative teaching and learning strategies, such as the multi-discipline approach, the sector can enable students to travel, explore, test, and investigate design within a world associated with complexity, rapid change, and the continuous introduction of new technologies.

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Collaborating online with strangers

Franci Cronje, *Independent*

Carla Enslin, *Vega*

"The truth is, when you are collaborating with strangers – whom you cannot always see – it brings up its own unique challenges, so conflicts in opinions are bound to happen, but I am very proud of how it was managed and of my group" *– design student reflection.*

Abstract

This paper reports on a qualitative case study exploring design student reflections about their experiences of a transdisciplinary online collaboration in a real-world learning project implemented in October 2020. The spread of a global pandemic that caused a primary and rapid shift from a contact-based learning model to fully fledged online teaching marked the year and learning for student participants. Applying an interpretivist paradigm, the researchers thematically analysed reflection essays from a sample of thirty-two design students to expose dominant perceptions.

Using social constructivism and online collaborative learning theory (OCL) as a conceptual framework, the authors highlight the authentic learning experienced by design students and the newfound insights of these students about sharing ideas in an online collaborative model. OCL builds upon three phases of knowledge construction, namely idea generation, idea organisation, and intellectual convergence to facilitate authentic learning. In this scenario, teams composed of final-year students (of which most were previously unknown) from the design, copywriting, and strategy disciplines met online daily for four weeks to develop and design original and meaningful strategic and creative solutions for challenges in South African business and society. The brief stipulated students should author reflective essays about their collaborative learning experiences on completion of the project.

Using innovative technologies combined with the present challenging socio-economic conditions suggests that online collaboration will become more prevalent in the learning and working world of design students and graduates. The authors posit that as design student learning grows beyond the initial novel sense of participating in transdisciplinary online collaboration on real-world challenges, they will find increasingly meaningful connections with their own personal lived experiences. Insights in these connections may assist researchers and educators towards a better understanding of how to design projects and facilitate authentic social interactions and learning in transdisciplinary student collaborations.

Keywords: Authentic learning, creative collaboration, real-world learning, transdisciplinary online collaboration

Introduction

Problem based learning (PBL) projects designed for student learning in transdisciplinary collaboration are not a new phenomenon. However, never has it been so necessary to create such projects for the online collaborative learning space. The necessary social isolation because of a global pandemic outbreak urgently prompted education into the digital space. This paper reports on explorative research that looked at third-year design students' experience in such a transdisciplinary project. The researchers used Linda Harasim's online collaborative learning (OCL) principles (1990) as described by Johnson and Johnson (1999) within the constructivist learning philosophy (Reeves, Herrington & Oliver 2002) to inductively arrive at repeating themes that crystallised from respondents' project reflection essays.

Theoretical framework

The constructivist learning philosophy in the online environment

The researchers ground the study in the constructivist philosophy, with which Reeves, et al. (2002, p. 562) state:

> [P]roblem-based and case-based learning, and the use of immersive scenarios and role-play have placed the activity students' complete as they study firmly at the heart of the curriculum.

Such activities can be any activity beyond reading or listening, such as to 'practice, apply, evaluate, or in any other way respond to curricular content' (Brophy & Alleman 1991: 9).

If we describe the design of this project against the constructivist learning's ten authentic activities as described by Reeves, et al., the following is true:
Teams collaborated on real life briefs with **real-world relevance** (1), for actual clients. These real-life briefs purposefully focused on social and/or business challenges unique to South Africa or Africa. Tasks were situational and **ill-defined** (2). Every team worked with a different brief that required a different output. The **complex tasks** (3) ran over four weeks and required research, strategic direction, creative outputs, and presentations. Teams contained students schooled in various disciplines, with **inherently different perspectives** (4), resources and skill sets. Individual team members **collaborated** (5) to complete the complex task, since the challenge required various backgrounds and expertise to make sense of conditions to develop- and execute a meaningful solution. Teams created **daily reflection opportunities** (6), and weekly presentations to a panel of educator experts. It integrated activities into one overall goal, with various stages and aspects that drew on all team members' individual expertise. However, the overall outcome is a **non-specific goal** (7) that they could only achieve with transdisciplinary collaboration. The entire project was **assessed for the overall outcome** (8), with no focus on individual aspects. The final project solution required a comprehensive skill set of all **role players** (9) to produce a meaningful creative solution and presentation to the client. Each team's **solution was unique** (10) with diverse outcomes, since the brief's complexity opens the process up for an endless variety of options.

Online collaborative learning

Taking the project online, the researchers describe it in terms of OCL (Johnson & Johnson 1999), with its five descriptors:

- **Positive mutual dependency**: Members have and lean on each other's unique competencies such as strategy, copywriting, graphic design, and digital design. Although they are all trained in research, their capabilities in the latter focus mostly on their own disciplines and competencies;
- **Personal accountability**: Consequently, team members are constantly reliant on the rest of the team's input to progress in their own direction. A collective team ethic encourages personal engagement and commitment to team expectations;
- **Promoting interaction**: By online communication and collaboration tools in the Blackboard LMS (the platform in this case), and any additional online tools that a team might want to add to their tool kit;
- **Social Skills**: The project requires advanced social skills in online communication and collaboration. Important levels of empathy are required to engage a multiple of conditions and perspectives to develop an original and meaningful solution; and
- **Group process**: The project is a group process and requires transdisciplinary problem solving.

Figure 1 captures the five requirements and context that explored design students' reflections. The final insights gleaned from the research, connect particularly with the aspects below:

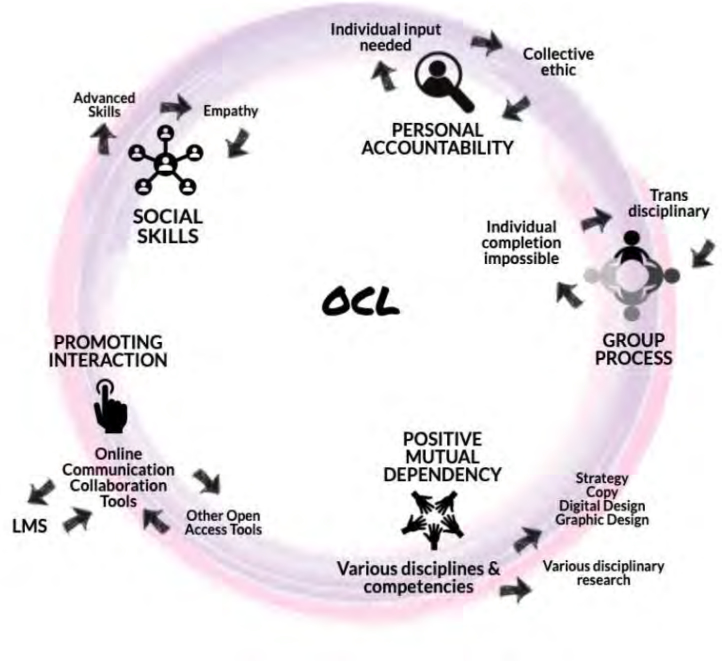

Figure 1: Five aspects of online collaboration and how they connect in this research

The importance of a transdisciplinary online collaborative process

Padurean and Cheveresan usefully define transdisciplinarity in education (2010: 127):

> *[The] principle of scientific research and interdisciplinary behaviour and practice that presupposes the application of scientific approaches to matters that lie between, across and beyond the boundaries of traditional, conventional academic disciplines. Its aim is the holistic understanding of this world and the unity of knowledge needed for this.*

Nordahl and Serafin (2008: 2) explain that transdisciplinary studies typically proceed from a problem to engage disciplines in solving it while interdisciplinary studies develop a relevant problem, as illustrated:

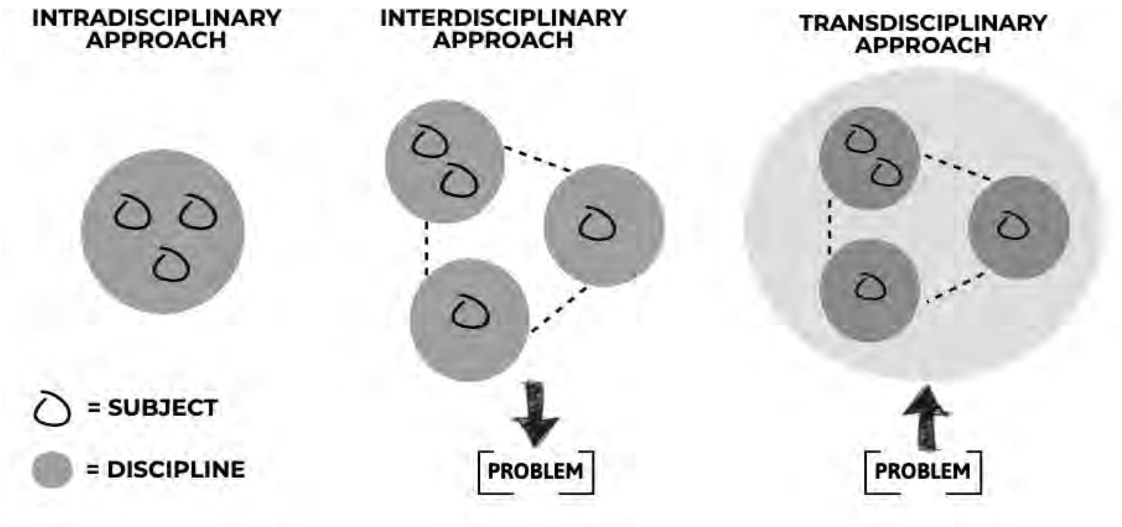

Figure 2: Disciplinary systems (Nordahl & Serafin 2008: 2)

OCL and problem-based learning (PBL) in the case of this study is viewed through a transdisciplinary lens of student reflections on collaborative idea generation, organisation, and intellectual convergence as phases of knowledge construction (Han & Resta, 2020). Jacoby-Volk and Bar-Eli (2021: 221) claim that this is the only way to use design projects for problem solving:

> *Only by introducing risk-taking PBL methodologies, generating organic leadership and promoting short- and long-term learning using the components of transdisciplinary performance can real-life design projects be initiated to solve problems and empower all involved stakeholders.*

When OCL and PBL is situated in transdisciplinary performance, top sought-after skills such as those flagged by the World Economic Forum in the Future of Jobs Report (2020), are developed – analytical thinking and innovation; active learning; complex problem-solving; critical thinking and analysis; resilience, stress tolerance, and flexibility. With a research focus on online collaboration in professional transdisciplinary teams, Dale, Newman, and Ling (2010) stress the need to develop professionals' soft skills and online dialogic techniques in effectively building a common language and mutual trust. In an increasingly interconnected and immersive world the need for graduate talent with well-rounded soft skills and the confidence and competence to participate and perform in transdisciplinary online collaboratives motivates contemporary design education to embed collaborative co-design approaches into curricula (Moreira, 2018; Lee, Ahn, Kim & Kho, 2019; McAra & Ross, 2020; Rowe, 2020). However, researchers still accept that it is difficult to facilitate these skills in a traditional higher education institutional context (Fisher & Newton, 2014) because many institutions still design their learning spaces to fit the accepted conventions of the last two centuries, with a pervasive industrial-age "egg-crate classroom" model of teaching and learning (2014: 903). Kauppi, Muukkonen, Suorsa and Takala (2020) furthermore posit that well evidenced insight into the pedagogical design principles that should guide the design or construction of collaborative projects remain scant.

Thematic analysis of design students' reflections

The confluence of relevant literature, the conceptual framework for social constructivism and OCL, directed an interpretivist and inductive approach for the research. It proposed this paradigm, as the researchers aspired to explore student experiences towards a better understanding of how to design for and facilitate authentic learning in a transdisciplinary online student collaboration (Flick, 2018; Rahi, 2017; Thanh & Thanh, 2015).

Upon completion of the problem-based online project under study, students submitted individual reflective essays in which they critically reviewed their learning experience and how it evolved over the four dedicated weeks of continuous online collaboration. They also reflected on three presentation- and feedback cycles with internal panels of educator experts, and finally a presentation to the originators of the brief (real-world clients). They reported on the social learning experience that required critical contemplation about the dedicated process and period of online collaboration with colleagues from various disciplines. As Papert in Picciano (2017) explains it, the learning process involved a continuous, deepening experience – students self-organised and progressed under complex conditions. The student essays presented a meaningful culmination- and rich reflection upon an authentic experience and it is these reflections, by graphic and digital design students, which served as the units of analysis for this exploratory study.

75 transdisciplinary online teams
25 real-world briefs/clients
4 dedicated and continuous weeks of online collaboration (Blackboard as primary platform – project resources, group rooms, file exchange, messaging, and access to panel feedback to all teams)
6 expert educator panels
Population: 33 Copywriting students 162 Design students (spanning graphic and digital disciplines) 297 Strategy students (spanning brand communication, brand-business, and digital marketing disciplines)
Sample and units of analysis: 32 reflection essays authored by design students

Figure 3: Project scope and units of analysis

The population of reflective essayists existed as known learning communities, organised in clear sets of classes and class lists. Therefore, the study employed systematic probability sampling to limit bias, respect the units of analysis (the reflections of design students about the transdisciplinary online collaboration experience), and to create a frame of thirty-two reflective essays to facilitate data saturation (Du Plooy-Cilliers, Davis & Bezuidenhout, 2014). Importantly, the individual social artefacts or reflective essays was not the focus of the explorative study, but collective insights gleaned from thematic analyses of all design students' reflections. The researchers applied inductive reasoning to the theoretical foundation of OCL and PBL theory, and analysed students' reflections on their learning experience to generate themes and underlying subthemes (Vaismoradi, Jones, Turunen & Snelgrove, 2016). With no preconceptions or hypotheses in place, reflections could speak for themselves. Through categorising or grouping reflections, themes or patterns emerged. To ensure a prominent level of trustworthiness in the inductive thematic analysis, the researchers employed Taguette (Rampin, Rampin & DeMott, 2021) as an open-access qualitative research tool, facilitating a step-by-step thematic data analysis process, with documented support (Nowell, Norris, White & Moules, 2017). The process developed from familiarisation with essays and reflections to a first set of open codes, categorised, and finally, the emergence of themes with subthemes.

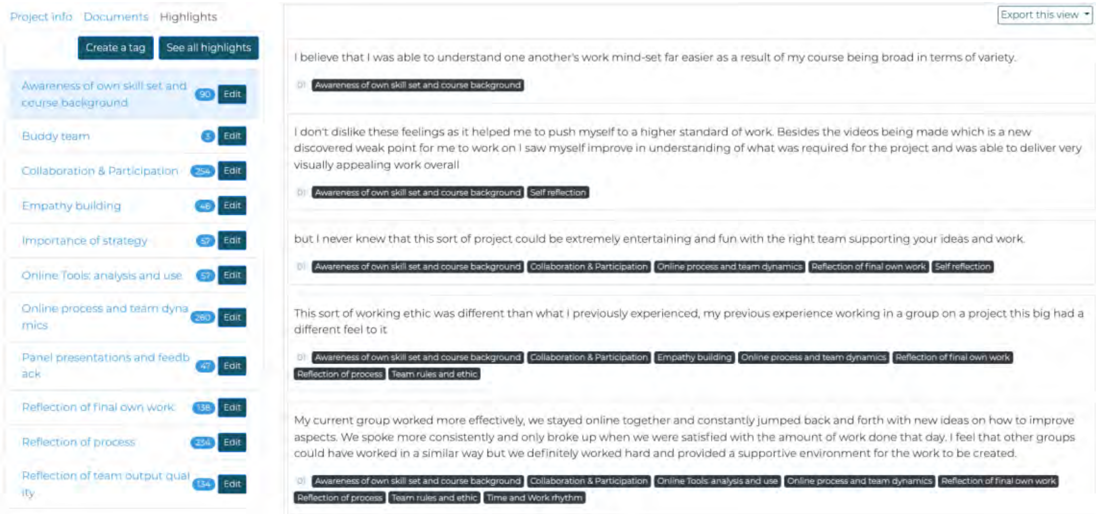

Figure 4: Screenshot of Taguette as part of thematic analysis

When working with student reflections, ethical considerations about confidentiality are crucial. The researchers obtained institutional ethical clearance and present thematic analyses using anonymous verbatim quotes only to reinforce and illustrate the discussion (Jowett, 2020).

Themes and Subthemes

Figure 5 illustrates emergent themes and subthemes from the inductive thematic analysis. Four main themes crystallised and are presented and discussed in terms of how they relate to one another in context of students' reflections on the transdisciplinary online collaboration.

Online Collaboration (with subthemes such as professional preparation, and practical online solutions and tools); Time Management and related issues (describing specifics such as the value of methods and conduct consensus, working method diversity and collaborator recognition); Personal issues, interests, skills and development (such as personal interest and skills, professional growth through collaboration, organising personal work and content, and interdisciplinary interests), and the Sum of the Parts (with mentions regarding creative project outcomes, the value of online collaborative learning, and transdisciplinary insights). The researchers emphasise that students do not mention these themes by scholarly terms but describe events and personal reflections. As researchers, we could classify descriptions into categories.

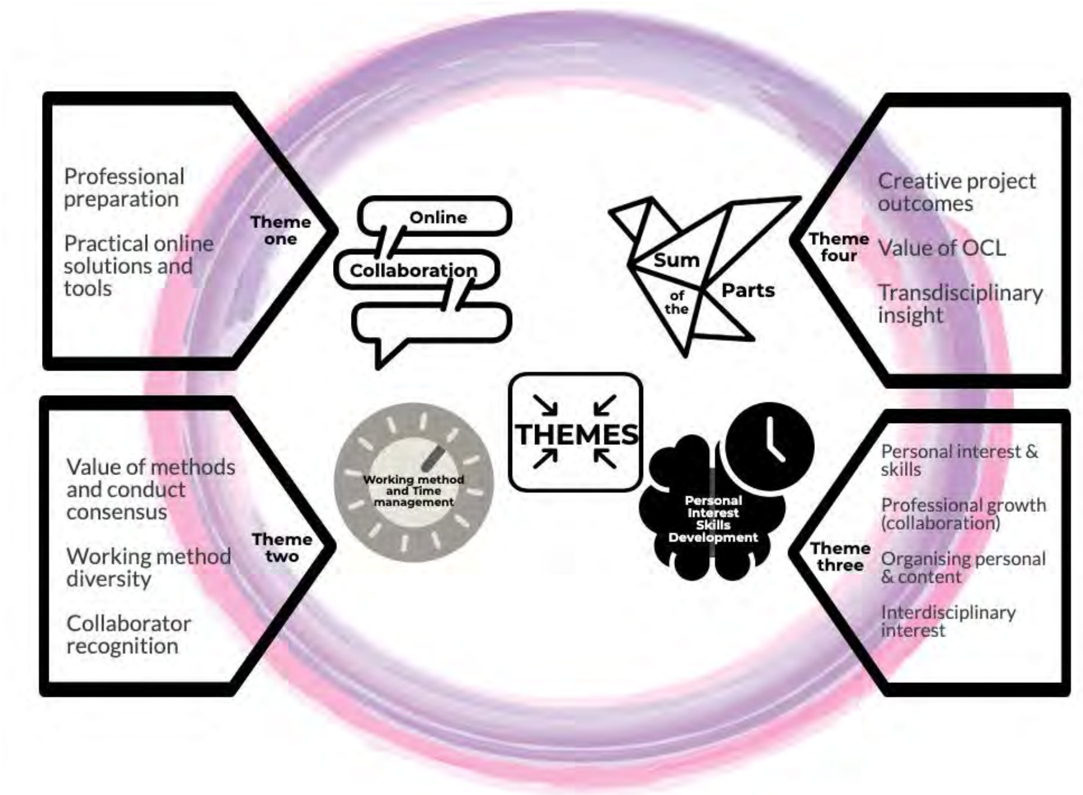

Figure 5: OCL Themes and subthemes from the data

Theme 1: Online collaboration

All design students in the sample group have experienced transdisciplinary real-world projects. However, these projects were localised, in face-to-face contact teams. The online collaboration involving transdisciplinary student teams based in disparate localities nationally was, therefore, novel for the student community. The researchers expected a preponderance of reflections primarily focused on the 2020 pandemic and the requirements for collaborating in a large-scale project online. Contrastingly, reflections of the design students about subjects were secondary, and mostly mindful, sober, and practical.

For many, the value of gaining experience in an online collaboration was clear and manifested as being better prepared for the working world:

> *A tester into how our interviews for jobs potentially could be conducted, as well as presented to clients in future;*
> and
> *Out of all the group projects and activations, [this project] held the most valuable lessons, it was great meeting new people and learning how they did things.*

The thematic analysis furthermore revealed that many teams effectively sourced practical online solutions and tools to enhance team dynamics or working methods:

> *Due to the constant updating that is required to co-work on X we discovered Y.*

Students mentioned various methods and tools, and typically described them:

> *Useful for real-time collaboration;*
> *Very efficient tool - access it from any device with my sign in information;* and
> *Very useful and time saving.*

Student reflections concluded:

> *I will be using it in the future;* and
> *I was able to do what was required from me in my own space concisely as well as with strangrs thanks to all the technology we have today.*

Some design student reflections mentioned team frustrations with unstable internet connectivity or limited data plans. However, a solution-focused approach or sense of resilience accompanies most reflections:

> *But for the days that connectivity was an issue we switched to Y;*
> *(we had) the odd technical difficulties at the most crucial times like presenting to the panel, which was frustrating but luckily we could take it in our stride and carry on;*
> and
> *Determine who has good presentation skills and a stable internet connection.*

In few cases student reflections expressed a preference for face-to-face collaboration while recognising that they need to collaborate effectively online:

> *Although working virtually is a whole different ball game that I had to accept and make the most of, I think I would have obviously preferred to have worked in person, but it all worked out well in the end.*

In isolated instances, reflections expressed deep frustration with online collaboration:

> *The experience was incredibly isolating.*

While some reflections also showed deep-seated regard for collaborative online team support:

> *I am extremely grateful for being able to have bonded with someone from another city that I met online and how she helped me through an emotional turmoil, like a true teammate.*

Theme 2: Working method and time management

Three subthemes emerged from design students' reflections on working methods and time management in an online collaborative. These include the introduction and value of agreed upon working methods and codes of conduct, differences, and adjustments in working methods and recognition of valuable new working methods.

It seems that several teams anticipated online collaboration might present new or additional challenges regarding team dynamics and thus introduced **agreed-upon working methods and codes of conduct** from the outset:

> *It encouraged all of us to participate and feel empowered to work for the eventual success of the group;*
> *Doing so allowed everyone to honestly and openly express their thoughs and opinions, creating a safe space for any discussions;* and
> *Members conducted themselves according to the agreed conflict resolution guidelines and the problems were addressed effectively.*

Some student reflections referenced steps taken by the team to realign and reinforce codes of conduct throughout the online collaboration:

> *Certain group members felt less obligated to participate within the group behind their screens;* and
> *This proved to be challenging as users in the team were not as open to turning on their webcams or even microphones on some days.*

And some reflections of design students highlight team performance specifically because of effective governance.

> *The final product was developed according to strict deadlines, day-to-day meetings, and consultations;*
> *Due to our healthy and clear ground rules that had been set in place from the beginning, we were able to work through this (challenge) and still work together as a team;* and
> *I learned that a group functions better when each member is empathetic and considerate of the next person, this calls for open communication and a conflict resolution plan that is actually followed by the members.*

Several design students' reflections reveal self-recognition of how **personal working methods differed** from that of colleagues, which for most motivated **an adjustment to align** with the dominant and preferred online working method. The dominant topics in this regard seem to align time schedules and creative outcomes:

> *It just took some rearranging in our personal timeframe schedules that we had set out for ourselves;* and
> *I did work differently, then whatever their feedback or suggestions were, I would make some changes to make sure it is good enough for the work or presentation.*

Many design students furthermore reflected on *valuable working methods* in online collaboration.

> *We stayed online together and constantly jumped back and forth with new ideas on how to improve aspects;* and
> *Constant check-ins and clear communication amongst all team members helped.*

Student reflections also reference working methods of colleagues that were impressive or effective and that they would like to incorporate into their own skill sets.

> *I would like to improve on my techniques and versatility (such as having to work with other tools and resources to enhance my skill set);* and
> *It was really satisfying to work with other designers, and it inspired me to try out work that I never attempted before.*

Whether from the outset or in realigning the team to resolve a particular challenge at hand, many essays in the research sample shared positive reflections about the online working methods and time management of the teams. Reflections on negative experiences were noticeably less, and mostly reflected imbalances in work schedules or work ethic.

> *Some group members did not take accountability and responsibility for their own work. This was incredibly hard to navigate.*

Still, many reflections also contained some recognition where personal working methods could be improved.

> *One thing I would like to improve upon is my time-management skills, this really did catch me off-guard.*

Theme 3: Self-reflection: Personal interests, skills, and development

A dominant theme emerging from design students' self-reflections is the **discovery or affirmation of personal interests and embedded skills:**

> *There were moments in this experience that made me realise that I am smarter and more creative than I realised;*
> *I discovered that I really handled stress much better than I initially gave myself credit for. I also learnt that I adapt very fast to changes;*
> *I can produce more than I thought I could, which was a good self-esteem booster;* and
> *I found a renewed passion for my education, and this experience motivated me to work harder than ever.*

As a counterpoint, some design students found the discovery equally valuable that a particular design practice may after all have not turned out as their primary personal interest.

> *This (project) made me question where I want to work and how I want to showcase myself as a designer;* and
> *My strengths and my passions lie somewhere else... - that's a tremendously valuable thing to uncover in one's own identity.*

Design students' self-reflections mostly revealed four specific areas where students wanted to **develop and grow as young design professionals** – foremost, the desire to master **newfound design skills or design** tools were inspired by observing and reflecting upon the unique styles, and capabilities of colleagues or by discovering a new online solution to a specific design challenge.

> *It was very interesting to observe how my fellow crew members would develop ideas and how they would expand on those ideas in ways that would never occur to me;*
> *When one of us did not know how to do something, the others would stop to teach or to listen as well. So, the process was very satisfying;* and
> *The other creative gave me tips and tricks and different ways to accomplish things I till then thought could only be done the hard way.*

Reflections on opportunities to further develop own skill sets were followed by desires to develop soft skills, specifically in **sharing views in a collaboration and doing so truthfully and empathetically:**

> *I will change the fact that I do not give my honest opinion in group situations and instead of worrying about how others may take it, I will tell the truth in a polite manner;* and
> *Criticism is part of our work and we need to learn to be open to it.*

Other design students reasoned:

> *To provide constructive criticism to the work presented but also suggest solutions to improve it.*

Designers furthermore reflected on becoming better disciplined in **organising both themselves and the produced content:**

> *Folders to contain work became difficult to manage and navigate as there was an abundance of folders to sort through;* and
> *I have since renamed folders, created folders and organised my workspace.*

Lastly, some students' self-reflections on developing and growing as design professionals reveal **a genuine interest in other disciplines** practiced in the team.

> *This project has revealed that I am definitely a lot more into X side of things than I thought I was;*
> *I found myself getting really involved in X and wanting to contribute and learn more;* and
> *I really enjoy X, and I would like to pursue further education in X.*

Theme 4: The sum of the parts

Most of the design students' reflections reveal an important level of satisfaction with the final **overall creative outcome of the online project**, coupled with a specific aspect of the work that could, in their opinions, have been done better.

> *I feel like some of the executions could have been more polished... but ultimately, I am impressed and happy with what we were able to do;*
> *This is a project that I am super proud of and will definitely put into my portfolio to show off. I do think it could be developed further;* and
> *I really believe that my group produced an incredible X that was of industry standard.*

Reflections that revealed a level of dissatisfaction with or disconnect from the final and overall creative product were in the minority and again seem to contain valuable learnings, for example:

> *It cemented my understanding of myself that I prefer to work more idealistically which is both good and bad because I do find myself having unrealistic expectations of the industry.*

Most significant, is the design students' reflections on the overall value of the online collaborative learning experience. For many students, the ultimate value was in the learning journey or in the entire transdisciplinary synthesis.

> *Our final execution as a whole had to be the most satisfying part;*
> *Seeing all of the insights and research pull into the final ideas;*
> *This experience made me realise how integrated all my past modules really were and how each one had a role in a large-scale project;* and
> *It was a true culmination of everything that I have learnt. It showed me how much I have learnt.. as well as how much more I can learn.*

Several students then also reflected on the success achieved, given the complexity embedded in an online transdisciplinary real-world project.

> *We had an enormous amount of in-depth information on X, to support our idea was a long process, the most satisfying part was both the finished product and the process;*
> *Creating a successful campaign for a client is a large task, that needs to be executed correctly and effectively in all areas;* and
> *Looking back on the experience there is a firm sense of accomplishment and pride considering the complexity of the challenge itself, and experienceing a live brief with a group from around the country.*

The expression most design students used in describing the workings of transdisciplinarity was the continuous need of **a golden thread:**

> *Tying each element together and finding a golden thread.*

Some teams had to revisit team structures and communication platforms to enable the development and execution of a cohesive creative outcome.

> *This was because we weren't working together as the team was split into two, the creatives and the strategists.*

However, most of these reflections show teams recognised and resolved such counter collaborative working methods effectively. Some student reflections also comment on the value of the review sessions with the transdisciplinary panels of expert educators, who kept teams on their *"toes and grounded"* or *"when we did go off track slightly",* working toward a cohesive creative outcome.

Closely related to the learning journey or entire project synthesis is a pattern of **transdisciplinary insight,** or perceived lack thereof. Although most of the design students saw their training in disciplines that inform design, for example research and strategy, come to life with appreciation and interest, many expressed frustrations with the lack of insight that colleagues from other disciplines had into the practice of design. This, for most, entailed:

> *A lack of understanding and appreciation;*
> *As to how long it takes to come up with and execute a creative idea;* and related to this
> *an overall lack of understanding of what an insight is and how this leads to a big idea;* or
> *How to roll out a strategy into a creative idea.*

Despite the hurdles encountered in this real-life transdisciplinary online project, many reflections are focused on the satisfaction of having succeeded as a team.

> *A life changing experience filled with different viewpoints, different backgrounds and different cities;*
> *Both the process with the team and the final product was equally satisfying, as the team consistently pulled through the most negative times and came together to solve problems;* and
> *Looking back, I am very proud of the work that we produced. I am especially proud of it considering the journey that it took to get to our final product.*

Discussion

The design student reflections revealed an important level of regard for the learning journey and the transdisciplinary synthesis achieved with the final overall creative outcome of the online project under study. A prominent level of critical self-reflection is noted as students came to better understand themselves as designers and as young professionals in a transdisciplinary team working on a complex challenge online. Reflections are rich in considering the hard and soft skills embedded and those already developed or are yet to be. It is important to note that in this regard most students seem to have been inspired by observing and reflecting upon the unique styles, capabilities, or inputs of colleagues or by discovering a new online solution to a specific design challenge. Authentic learning took place as students moved beyond the novelty of collaborating with members from other disciplines and campuses online and made meaningful connections with their own lived experience (Han & Resta, 2020).

Of the five required components described by Johnson and Johnson (1999) regarding successful OCL design, elements of **positive mutual dependency** among team members emerged as the most essential element for research into this one project. Although personal accountability, promoting interaction, building social skills and an effective group process are inherently important and interrelated, reflections regarding the above, dominated. Four insights evidenced this:

Despite the spread of a global pandemic that caused a primary and rapid shift from a contact-based learning model to fully fledged online teaching, the thematic analysis did not produce a preponderance of reflections focused on the requirements for collaborating in a large-scale project online.

> *When you are collaborating with strangers - whom you cannot always see - it brings up its own unique challenges;* and
> *There was no set expectation, no one knew what was coming and how to mentally prepare. It was somehow reassuring that we were all in the same boat.*

Research conducted by Magen-Nagar and Shonfeld (2017), indicates that team members' feelings of intrinsic motivation and investment in the collaborative team and product extend to their confidence in and liking of collaborating online. Vladova, Ullrich, Bender and Gronau (2021) also caution that students in disciplines where they do not collaborate online regularly, seem to accept digital platforms slower. Our research focused on the reflections of design students who are, by their nature, described as enthusiastic digital participants (Zaphiris & Ioannou, 2018). The dominant reflective focus fell on the overall experience and value of collaborating in a transdisciplinary team online and producing a meaningful and well-integrated solution to a complex challenge. A transdisciplinary OCL and PBL project design should be cognizant of students' **comfort with online collaboration and capitalise on it**.

Related to the above insight, the thematic analysis revealed that a transdisciplinary online project design should facilitate positive mutual dependency and interaction at the onset and thus enable and support authentic collaboration.

> *It was incredibly difficult to work with individuals I have not met before, this proved problematic during the first week as I was too afraid to speak my mind;* and
> *This subsided fast as we got to know each other.*

This insight underscores the importance of factoring in more time for team members to get to know each other and to gain insight into discipline specific strengths and working methods. Although a fast start might feel comfortable for students with extroverted personalities, it also means that a team might not fire on all cylinders initially. An online transdisciplinary project design should empower students to first get to know one another, to share personal goals, professional strengths, and toolkits. Based on the reflections of students in this study, a norming phase should then also enable the team to co-create and implement an agreed upon code of conduct, mindful of supportive team structures, working methods, communication channels and styles.

An OCL project toolkit could therefore include team-building exercises to **stimulate and support positive transdisciplinary mutual dependency and interaction at the onset**. The researchers Ergulec and Zydney (2019), for example introduce the application of a *Fears, Hopes and Norms Protocol* before an online transdisciplinary project commences with prompts that enable the team to reflect, to share and to shape the code of behaviours that they wish to uphold – *if this team turns out to be one of the worst ever, what will its characteristics be?* Ergulec and Zydney (2019) then also encourage teams to scrutinise team norms and how they could work better in a next project phase, as much as they would reflect upon the progress of the project itself.

A third insight gained from the thematic analysis of design students reflections suggests that the design of an online collaborative learning project should consider how **to streamline workflow and enhance their time management.** This seems amplified when collaborating in a transdisciplinary team because individual ways of working and time demands are not necessarily common knowledge or practice. In supporting positive mutual dependency and interaction at the onset, project designers should therefore also concentrate on resources and toolkits that would simplify and streamline collaboration in such a project. Project resources should incorporate online kits composed of team collaboration, as well as time, and content management tools, and online presentation guidelines and checklists. Students might be prepared by exploring such tools earlier in their programmes and then be encouraged to share preferred methods with team members in norming the transdisciplinary online team. Kauppi, Muukkonen, Suorsa and Takala's (2020) research also suggests that student teams benefit from guidelines and support in preparation of social interaction and collaboration online, which Han and Resta (2020), also reinforce as the most crucial facet of collaborative learning.

Lastly, team leadership did not emerge as a dominant theme in design students' reflections. Sometimes, reflections celebrated the approach of a single leader.

> *He was a true leader, humble, kind and compassionate and was always willing to go the extra mile to make sure we were all on the right track.*

In most instances **leadership emerged distributed** across disciplines, phases and or specific tasks such as taking the lead in workflows. This organic result aligns with Ergulec and Zydney's (2019) suggestion of rotating leadership in assisting online collaborative teams to learn to work together and to avoid one person from dominating the team. Before students attempt to start solving complex problems as a transdisciplinary team with an online project of this scale and complexity, they may benefit from a well-rounded conversation to help them properly grasp the interrelationships between diversity, distributed leadership, and creativity. Research indicates that inclusive acceptance of differing perspectives enables team members to better bridge socio-cultural variations through mutual recognition, thus enabling and stimulating collaborative idea generation (Hawlina, Gillespie & Zittoun, 2019). Pedagogical principles should guide and facilitate diverse student teams towards productive collaboration inasmuch as they provide for the development of skillsets for original, meaningful strategic and creative solutions to those diverse and complex challenges posed by South African and African business and societies.

Conclusion

Contemporary design education should embed collaborative co-design approaches into curricula to develop well-rounded hard and soft skill sets and thus the confidence and competence to participate and perform in transdisciplinary online collaboratives. It struck the researchers how student focus on social and interpersonal dynamics emerged from the reflections. Personal dynamics, and the importance of social connection, dominated many reflections and apart from a few outliers, design students built an understanding of and meaningful relationships with remote team members from other disciplines. These themes resonate with the OCL theory's first descriptor, namely that of positive mutual dependency as foundation to idea generation, organisation, and intellectual convergence and the construction of new knowledge through authentic learning.

The themes and insights also emphasise the critical role that educators play as project designers. A transdisciplinary collaborative can stimulate and facilitate in-depth authentic learning, but it requires careful designing. It is also clear that project designers need to allow time for and optimise connecting and norming, since teammates stem from various disciplines and do not necessarily know each other. A transdisciplinary OCL project toolkit can play a critical role at the onset in facilitating positive mutual dependency and social interaction in transdisciplinary student teams. All students should have time beforehand to familiarise themselves with such a starter kit. They might be comfortable with design-related software and tools that they use regularly, but in the transdisciplinary environment, an online project kit composed of methods and tools that facilitate online norming and collaboration, professional project management and the delivery of compelling presentations to internal and external parties, could support the collective to collaborate and function optimally. Additionally, to expand the study, the researchers aim to conduct thematic analysis of copywriting and strategy students' reflections on the same collaborative project, which may contribute further insights on how to design projects and facilitate authentic social interactions and learning in transdisciplinary student collaborations online.

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SESSION 7: Thinking through 4IR Reflection on teaching in the digital space

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

A systemic framing of the challenges faced in design education during the COVID-19 lockdown

Hadassah Meyers, *University of Johannesburg*

Abstract

The COVID-19 pandemic has exposed the deep cracks of inequality within the South African educational system (Gustafsson & Deliwe, 2020). The fourth industrial revolution (4IR) has presented a range of new technology applications (Lacy, Long, & Spindler, 2020). These technologies can be leveraged to provide more equal access to the technology needed for remote learning (Du Preez & Sinha, 2020). This paper uses a systemic design approach to reflect on the challenges faced in design education during the COVID-19 pandemic. Student feedback on the online learning experience during the COVID-19 lockdown was reflected on. Observations were organised in themes and then explored using the first step of Namahn and shiftN's Systemic Design Toolkit (Van Ael & Vandenbroeck, 2016). Design thinking toolkits are well-established tools for a design process (Tschimmel, 2012). A systemic design toolkit was chosen as a method that incorporates tools from both Design and System's practice (Vandenbroeck, Van Ael, Thoelen, & Bertels, 2016). The primary aim of this study is to frame the complex systems that contributed to the problems exposed. This inquiry uncovered interlinking issues that exacerbated the challenges of remote learning during the COVID-19 pandemic.

Keywords: 4IR, COVID-19, educational inequalities, mapping, systems

Introduction

This paper illustrates how a systems-orientated approach to Design can be useful in a study that deals with complex socio-technical problems. It does so by presenting my personal account of the challenges experienced by the Multimedia Department at the University of Johannesburg (UJ), during the COVID-19 pandemic. I reflect on the practices that were found to be helpful in mitigating the implications of digital inequality on our students. I have used a Systems approach to expand the framing of the problem context, and by doing so, highlight the systemic nature of design education during the COVID-19 pandemic. I present my experiences during this time and showcase an exploration of Systemic Design tools for *framing a system*, to illustrate how Systems Thinking (ST) can be integrated into the practice of Design.

Challenges in design education during the COVID-19 lockdown

In March of 2020, the first case of COVID-19 was reported in South Africa. President Ramaphosa declared a National State of Disaster and implemented a national lockdown. From 23 March, until the 30 April 2020, no one besides essential workers was allowed out of their homes. All non-essential industries were closed (Arndt, et al., 2020). Schools and universities were shut, and students living in campus accommodation had to make alternative arrangements (Crawford, et al., 2020). The South African government instituted a five-level alert system. *Level 5* was reduced to *Level 4* in May, *Level 3* in June, *Level 2* in August, and *Level 1* in September (South African Government, 2020). During *Level 5* no students were allowed on campus. This changed during *Level 4* when final year students were allowed back. As can be seen in Table 1, there was a gradual increase of access to campus from 33% of students being allowed back during *Level 3*, 66% during *Level 2*. All students requiring access to university facilities were allowed back on campus during *Level 1* (with spacing limitations).

Table 1: Student access to university campuses mapped to the COVID-19 five-level alert system (South African Government, 2020)

	Level 5	**Level 4**	**Level 3**	**Level 2**	**Level 1**
Alert level timeline:	*26 March to 30 April 2020*	*1 to 31 May 2020*	*1 June to 17 August 2020, 29 December 2020 to 28 February 2021*	*18 August 2020- 20 September 2020*	*21 September to 28 December 2020.*
Student access to campus:	No students allowed on campus	Final year students allowed on campus	33% of senior students allowed on campus	66% of students allowed on campus	100% of students allowed on campus

When the COVID-19 lockdown began, UJ developed a plan for remote learning as all students and staff were required to be off-site during this initial national lockdown. Blackboard was the primary Learning Management System (LMS) used by UJ to deliver online teaching. It is worth noting that over 60% of undergraduate students at UJ are funded by the National Student Financial Aid Scheme (NSFAS). Over and above that, there are also students who fall into the "Missing Middle" category (i.e. Above the income threshold for government funding, but still require financial assistance). Senior academic leaders Motala and Menon (2020), offer insight into the COVID-19 learning experiences faced at UJ. They noted that not all students were afforded the same level of access to the online platforms needed for remote learning. Several factors contributed to this problem, such as limited or no network coverage, lack of a suitable computing device, high data costs, and limited bandwidth. External considerations such as living conditions and psychosocial factors also compromised the COVID-19 online learning experience of many students (Motala & Menon, 2020). The COVID-19 pandemic forced the speeding up of the 4IR journey across UJ, with all faculties and disciplines having to make continuous adjustments to course delivery, bearing in mind digital inequality. Flexibility and agility were essential tools for experimenting with various approaches (Motala & Menon, 2020). The Multimedia Department was by no means unique in this journey, however, like in many other departments, it became apparent that the nature of the discipline contributed to the experience of remote learning.

As a multimedia department, our job is to prepare students for a career in digital media. We equip students with skills for technology-based design. This could take the form of digital content creation (such as video and animation) or the design of digital products and interactive platforms (such as websites and applications). The course has both a theoretical and practical component. Design is a practice-based discipline and there are practical and technical competencies that students need to master. When the initial COVID-19 lockdown forced all academics online, it was the practice-based modules that were of primary concern. The nature of digital media means that design and technology are completely intertwined. Without access to the relevant technology, many aspects of digital media design cannot be undertaken.

Our department took the strategy of rearranging the curriculum. The idea was that the theoretical course requirements were done during the period that the campus was closed, leaving the technical components to the later part of the year. It was hoped that by that time, students would once again have access to campus facilities and computer labs. This strategy worked well for final year students, as they were allowed back onto campus after a few weeks. However, as the lockdown dragged on it became noticeable that a high proportion of first-year students in our department were not attending online classes and not submitting work. We flagged these students as being "at-risk" of failing the year. As a first-year coordinator, I had the responsibility of communicating with these students. It proved difficult to contact many students. Some students did not seem to have access to their e-mail. There were a few instances where the student's phone numbers were out of service. This highlighted the very real problem of equitable technology access. Our department made a supreme effort to track down as many students as possible and offer them assistance. We wanted to try and understand the barriers to successful remote learning during the COVID-19 lockdown. I had many productive conversations with students, and I noted the re-occurring challenges described. I then took this feedback to our staff meetings, and as a department, we brainstormed possible strategies to deal with the issues discovered.

Systemic design as a tool for reflecting on the challenges of design education during the COVID-19 lockdown

The experience of remote learning during the COVID-19 pandemic held many challenges for Design students in South African universities. As a design educator, I intuitively felt the need to explore the challenges and experiences of this time through the lens of design. The arrival of the 4IR has shifted the traditional notion of an artefact. As things start to become interconnected, artefacts or "things" must be seen as a system of "things" (Holman, Walker, Lansdown, & Hulme, 2020). For this reason, I believe that any design inquiry dealing with interconnected societal and technological issues should be systemic in nature.

Design thinking

Design thinking (DT) is a well-established strategy used in design practice. DT has been popularised within the spheres of innovation and business management. The roots of DT can be found in the meticulous research documented in the *Design Thinking Research Symposium* series. The focus of this forum was to try and understand the cognitive aspects of a design process. DT grew out of a human-centred design (HCD) approach to the process-based methods used for design as a problem-solving activity (Bousbaci, 2008). The practice of DT involves formulating a problem definition and solution proposition (Tonkinwise, 2011).

The notion of *wicked problems* is deeply embedded in DT practice (Buchanan, 1992). Rittel and Webber have been credited for establishing this term in DT (Skaburskis, 2008). The term was originally used to describe the complex, systemic problems found in urban planning. Unlike scientific problems, societal problems are too complex ever to be "solved". Rather they are temporarily resolved or “tamed” (Rittel & Webber, 1973). Social system *wicked problems* arise when there are too many stakeholders with conflicting values (Churchman, 1967). Within the practice of DT, it is understood that complicated and multi-faceted problems cannot be solved using a purely scientific method (Churchman, 1967). Complex problems need to be understood in their complexity and solutions must be envisioned and constructed (Buchanan, 1992).

It is clear that complex systems theory (CST) has a strong link to DT. Peter Jones notes that Systemics and Design have had a long-standing but uneasy relationship (2014). The attempt to pull these two fields together has an extensive history. Over the years, various philosophies including pragmatism, critical theory, and phenomenology have blended and influenced design methodologies. Systemics naturally flows as an enriching methodology for practice (Jones, C., 2003). This evolution is acknowledged, yet there is no absolute consensus as to what this interdisciplinary field is called (Jones, 2014). Within this current context, systemic design (SD) practice has emerged as a field of study (Bijl-Brouwer & Malcolm, 2020). SD intentionally brings together ST and DT (Ryan, 2014).

Systemic design

The key differentiating factor in SD is the expanded **framing** of the design situation. ST is used to zoom out and DT is used to zoom in on the problem. SD is well suited to be practised in complex social, political, and highly complex systems such as governance and policymaking (Jones, P., 2014). SD is different from traditional HCD-based DT practice, in that it frames design problems within socio-technical complexity. SD focuses on the complexity of systems and subsystems. The focus is not only on products and services but expands to organisational and policy contexts (Jones, 2014). SD draws on multiple Design methodologies, including generative tools, sketching techniques, ethnographic research, and process reasoning. Systems Theory’s *Action Research* tradition is also employed (Jones, P. & Sevaldson, 2019).

Jones outlines ten shared Systems and Design principles that are highlighted in Figure 1:

- Idealisation
- Wickedness
- Purpose
- Boundary framing
- Requisite variety
- Feedback coordination
- Ordering
- Generative emergence
- Continuous adaptation
- Self-organising.

Jones notes that any design process can be used and that these ten principles are adaptable and should not be seen as a fundamental baseline (2014). The purpose of mapping a design process model to SD principles is to ensure that both Design and Systems principles are equally considered during the design process (Jones, 2014).

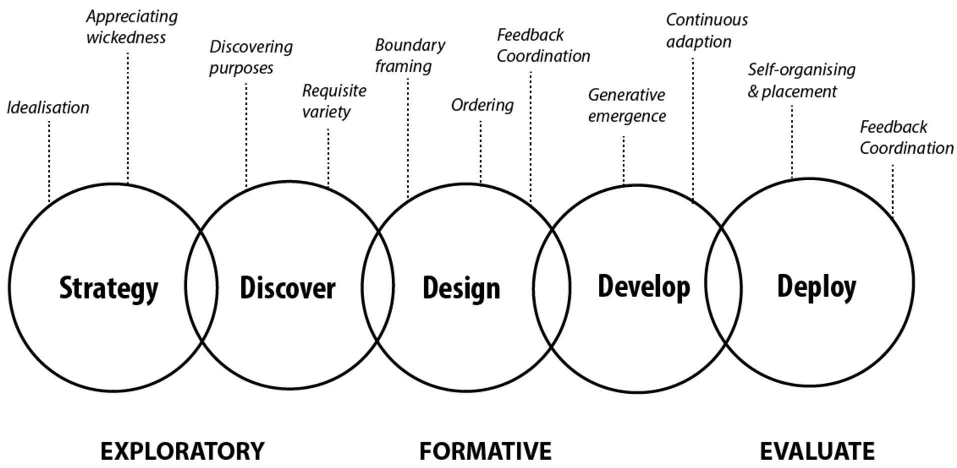

Figure 9: Jones's design principles mapped to design model: Adapted from (Jones, 2014)

One of the successes of DT has been the adaption of its processes into industry practice. This was facilitated by design-based innovation tools and models. David Kelly from Stanford Design School created the five-step DT process of:

- Empathise
- Define
- Ideate
- Prototype
- Test.

Kelly also founded the IDEO company (Denning, 2013). IDEO's famous DT toolkit is available for download and there is even a facilitator version available (Tschimmel, 2012).

SD is a growing form of design practice, as can be seen by the creation of Namahn and shiftN's Systemic Design Toolkit*.* This toolkit is a codification of the convergence of DT and ST, and comprises seven phases (Jones, P., 2019).

- The toolkit has multiple techniques categorised according to the SD process:
- Framing the system
- Listening to the system
- Understanding the system
- Defining the desired future
- Exploring the possibility space
- Designing the intervention model
- Fostering the transition.

Figure 2 illustrates the seven phases of what I will call the systemic design thinking (SDT) process. The SDT process cycles through ST and DT steps in a toggling fashion. The first step in the model uses ST to *frame the system*.

The intention of this study is not to present solutions to the problems I describe, using DT. Rather SD strategies have been employed to frame and unpack my experiences, observations, and practices our department found useful, during this time.

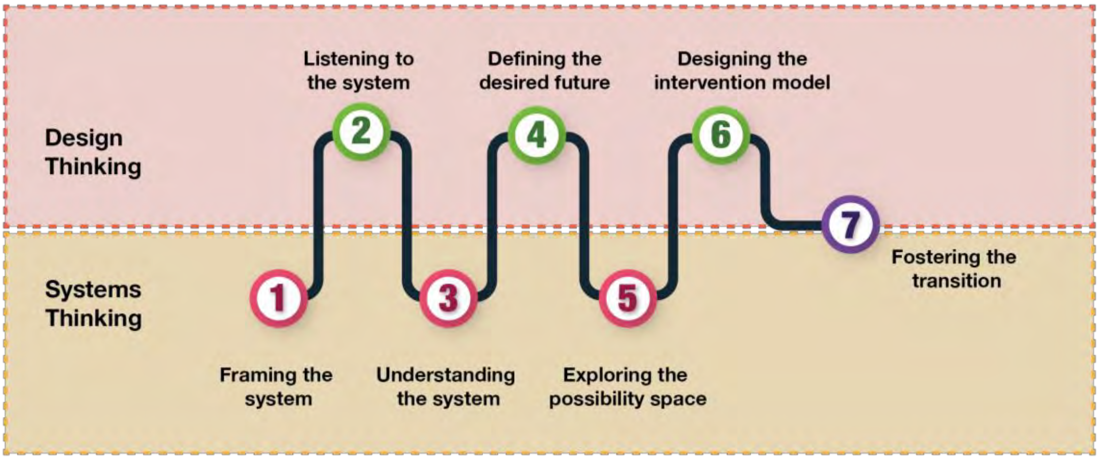

Figure 10: Adaption of the systemic design toolkit (From Jones, P., 2019)

The first phase in the SDT process is to *frame the system*. Noted systems thinker, Peter Checkland[35] argued that prior to defining any problem, an exploration into the problem situation needs to be undertaken and framed from multiple standpoints. He suggests that the tension between what is and what might be provides areas for creative thinking. Comparing different viewpoints of the real-world problem leads to ideas for improvement. He proposes a method called *rich picture*, to describe the richness of "messy" or *wicked problems*. Mapping and sketching tools can be used, though they should not be expressed as a logical process diagram (Williams & Hummelbrunner, 2020).

Geels notes that when it comes to innovation within a Socio-Technical System (STS), innovation occurs through the interplay of dynamics on multiple levels. With this multi-level perspective, a problem context can be addressed by looking at the current modus operandi, then drawing out the long-term trends that will affect the landscape. This prompts conversations about emerging and preferred alternatives (2005). Visualising an ideal future can be useful for addressing problems that relate to 4IR technology, as it points to possible levers that can be used for addressing the problem in innovative ways (Philbeck & Davis, 2018). Stakeholder and actor mapping tools are useful for uncovering the actors in the system, the power and knowledge relationships, and the nuances of the interactions between the actors. A Systems Approach to actor mapping also considers non-human agents that influence the system. Namahn and shiftN have created some canvas tools for framing a system in their SD toolkit (Jones, 2019).

I have used their *rich context* and *ideal(ised) future* canvas tools to visually map, explore and frame the systemic nature of design education during the COVID-19 pandemic.

A reflection on design education during the COVID-19 lockdown articulated through the lens of systemic design.

Framing the system: Rich Context

I have used the SD *rich context* canvas tool to frame the STS context faced in design education during the COVID-19 pandemic. This tool prompts the designer to consider the nature of the current social system and technology landscape and look at what emerging niche initiatives can be used to address the problem innovatively.

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35 Peter Checkland developed Soft Systems Methodology (SSM), which persists that there are multiple perspectives within any given situation

Figure 3 illustrates how the canvas is divided into four categories:

- Institutional structures
- Economic considerations
- Cultural influences
- Human action/behaviour.

These subsystems will always contribute to the messiness of a problem context. The canvas places these subsystems in a circular fashion around a section dedicated to considering long-term trends. Like other wicked problems, design education during the COVID-19 pandemic was influenced by many separate but interconnected subsystems.

Policies that were taken by the **institutional** bodies directly affected the experience of students and lecturers during the COVID-19 pandemic. The university system was affected by power structures including the government, the Department of Education, and the Department of Health. Decisions to close residences and only allow final year students access to campus created a situation where junior students no longer had access to campus facilities.

The broader **economic** structures in South Africa and UJ affected students on a very practical level. Disadvantaged students rely on bursaries to afford their education and learning supplies. NASFAS provided students with a hybrid laptop-tablet. These devices gave the students a means of participating in the online modules. However, these devices were very basic and could not handle heavy design software. Many students from the “Missing Middle”, relied solely on their mobile phones to access the learning platforms. Another problem faced by students was the cost of data. Mobile data is expensive in South Africa (Phokeer, Densmore, Johnson, & Feamster, 2016). Remote learning is usually very heavy on data due to video streaming. Added to these problems was the problem of electricity. Not only was load-shedding taking place during the lockdown, but some students had gone home to areas where electricity is intermittent and unreliable.

The **cultural** context also affected students’ ability to participate in remote learning. Some students reported family expectations and priorities when residing at home. There seemed to be a culture gap in issues of communication between lecturers and students. This might have stemmed from the lack of face-to-face communication opportunities; however, the possibility of a power imbalance (actual or perceived) was not ignored.

It was noted that certain **actions and behaviours** influenced the student’s experience. Informal channels of communication and the responsibilities taken by class representatives (reps) were acknowledged as important practices.

The importance of considering long-term trends was found to be particularly useful when reflecting on the problem context. Visually laying out social and technological trends proved to be highly beneficial for thinking about the solution space. UJ places a strong emphasis on the possibilities the 4IR holds for social innovation in a South African context (Du Preez & Sinha, 2020). Technology products are part of an interconnected system of human and non-human actors. Considering the actors, their relationships, and the tension between the current reality and what could be provided a great springboard for considering niche initiatives to improve the system. The unexpected and sudden nature of the global pandemic did not allow for much preparation time, but long-term trends paved the way for innovative workarounds. In this reflective study, trends that fit into the design education context are 4IR technology such as cloud computing, online learning platforms, open-source software, ubiquitous access to mobile phones and social media platforms.

Framing the system: Ideal(ised) future

I have used the SD *ideal(ised) future* canvas tool to explore the nature of the challenges that arose for Design students during the COVID-19 lockdown and identify the resources that were and could be used to improve the situation. As seen in Figure 4 the canvas is divided into six boxes. The desired future is considered through six considerations:

- Ultimate goal/purpose
- Desired result
- Driving forces
- Barriers
- Emerging initiatives
- Capacities and resources.

This leads to articulating the design challenge. The purpose of this paper is to reflect on students' experiences during the COVID-19 lockdown and find new methods that will best afford all students the opportunity for quality and accessible design education during and beyond the pandemic.

By thinking about an ideal future, areas for systems improvement became clear. The nature of the COVID-19 lockdown brought to light underlying social inequalities. The nature of design education further compromised disadvantaged students. First and foremost, access to appropriate hardware and software is imperative for successful remote learning. Students need to be able to retrieve the lectures and complete practical assignments. The notoriously expensive Adobe Suite has traditionally been taught by the department. The software is loaded onto the lab computers. Simply moving lectures online via platforms like Teams or Zoom was not practical, as students did not have constant internet access, and relied on costly mobile data. They also needed design software that works on a low-cost device. Flexible learning strategies were necessary to facilitate remote learning. There was a need to promote open communication between students and lecturers.

Section 5 and 6 on the *ideal(ised) future* canvas, showcased in Figure 4, asks a designer to consider other initiatives. This is done by looking for innovations that address the problem in a novel way, as well as by scouting for existing resources that can be built upon. The Digital Divide is a well-known phenomenon in South Africa (Bornman, 2016). Financial Technology (FinTech) innovation has been addressing this issue for many years (Yermack, 2018). Some innovative solutions include providing free data to customers. Leveraging the widespread adoption of mobile phones has proven successful in a South African context (Makina, 2019). Corporate partnerships have also been used to assist in bridging the gap between advantaged and disadvantaged students. Telecommunication companies came to the aid of the University by providing students with 10GB of free data per month during campus lockdowns (Motala & Menon, 2020). Searching for ways this problem has been addressed, found that online learning platforms such as Udacity, do consider access issues native to certain regions. Their LMS provides the option of pre-downloading course content, so students can work even when they do not have internet access (Udacity).

The Multimedia Department looked at other existing initiatives and considered what resources could be leveraged to address some of the issues that arose. We brainstormed our ideas during staff meetings and employed creative problem-solving techniques to find ways of facilitating better and more accessible education during the COVID-19 pandemic.

Observations and reflections

The practices that proved useful were:

Pre-recorded lectures

A useful technique for migrating the face-to-face lectures to an online platform was to diverge from live Zoom classes. Instead, lectures were made by creating PowerPoint presentations that were converted to low-resolution PDFs. Lectures were recorded in audio-only formats and broken up into smaller lessons. This way files could be downloaded easily and not use up too much data.

Corporate partnerships

At the beginning of the COVID-19 lockdown, students were given three months of free Adobe licenses (personal communication Sept 9). This was helpful for students who had access to appropriate computing devices. Many students were not able to use Adobe software because of the large size of the applications. Contact was made with the InVision company with the purpose of finding a workable alternative. InVision provides a cloud-based web prototyping platform, as well as a full-blown design software package. InVision provided accounts for students valid until six months after graduation (personal communication Oct 1).

Alternative software

Lecturers compiled a list of open-source and free software that could be used as alternatives for practical work. Only, software that is light on RAM or could be used on the cloud was recommended. The list included: (1) GIMP – a substitute for Photoshop, has photo editing, drawing, and painting tools (free to use and light to run, 128MB versus the 4GB that Photoshop requires), (2) Inkscape – free software, similar to Adobe Illustrator, (3) Darktable – free photo editing software (good for photo editing and will handle RAW files, it is analogous to Adobe Lightroom), (4) Pencil 2D – free 2D animation software, including backgrounds, sounds, and camera, (5) Opentoonz – free 2D animation software, (6) DaVinci Resolve – powerful, professional and free video editing software, compositors like After Effects, (7) Olive Video Editor – free video editor, (8) Kdenlive – free open-source video editor, (9) Natron – free compositing software (like After Effects), (10) Audacity – free open-source audio recording and editing software, (11) Visual Studio – free internet development environment (IDE) and (12) Google Docs – an alternative to Office 365, can be used on the cloud. Students found this list very useful, and most students were able to complete their practical work, even when they did not have campus access.

Informal channels and platforms

Since some students were not responding to e-mail or Blackboard communication. Lecturers brought in the class reps to assist in communication. Class reps were often able to contact students when lecturers were struggling to do so. WhatsApp groups were found useful for quick and direct communication. Class reps assisted in adding students to the class groups. Some students had very basic phones and had to connect to the internet via internet cafes. A useful solution was for these students to load an android emulator onto their laptop and view the class chats when they had connectivity. Google Drive was an alternative platform that was used to share files and upload projects.

Figures 3 and 4 illustrate how I used the SD toolkit for contextualising and broadening the framing of design education in South Africa during the COVID-19 pandemic. Systems framing tools provided insights that showcase the power of combining Design and Systems thinking. The process of *framing the system* uncovered social and technical levers for change that can be expanded upon to create better learning opportunities for students beyond the COVID-19 pandemic. This paper showcases one phase of the seven-phase SD toolkit. Following the entire seven-step process would no doubt prove useful for future research.

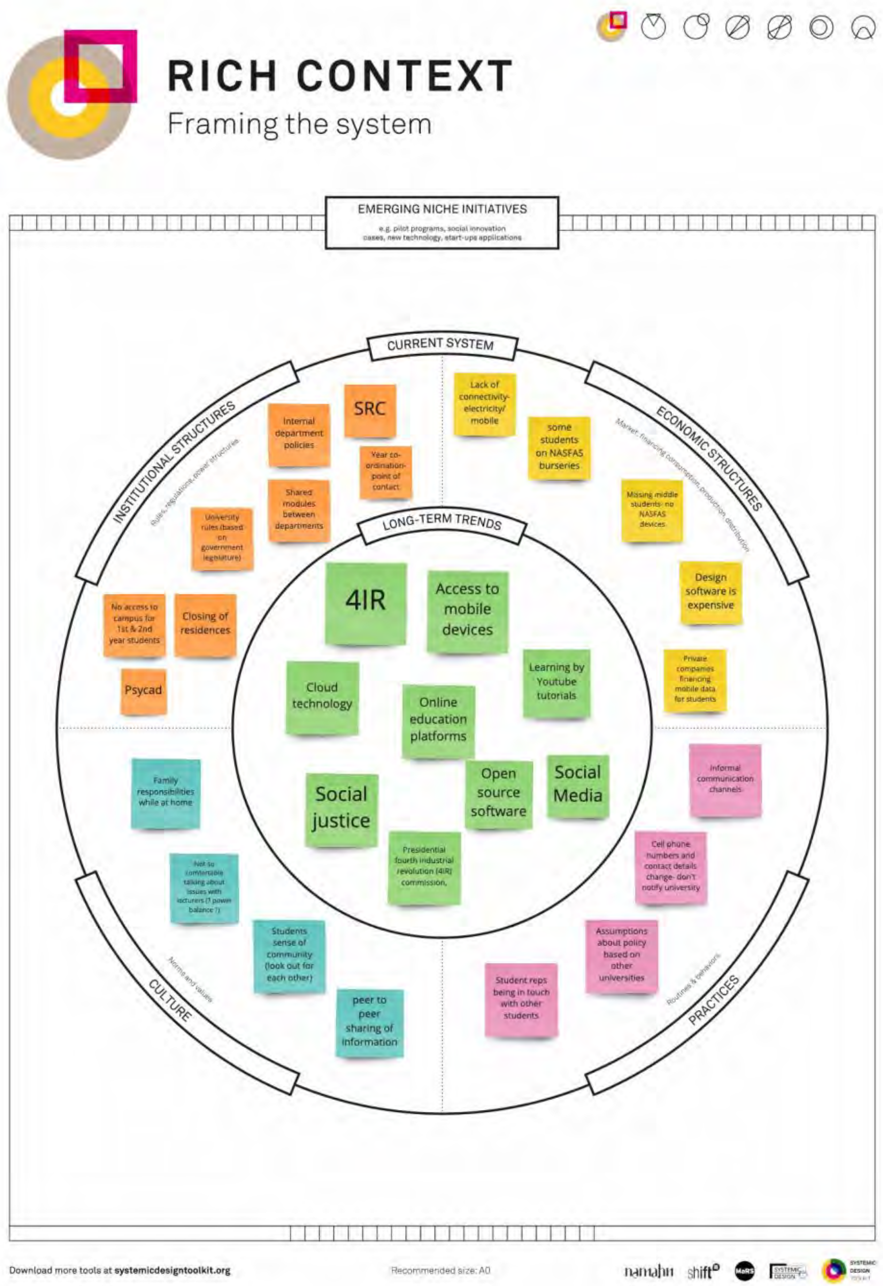

Figure 11: Reflections on design education during the COVID-19 pandemic framed using Namahn and shiftN's rich context canvas tool

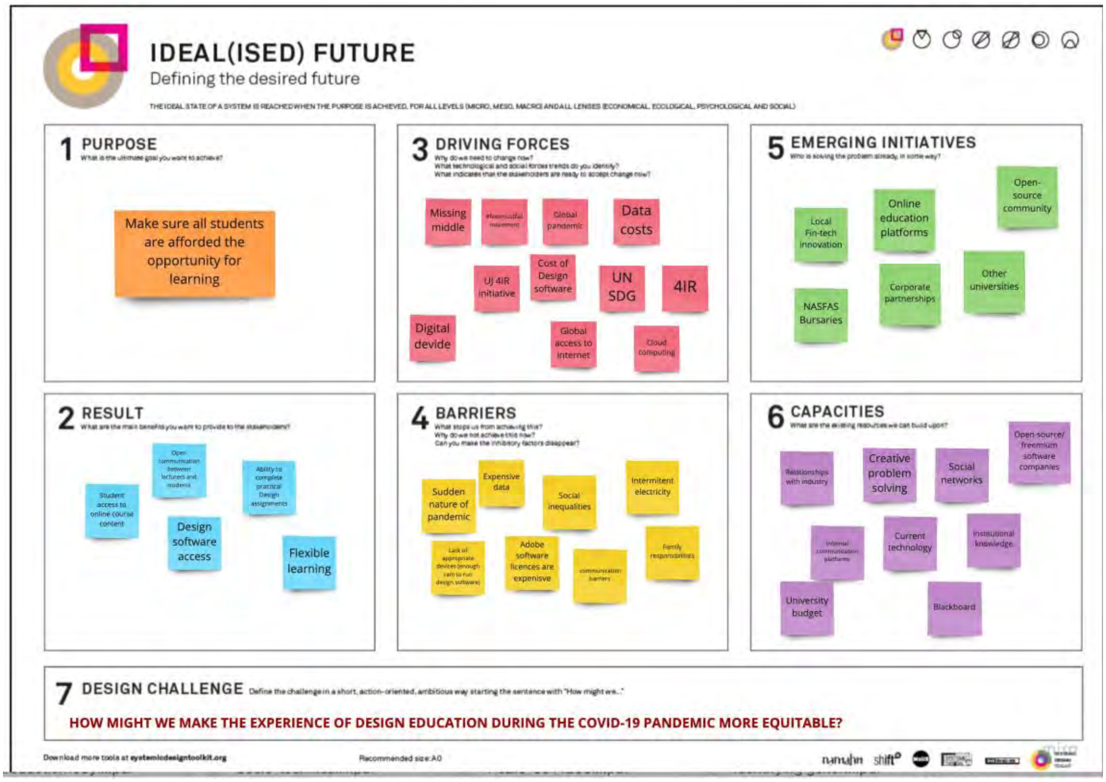

Figure 12: Defining the desired future of design education during the COVID-19 pandemic using Namahn and shiftN's ideal(ised) future canvas tool

Conclusion

At the time of writing this paper, there is still much uncertainty surrounding the COVID-19 pandemic. In South Africa, alert levels are still in flux, and departments must close immediately when an outbreak of COVID-19 cases occur. The vaccine drive had a slow start (Bateman, 2021), and the constant mutations of the virus are cause for concern both locally and internationally (Thom, 2021). Equal access to online design education will undoubtedly continue to be an issue that needs to be addressed and improved on. The outbreak of COVID-19 accelerated the integration of 4IR technologies into design education. Many useful practices were bootstrapped on the fly and should be further considered going forward. The problems that have been described confirm the necessity of taking a systems approach to advancing design education in South Africa within the context of the 4IR era. The exploration of one of the tools used in SDT has exposed how useful a systematic approach to Design can be for thinking about complex *wicked problems* such as the COVID-19 pandemic's effect on accessible education.

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Learning from a distance: A conceptual teaching framework that supports positive emotions and novelty during independent fashion design processes

AJC (Lee) de Wet, *University of Johannesburg*

Abstract

The importance of cultivating a creative mindset in fashion design students to eventually thrive in the rapidly changing work environment that demands novelty in design is becoming increasingly relevant from an educational perspective. In addition, the challenges to enhance creative design processes of students have been exacerbated by the COVID-19 pandemic in 2020, which caused a sudden transformation from traditional contact education, to online and later blended learning. This implies that educators are challenged to re-think traditional strategies of teaching creativity to align to the shifting conditions. This paper addresses a possible means to re-conceptualise a creativity framework that has been developed and implemented in a previous study for collaborative face-to-face learning environments, to align with the new learning situation. A framework from this study highlights, firstly, that it is important for students to apply creative problem solving with cognitive fluency, flexibility, and flow, particularly in constantly changing environments where it is necessary for a designer to be agile. Secondly, the role of positive emotions is imperative in students' creative design processes, as experiencing these emotions can ignite an open mind that may enhance the ability to think creatively to produce novelty. It is therefore important that students' positive emotions are supported during independent creative design processes.

The purpose of this paper is to propose a conceptual teaching framework that presents principles to enhance students' positive emotions and novelty during design processes in a blended learning context with a strong online component. A conceptual approach was taken to construct the proposed framework. The inquiry followed reasoned argumentation to synthesise a) the four pedagogical areas of Cronje's (2021) suggested integrated blended learning matrix for decision-making learning contexts, namely Known knowledge, Complex knowledge, as well as the domains of Knowable and Chaos with, b) literature, including previously published papers by the researcher/author of this paper, and c) the researcher's interpretations of how these can be applied to derive a logical framework for the purpose of this paper. The discussion of the synthesis for the proposed framework links Cronje's (2021) model logically to positive emotion theory in terms of interest, pleasure, pride, and satisfaction, and then relates these to aspects of the fashion design process. This synthesis of information is then consolidated into a diagrammatical framework to illustrate how the concepts in the structure relate. The conceptual framework of this paper provides a valuable starting point but needs further investigation and implementation to assess the efficiency of the structure for students' independent creative design processes.

Keywords: Blended learning, conceptual teaching framework, fashion design processes, novelty, positive emotions

Introduction

An open creative mindset is vital for fashion designers to thrive in the rapidly changing work environment today where novelty in design is key, especially in terms of a significant shift in the industry towards niche fashion products sold online, where goods are often selected based on their originality (Choi, Ko, Kim & Mattila, 2014; De Wet, 2016). It is therefore becoming increasingly important from an education perspective to cultivate creative thinking skills in students. In 2019, lecturers (one who is the author of this paper) involved in a tertiary Fashion Design programme in South Africa developed a creativity framework to enhance students' creative flexibility, fluency, and flow that are relevant skills needed to continuously shift personal design perspectives to align with the various needs of clients (De Wet & Tselepis, 2020). This framework is underpinned by Fredrickson's (2004; 2001; 1998) positive emotion theory to enhance awareness and open-mindedness during the design process. This structure was empirically implemented and evaluated in the context of traditional contact teaching and learning, as part of a third-year design project. The findings of this study indicated that the applied strategy had notable positive effects on students' ability to solve problems creatively during the design process (De Wet & Tselepis, 2020). However, the COVID-19 pandemic in 2020 that resulted in online and later blended learning, challenges the effectiveness of the existing framework within this new context.

In a traditional contact class situation, maintaining positive emotions in students and encouraging creativity during the design process of a project was relatively simple to achieve (De Wet & Tselepis, 2020). In this context, the lecturer had a physical space to interact with students and could therefore influence students' emotional state and creativity throughout the design process with personal feedback and guidance. Also, group dynamics between students and with a lecturer could inspire collective creativity that has proven beneficial for triggering new interpretations and discoveries that an individual alone may not have been able to generate (Hargadon & Bhechky 2006; Tadmor, Statterstrom, Lang & Polzer, 2012).

However, observations documented by the lecturer (author of this paper) in a personal reflective teaching journal during 2020, suggested that motivating positive emotions was significantly more challenging in a virtual context where instructors and students were engaging with activities of design projects distantly, independently, and with no/limited physical interaction. The above concern was affirmed in email communications to the lecturer, as well as evaluations of design projects conducted by the institution in 2020 that reflected feelings of anxiety and being overwhelmed by the expectations of the new self-directed learning demands. Fredrickson (2004; 2001; 1998) maintains that experiencing negative emotions such as anxiety caused by circumstances can narrow a person's attentional focus and impede creativity. This implies that positive emotions, on the other end of the spectrum, could then enhance a person's creative thinking ability to create novelty (De Wet & Tselepis, 2020).

Given the above-explained context of the study, the purpose of this paper is to propose a conceptual teaching framework that presents principles that can support students' positive emotions and novelty, during design processes in a blended learning context with a strong online component. The importance of novelty is not new in design (Dorst & Cross 2001; Mitcham & Holbrook 2006, pp. 106), but this paper argues that in the context of COVID-19 that resulted in blended learning, finding a way to support novelty is probably even more pertinent than before. The question is, what a teaching framework should involve, to evoke and maintain students' positive emotions that might encourage creativity and novelty during design processes in a blended learning environment?

The next section presents a review of relevant literature concerning the key concepts of the study. By means of introduction, creativity promoting novelty in fashion design is discussed first. Thereafter, follows a discussion involving a creative environment promoting positive emotions. Following this, the research methods and materials informing the development of the proposed teaching framework, along with the research objectives are presented. The findings and synthesis of theoretical constructs that form the suggested conceptual teaching framework are explained next. This synthesis of information is then consolidated into a diagrammatical framework to illustrate how the concepts in the structure relate. The paper concludes with implications for fashion design education in providing a teaching strategy to support positive emotions and novelty in a blended learning context.

Literature review

Creativity in fashion design promotes novelty

Creativity is a complex notion that can be viewed from various perspectives (Davis, 2011; Demirikan & Hasirce 2009; Montuori, 2010). These views include 1) the creative thinking of a person that is often associated with design thinking and actions (Liikkanen & Perttula, 2009), 2) the creative process applied, 3) the creative environment, and 4) the creative product that embodies the creative ideas of a person (Demirkan & Harisrci 2009; Gemmil, 2011). This paper views creativity as a thinking ability that enables individuals, such as fashion designers, to create novel ideas, insights, or artistic products (Carlgren, Elmquist & Rauth, 2016; Lan & Kaufman, 2012; Proctor, 2018). The importance of novelty in a fashion design is therefore highlighted in this paper.

According to Fiore (2010, pp. 347), novelty in terms of fashion can be defined as the perceived newness of products that are based on a comparison of present items with those of the past. The importance of novelty in fashion design is further reflected in the statement that consumers are attracted to new, unusual, and innovative items when selecting products to purchase (Choi, Ko, Kim & Mattila, 2014; Fiore, 2010, pp. 360). Nevertheless, Fredrickson (2001; 1998) points out that for creative thinking to result in novelty, experiencing positive emotions to ignite an open mind is imperative. The argument can therefore be made that creative thinking requires a conducive environment that promotes positive emotions (Bell & Ternus, 2007, pp. 15).

A creative environment promotes positive emotions

De Wet and Tselepis (2020) link an ideal environment for the application of creative thinking skills in design processes to conditions that promote 1) a person's positive emotions, 2) exploration (Bell & Ternus, 2007, pp. 15), and 3) interaction and collaboration that can spark collective creativity (Hargadon & Bhechky 2006; Tadmor, Statterstrom, Lang & Polzer, 2012). Positive emotions can be defined as situational responses relating to interest, pleasure/joy, contentment/satisfaction, pride, and love (Fredrickson 2001). This author explains, in short, that pleasure ignites an urge to play, interest sparks exploration and to take in new experiences and information, contentment to savour and integrate to derive new views or answers, and pride following achievements, create a desire to share with others. Lastly, love spurs a reoccurring cycle of each of these positive emotions. A creative environment promoting a positive mindset is therefore an important dimension of creative thinking that according to Botha, Tselepis and De Wet (2020) can enhance the ability to create novel ideas and products.

Research methods and material informing the proposed conceptual teaching framework

A conceptual approach was taken to construct the proposed framework of this study, guided by a specific research paradigm to support how information is analysed and interpreted (Mackenzie & Knipe, 2006). The investigation applied a constructivist research paradigm (also referred to as interpretive paradigm) since according to Rehman and Alharthi (2016), the nature of constructivism/interpretivism concerns understanding and making sense of reality and/or ascribing meaning to certain aspects or phenomena. A constructivist research paradigm further implies that individuals construct their own knowledge and understanding of a situation through experience and reflecting on those experiences (Rehman & Alharthi, 2016). In this study, extensive experience in fashion design education guided the researcher's process of understanding and ascribing meaning to the constructs and dimensions from various materials to develop a framework for the specific purpose of this study. The research process to conceptualise and construct the framework was operationalised in two research phases with two objectives.

Research Phase 1

Objective 1: To explore Cronje's (2021) integrated blended learning matrix for decision-making considerations to identify relevant aspects within this author's proposed four learning contexts that can be linked to positive emotions and novelty.

The decision-making matrix for blended learning by Cronje (2021) was deemed appropriate to guide the development of the framework presented in this paper for the following reasons: 1) it is a very recent publication (2021), and 2) works of several authors are incorporated in the construction of the proposed matrix of this paper. As recommended by Cronje (2021), the framework presented in this paper focuses on learning approaches, rather than delivery mechanisms.

Research Phase 2

Objective 2: To compile a framework that can be applied to enhance students' positive emotions and novelty in a blended learning design environment.

In the second phase, the research followed reasoned argumentation to synthesise: a) identified relevant dimensions of Cronje's (2021) matrix with, b) literature, including previously published papers by the researcher, and c) the researcher's interpretations of how these can be applied to derive a logical framework to enhance students' positive emotions and novelty in a blended learning design environment.

Quality of the data

In the process of reasoned argumentation to interpret and synthesise the various constructs, the role of the researcher is central. In this regard, the experience of the researcher in fashion design education and involvement in the scholarship of teaching and learning is important, since according to a qualitative approach, these factors can contribute to the credibility of the data or conclusions (Anney, 2014). The researcher in this study, has over 25 years of experience in tertiary education, particularly in teaching creative design. The researcher also has practical design experience and theoretical grounding in the field of creativity and design. These theoretical and practical backgrounds assisted in identifying and validating the theoretical constructs, as well as how these could be linked to the purpose of this paper. Another strategy implemented to enhance the credibility of ideas formulated, particularly to obtain 'believability', entailed using a peer to soundboard, and validate initial theoretical ideas on a preliminary framework. This is referred to as peer debriefing (Anney, 2014). To this end, a peer with a fashion education background was specifically selected to validate and interrogate the dimensions, the reasoned arguments, and the proposed framework. This practice enhances the trustworthiness of the data.

Ethical conduct

Ethical conduct to proceed with this conceptual research paper was ensured by acquiring written permission from the relevant institutional research committee to proceed to reflect on observations and confirmations documented in a personal teaching journal that did not involve any participants. Observations and confirmations served to inform the problem and identify a gap for potential future empirical research.

Findings and synthesis of theoretical constructs

This section of this paper offers the findings and a synthesis between a proposed blended learning matrix for decision making, considering the various aspects presented by Cronje (2021), as well as the creative process of fashion design students who want to acquire novelty. Ultimately, from a lecturer's point of view, the aim is to support positive emotions throughout a creative design process. To this end, the argument was made earlier in the literature review that positive emotions could also contribute to novelty and that it might be particularly important in the instance where students must engage with creative design processes more from a distance and not in the face-to-face studio set-ups, they are accustomed to.

Exploring integrated blended learning for positive emotions and novelty

Blended learning is commonly defined as a mode of teaching that combines computer-facilitated instruction via virtual platforms, with traditional face-to-face instruction that requires the co-presence of lecturer and students (Friesen, 2012; Graham 2006; Keengwe & Kid, 2010; Kim & Bonk, 2006). Cronje (2021, pp. 120) refines this definition by placing emphasis on the learning aspect of the term and presents blended learning as a teaching approach that includes the "appropriate use of a mix of theories, methods, and technologies to optimise learning in a given context". The theory and matrix for blended learning offered by Cronje (2021) certainly provide valuable guidance for making decisions in the compilation of the proposed teaching framework of this paper, aimed at supporting positive emotions and novelty during independent fashion design processes. Nevertheless, although Cronje (2021) points out that a positive attitude is a contributor to students' satisfaction and intrinsic motivation in blended learning (Kintu & Zhu, 2016), guiding theory to support these emotions is not offered in this paper.

I start by presenting the comprehensive matrix of Cronje (2021) in table 1 that can guide a lecturer's decision-making for blended learning.

Table 1: Blended learning decision matrix (Cronje, 2021)

Context (Kurtz & Snowden)	Theory (Cronje)	Methods	Technologies
Known	Injection	Tutorial Drill	Lecture Book Video
Complex	Construction	Construction Exploration	Open-ended learning environments Construction kits and tools Spreadsheets
Knowable	Integration	Puzzle Discussion Debate	Games Discussion tools
Chaos	Immersion	Experience Field trip Apprenticeship	Blogs Logbooks Assessment tools

Discussion of the synthesis for the proposed framework

In response to Clark (1994), Korma (1994), and Russell (1999) (cited in Cronje, 2021), Cronje argues that pedagogical context drives the decision of what and how to combine for blended learning. Guided by Kurtz and Snowdens' (2003) Cynefin framework, Cronje (2021) presents four areas of learning contexts, namely Known knowledge, Complex knowledge, as well as the domains of Knowable and Chaos. In blended learning, these pedagogical approaches can be combined to optimise learning, irrespective of the instructional technology (Cronje, 2021).

Known knowledge represents best practices and standard operating procedures, and the blended model would focus here on modes of instruction or *Injection* (Cronje, 2021). In terms of a typical fashion design project involving the application of the design process, *Injection* can be linked to the input provided by the lecturer to guide the process and inform students of project requirements, and for students to apply the information (De Wet & Tselepis, 2020). Guided by Cronje's suggestions, some techniques that are relevant to fashion design that can be delivered virtually include (1) a clear project brief, (2) short live or pre-recorded lectures and video demonstrations, (3) notes/books, (4) regular lecturer interaction involving meaningful communication and feedback on design work to guide students' creative design process. Considering Fredrickson's (2004; 2001; 1998) positive emotion theory, the point is made that appropriate, clear, and meaningful input to fully understand project expectations could provide confidence that can lead to experiencing *pleasure*, which might spark a desire to act.

For *Complex knowledge*, abductive reasoning is applied as students learn how to make sense of complexities and making logical conclusions from their observations. Cronje (2021) proposes *construction* tasks, problem-based learning, and open-ended learning environments as suitable for complex knowledge. This paper links *Complex knowle*dge to design that consists of a course of actions aimed at solving design problems that are often complex, open-ended, and not obviously logical (Dorst & Cross 2001). In this context, the term 'construction' is equated to the term 'creation' in design. One can argue that for students to make sense of these complexities and attempt to create novel design solutions, first require *interest* to engage with a design situation. According to Fredrickson (2004; 2001; 1998), interest opens the mind and creates an urge to explore and 'figure' things out. For fashion design in a contact environment, inspiration due to a change of physical environment, followed by an activity such as quick sketching to explore many design ideas could evoke interest (De Wet & Tselepis, 2020). In a virtual environment, creation tools can be provided.

The *Knowable* domain requires analytical and reductionist thinking to understand something by breaking it down into smaller parts. This context calls for an *Integration* of learning approaches with the aim to teach systems thinking (Cronje, 2021). *Knowable knowledge* is associated here with design as a procedure that requires synthesising several ideas, elements, and processes into a cohesive whole to achieve a design goal (Dorst & Cross 2001; Mitcham & Holbrook 2006, pp. 106). Cronje (2021) provides some guidelines to support students' understanding of the holistic interrelation of elements within the whole. In a contact situation, peer discussions and sharing of ideas and processes are appropriate. In a virtual environment chat groups and discussion forums for students to contribute towards a larger design issue/idea, and discussions of each other's work could, create a beneficial collaborative ethos according to Kim and Bonk (2006). The argument is made here that *pleasure* and *pride* that might be achieved through shared energy and collective creativity can induce a feeling of *contentment*. Positive emotion theory by Fredrickson (2004; 2001; 1998) indicate that savouring feelings of *contentment* can support sense-making and integration of, in this case, several ideas, elements, and activities to achieve novelty as a design goal.

The domain of *Chaos* relates to experience. Traditionally this might have been known as 'being thrown into the deep end', or what Cronje (2021) refers to as *Immersion*. This typically relates to field trips, experiential learning, and apprenticeship, where teaching is notably absent and "learning is incidental and serendipitous" (Cronje, 2021, pp. 120). This paper relates *Immersion* to flow in creativity, which is a state of complete mental emersion when completing a challenging task (Csíkszentmihályi 1997, pp. 1990). Operating independently in unfamiliar situations, such as noted above, are likely to raise students' anxiety levels, and can impede creative flow (De Wet & Tselepis, 2020). Positive emotions relating to interest, pleasure, and joy may be viewed as opposites of anxiety (Fredrickson 2001) and should be encouraged to counter anxiety. Blogging is a useful technological tool and/or keeping a design journal to document personal design processes. Since the pedagogical focus here is on assessment rather than instruction (Cronje, 2021), students can be given checklists to complete to guide their process.

The next table demonstrates the proposed conceptual teaching framework that appropriates Cronje's (2021) model to the purpose of this paper, which is to support positive emotions and novelty during students' independent design processes.

Table 2: Teaching framework to support positive emotion and novelty during students' independent fashion design processes (appropriated using Cronje's (2021) blended learning decision-making matrix)

Context (Kurtz & Snowden)	**Theory (Cronje)**	**Possible positive emotions that can promote novelty (Author)**	**Methods (Appropriated by the author)**	**Technologies (Appropriated by the author)**
Known	Injection	Confidence leading to pleasure	Lecture Practice Meaningful lecturer interaction	Clear project briefs Short live or pre-recorded lectures & video demonstrations Notes/books (physical/digital)
Complex	Construction	Interest	Creation Exploration Change of physical	Online creation tools

			environment	
Knowable	Integration	Pleasure, pride, Contentment/satisfaction	Figure-out Discussion Collective creativity	Online discussion platforms
Chaos	Immersion	Opposite of anxiety: Interest, pleasure, joy	Experience Field trip Apprenticeship	Blogs Design journal Assessment tools

The above discussion of the synthesis for the proposed framework suggests that it may be possible to link positive emotion theory in terms of interest, pleasure, pride, and satisfaction in a logical way to Cronje's model for the purpose of this paper. The value of this synthesis is that the application thereof could enhance creative design processes to achieve novelty in students' independent learning processes, as well as to use online learning methods and technologies optimally, such as online discussion platforms to create a beneficial collaborative ethos that could ignite collective creativity.

Conclusions and implications for fashion design educators

The introduction of this paper highlighted that the change to blended learning with a strong virtual component, where students can no longer rely on the benefits of physical interactions with lecturers and peers to support their creative design processes, often causes anxiety that can impede creativity. This paper, therefore, argued that the role of positive emotions to promote creativity and novelty during students' independent fashion design processes should not be underestimated. It is important to note that blended learning is not simply about distance in an online sense, it is also about the distance that students may experience when they are not part of the collective creativity in a studio as they used to be before the 2020 pandemic. To this end, a conceptual teaching framework was presented in this paper that linked Cronje's (2021) blended learning matrix for decision making with positive emotion theory by Fredrickson (2004; 2001; 1998), aimed at promoting creativity, and ultimately novelty in fashion design.

Although the proposed framework is intended for fashion design, the principles offered may provide an opportunity for educators of other design disciplines to pursue and adapt to their situations. Nevertheless, the framework needs further investigation and implementation to assess the efficiency of the structure within its intended context. It is concluded that regardless of COVID-19, tertiary fashion design education will most likely continue to apply a blended learning approach as a long-term teaching strategy since the advantages of self-directed learning for students are too significant to ignore. And therefore, making the distance of independent creative design processes seem less distant for our students is imperative!

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COVID-19 lockdown music lessons: Digitalising for online music learning

Roland H Moses, *Tshwane University of Technology*

Abstract

With the COVID-19 outbreak, universities worldwide have moved towards online learning or distance education. Despite pioneering work by distance learning institutions globally, the digital platform remains unexplored, particularly for online music teaching and learning. Face-to-face teaching for practical based subjects is challenging due to COVID-19 protocols.

Online teaching and learning tools are being designed in response to curriculum, programme delivery, and assessment. Music educators are entrusted with finding creative ways to address their unique challenges. This study examines whether online music programmes address the unique challenges of music students. The music department of a leading South African university of technology is the case study where the teaching model is being digitalised to combat online learning challenges. A SMART (specific, measurable, achievable, realistic, and timely), stepwise, online lessons programme was designed to facilitate instrumental teaching during university closures and lockdowns.

The programme piloted in 2019 and was adapted according to stakeholder (students, teachers, curriculum experts) analysis. This programme provided insight on learning preferences, teaching techniques, assessment methods, online platform preferences, infrastructural availability, and challenges.

Results highlighted the improvement in success rate, peer learning, self-evaluation, self-learning, and student engagement. The results prompted the researcher to use this programme to provide online instrumental lessons to university music students. Due to its synchronous and asynchronous online instrument teaching approach, this programme transforms students' learning experience using digital technology and 4IR underpinnings. The programme can serve as a template for other practical subjects within various disciplines.

Keywords: 4IR, industry 4.0, music education, online learning, student-centred learning

Introduction

In 2020, the COVID-19 pandemic sped up digital transformation and revolutionised digital influences at universities (Mhlanga & Moloi, 2020). Lockdown protocols and social distancing forced universities to switch to emergency remote teaching (Bozkurt & Sharma, 2020) to continue teaching and learning.

Although affluent South African universities could switch to online platforms, economically challenged universities faced numerous hurdles to switching from face-to-face teaching to online platforms.

Traditional music lesson teaching and learning models were adversely impacted because the face-to-face teaching approach could no longer be applied. Extension of the university semester and makeup lessons proved inadequate, as students lost momentum in their learning.

An online teaching and learning tool was designed in response to the programme delivery, learning styles, and assessment methods. A flexible and relevant online music programme was designed, addressing the distinct challenges of this student profile. Student learning preferences, teaching techniques, assessment methods, online platform preferences, infrastructural availability, and challenges were considered. Therefore, this study seeks to address the research question: Can an online music programme address specific challenges of university music students?

Fourth industrial revolution (4IR) and university digitalisation

The fourth industrial revolution (4IR, industry 4.0) refers to the automation and digitalisation of work (Schwab, 2016). 4IR also affirms technological transformation, which results in new ways of 'perceiving, acting, and being' (Philbeck & Davis, 2018, pp. 17) and in new ways in which technology is integrated within society (Davis, 2016). 4IR is considered an important global trend that will change the world of work and how people relate to technology.[36]

Learning with 4IR technology emphasises pedagogical approaches and learning activities towards achieving meaningful learning instead of focusing on technological tools used to achieve the task (Bozalek & Ng'ambi, 2015). By creating a digital learning environment (digital 4IR), students are the central focus of a 'technology-enabled-learner-centred' approach (Oke & Fernandes, 2020, pp. 5).

The digitalisation of education involves using technology to improve and simplify technological infrastructure, as well as for pedagogical approaches and processes (Selwyn, 2016). Many universities use digital technologies to promote learning, encompassing a transformative learning and strategy agenda (Bozalek & Ng'ambi, 2015). Students use mobile technology, social media networking skills, and user-driven media initiatives for pedagogical exploration. Technology provides numerous opportunities to support flexible learning inside and outside the classroom (Bozalek & Ng'ambi, 2015).

Challenges with online learning at a university of technology

South African universities that lacked 4IR tools to enable online learning shut down during the lockdown necessitated by the COVID-19 pandemic (Mhlanga & Moloi, 2020). Subsequently, various digital learning platforms created by South African EdTech companies were investigated and implemented by the universities (Ngcamu, 2019). Although these platforms provided contemporary course content, access to digital tools and user-friendly technology favoured only economically stable students. Exorbitant data prices, unavailability of free wi-fi and mobile data inhibited previously disadvantaged students from gaining access to these platforms (Ngcamu, 2019).

[36] Key technologies include genetics, computer technology, nanotechnology, and biotechnology (Hirschi, 2018).

As a university of technology (UoT)[37] that caters for the previously disadvantaged and underprivileged students, these music students' challenges hinge on a low socio-economic background and lack of infrastructure (Bridge, 2015). The majority of the students lack access to music instruments, smartphones, laptops, and the internet. The bulk of the university's music students are funded by the National Student Financial Aid Scheme (NFSAS), which provides bursaries for tuition with limited funding for accommodation and books (NFSAS, 2020).

The majority of the music students have attended Quintile[38] 1 category schools located in communities with low average household incomes, high unemployment rates, and low literacy rates. In addition, these particular schools are associated with poor quality education (van Dyk & White, 2019).

The university music students require access to digital resources to participate in online teaching and learning. These resources include music learning tools, technological infrastructure,[39] recording devices,[40] music instruments, and practice space (Gonsalves, 2020; Naidoo, 2020). However, financial constraints restrict students' access to these resources required for effective online learning. In addition, the students are forced to use mobile-technology-based apps (WhatsApp, FaceTime), as the university lacks financial funding to assist with purchases of necessary online teaching and learning tools. Students require alternate electricity sources for powering electronic devices and internet technology to continue with online learning during electricity outages.

Theoretical framework

Lack of education funding in South Africa undermines the delivery of quality education (Mestry & Ndhlovu, 2014). Although the South African public school quintile ranking system aims to redress financial inequality to enhance the quality of teaching, the practical implementation creates difficulties for roleplayers (Van Dyk & White, 2019). The majority of university students attended lower-quintile-ranked schools and face socio-economic challenges pertaining to university admission. This article aims to ascertain the viability of an online music programme that addresses the specific challenges of music students.

This study was underpinned by a transformative framework that aimed to improve society through knowledge construction based on power and social relationships (Creswell, 2013). This study highlighted the low socio-economic background of the university music department's students and inequity of access to infrastructure necessary for effective online

[37] Universities and universities of technology offer similar qualifications ranging from higher certificates to doctoral degrees. The distinguishing factor is that universities of technology focus on technology innovation and transfer and offer technological career-directed educational programmes (Bridge, 2015). A university's mandate is to offer pragmatic and career-directed programmes and training.

[38] The quintile category indicates the socioeconomic status of a school by determining average household income, unemployment rates, and general literacy level in the school's geographical area. Quintile 1–3 represents poor schools and Quintile 4-5 are considered affluent schools (Graven, 2014; Hall & Giese, 2008; Mestry & Ndhlovu, 2014).

[39] Technological infrastructure – internet technology, high-end computers, MIDI keyboards, webcams, and headphones with built-in microphones, compatible software required to access zero-rated online learning platforms, and e-learning software.

[40] Recording devices – laptops, tablets, audio interfaces, microphones, high-resolution cameras, and recording software – Logic Pro, Final Cut Pro.

teaching and learning. This study advocates action through developing an online music-teaching programme that addresses the students' specific challenges.

The social constructivist approach focuses on the student's specific social context to understand their educational background and historical setting (Creswell, 2013). Shulman's constructivist perspective to teaching and learning outlines that pedagogical content knowledge underpins the online music programme construct. Pedagogical content knowledge is an integration of pedagogical knowledge and subject matter knowledge. This teaching expertise and a recognition of the students' socio-economic background served as the pedagogical tool/construct (Cox, 1987) to develop the online music-learning programme.

Methodology and data collection

The study used the qualitative approach to garner a rich description of a multifaceted phenomenon (Creswell, 2014). A case study method was used to investigate a phenomenon in the real-life environment (Yin, 2009). The case study centred around the music department of a leading South African university of technology in which the teaching model is digitalised to face the challenge of online learning. An exploratory research design was employed to gain information on a less-researched topic through systematic data collection (Given, 2008; Kumar, 2011). The constructivist approach was allowed for knowledge to be constructed through meaning and real-life experiences. This knowledge is fundamental in developing an online music-learning programme that caters for specific student needs (Leow, et al., 2016). Underpinned by a transformative paradigm, the exploratory qualitative data provides insight into social justice issues and the needs of marginalised student populations (Mertens, 2007).

Data collection sources included literature, student feedback,[41] a feedback-tracking tool (Appendix 1, 2, and 3), and interviews. Unstructured, informal interviews with pedagogues shed light on learning styles, teaching techniques, online platform preferences, and possible challenges. Students' online teaching preferences informed the framework and effectiveness of the innovation. Data was coded and securely stored in a database and students' anonymity and confidentiality were protected by not identifying their year group.

Written responses were not elicited from the students, as it was far more beneficial to allow for an environment of verbal engagement and self-reflection. This allowed students to comment and elaborate on each other's comments. Students with limited language ability were engaged in expressing themselves with verbal discussions, allowing for cross commentary that garnered richer data. Thematic content analysis coded the student responses into themes of opportunities, challenges, and best practices.

Literature review

Online music-learning literature reviewed for this study highlighted forms of online learning in the global and South African context. In developing an online music programme that addresses

[41] The informal class discussion was part of the class activity following verbal engagement with students and comprised verbal responses. The feedback did not require consent from the students as it was part of a general class discussion. Furthermore, the feedback had no bearing on their assessment or marks and there was no unbalance in power relationships between the lecturer and the students. The feedback was considered a reflective process which was not part of the assessment criteria.

specific challenges of music students, themes were explored of university digitalisation, the fourth industrial revolution, and various online-learning approaches pertaining to instrumental music teaching.

Emergency remote teaching

In response to the educational crisis, online emergency remote teaching (ERT) was implemented (Bozkurt & Sharma, 2020). The primary purpose of ERT is to provide temporary access to teaching and learning quickly and reliably during the crisis. ERT uses remote teaching solutions and alternate instructional modes (Golden, 2020) for education as a substitute for face-to-face or blended learning. The premise is that once the crisis abates, the teaching environment will return to previous teaching formats (Hodges, et al., 2020). ERT focuses on the students' varying needs and challenges, including learning contexts, availability, and accessibility of tools.

South African higher education online teaching and learning context

South African higher learning institutions were forced to switch from face-to-face classes to remote learning during the lockdown to curb the spread of the COVID-19 virus (Mhlanga & Moloi, 2020). Several affluent universities switched to remote online learning, using their pre-existing online platforms. Other universities and public schools had to shut down during the lockdown as they lacked 4IR technological infrastructure (Mhlanga & Moloi, 2020). Although remote learning provided flexibility for teaching and learning, the swift implementation of remote online teaching was dependent on funding, technology, connectivity, and accessibility.

Available funding to support online learning varies between higher education institutions, leading to disparities between online teaching and learning models. Online teaching and learning models were thus based on institutional financial support, student financial backgrounds, and accessibility of internet technology (Mhlanga & Moloi, 2020). Websites, Microsoft Teams, Skype, WhatsApp groups, and Zoom were the most popular internet tools for providing and facilitating remote learning (Mhlanga & Moloi, 2020).

Online learning and online courses

Online learning refers to web-based learning, e-learning, virtual learning, and internet-based learning (Keengwe & Kidd, 2010). Online learning embraces a wide variety of technological applications and platforms. Online learning and online courses in higher education encompass learner experiences, learning management systems, education theory, and pedagogy (Hansen & Imse, 2016; Ibrahim & Nat, 2019; Keengwe & Kidd, 2010). The method of delivery and content structure plays a crucial role in optimising the online learning experience.

Table 1 provides a brief outline of online learning, asynchronous learning, synchronous learning, and online courses (Barker, 2003; Browne, 2005; Hansen & Imse, 2016; Hrastinski, 2008; Milakovich & Wise, 2019; Schlesselmann, 2020; Thalheimer, 2017).

Table 1: Outline of online learning, synchronous, asynchronous, and online courses

Online learning	• Dynamic environments boast diverse pedagogical practices, including active learning and incorporating student-centred didactic approaches and techniques (Barker, 2003; Browne, 2005) • Alternative to traditional classroom teaching methods and settings • Flexible appeals to various types of learning styles – visual, auditory, and practical (Hansen & Imse, 2016)
Asynchronous learning	• Students are online when required • Students control learning pace – increases students' ability to process information and provide content-related responses (Milakovich & Wise, 2019) • Encourages cognitive participation – increased reflection and capacity to process information
Synchronous learning	• One-on-one and uses digital platforms to access online course content/media at the same time (Milakovich & Wise, 2019) • Increased psychological arousal, motivation, and convergence on meaning (Hrastinski, 2008)
Online courses	• Engaging and interactive • Increased interaction with the lecturer, students, and course material • Collaborative and flexible assessment methods (Schlesselmann, 2020) • Teaching method takes precedence over the teaching modality • Learning experience yield better results than face-to-face teaching (Thalheimer, 2017)

Blended learning

Blended learning is defined as a combination of face-to-face learning and web-based experiences (Ibrahim & Nat, 2019). A wide variety of teaching and learning environments are integrated, including asynchronous learning networks, web-based teaching platforms, and online learning tools. The challenges of this approach are limited access to technology and inadequate computer skills (Tshabala, et al., 2014).

Self-regulated learning

Self-regulated learning is crucial to music practice. Achievement levels and success are based on practice time and commitment. Practice methods involved a level of self-assessment and correction that leads to deliberate practising (Hallum & Bautista, 2012), active student engagements, and student-controlled learning processes. Motivation is the essential element in self-regulation intervention programmes that improved academic performance (Dignath, et al., 2008).

Student-centred learning

Student-centred learning or active learning engaged students with the subject content and encouraged students to control their learning. The teaching-and-learning and assessment strategies were adapted to suit the needs and abilities of the students (Brown, 2008). The skills required for the future success of music students are cultivated through peer evaluation, self-reflection, and problem solving. These activities form part of the student's music making (Hansen & Imse, 2016). A student-centred learning approach encourages lifelong learning and nurtures creativity and collaboration (Scott, 2011).

E-portfolio and assessment strategy

An electronic portfolio (e-portfolio) is a digital collection of content. An e-portfolio manages data and can be adapted to support learning (Abrami & Barrett, 2005). E-portfolios are used to recognise various learning styles of students and enhance their learning through self-reflection and self-regulated learning (Boulton, 3014; Yastibas & Yastibas, 2015).

Higher education institutions use e-portfolios as alternate assessment strategies (Van Wyk, 2017) since they allow for assessment flexibility. E-portfolios also serve as a record of evidence indicating knowledge and skills (Van Wyk, 2017), which in turn serves as an entrepreneurial tool (Mapundu & Musara, 2019). Ongoing feedback (diagnostic) and continuous monitoring of tasks are assessed according to specific evaluation criteria (Van Wyk, 2017).

Online music-teaching tools

Online music-teaching tools are an invaluable resource required for online learning. A selection of online music-teaching tools is based on availability, functionality, teaching efficacy, and integration with existing music software (Brook & Upitis, 2015). Self-regulation, self-learning, and student-driven learning are key learning approaches in online learning programmes (Brook & Upitis, 2015).

Internet MIDI, FaceTime, and method books are used as part of synchronous teaching approaches and create opportunities shaped by the online medium. Although synchronous online teaching approaches provide piano lessons to disadvantaged populations in remote areas, using Skype videoconferencing for music lessons was functional but not equivalent to face-to-face instruction (Dammers, 2009). Videoconference-based teaching is more intense, and the time delay hinders student and teachers from performing together (Sture Brändström, 2012). Other teaching challenges include complications related to lack of knowledge of equipment and technology (Kruse, et al., 2013), quality of videoconferencing equipment (Lancaster 2007), and latency dependent on internet bandwidth (Riley, et al., 2016).

Discussion

Traditional instrumental music teaching

Traditional learning environments in the western world are confined to a specific location, with teachers and students both present. The learning environment is teacher-controlled and presented in real-time using linear teaching methods (Dabbagh & NannaRitland, 2005). The music lesson format follows the master-apprentice model. Students and teachers meet weekly (Harwood 2007), where guidance and feedback are provided during the lesson. Teaching is structured into bite-size chunks to minimise overwhelming the students with information, promoting student engagement and motivation (Harwood, 2007).

Jazz teaching and learning tools pioneer technology-based education strategies that provide students with access to the actual music content (source) rather than mediated sources. Jazz ensemble and instrumental teaching and learning follow an apprenticeship model, incorporating music technology to analyse recordings and performances. Transcription is a process involving listening and copying aspects of performances and is a key tool for learning jazz styles and developing the ability to improvise. Transcription methods involve converting analogue audio to digital formats. This method has evolved from using cassette tape, then LPs, then CDs (manual playback to loop sections) to format and convert analogue audio to MP3 and waveform audio files (WAV) using music-recording software (LogicPro, ProTools) for flexible manipulation. Advancements in music technology include transcription and notation software[42] that are used to convert various audio formats into sheet music. Built-in editing tools adjust notes, beats, tempos, and time signatures to suit the range of the instrument and student ability.

Traditional teaching process

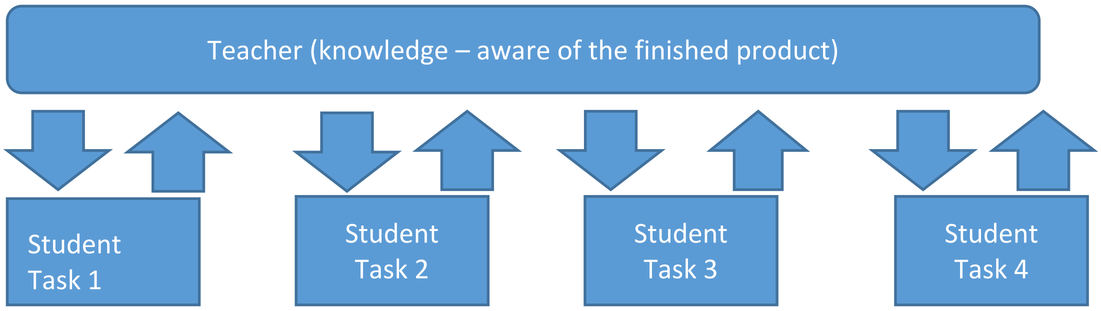

Figure 1: The traditional teaching and learning process

The traditional hierarchical teaching approach shows the teacher as the knowledgebase and controlling the learning process. Only the teacher is aware of the tasks and final product and sets out each task for the student (set of instructions).

Process:

- Teacher sets out the tasks for the student;
- Student completes the task and relays it back to the teacher; and
- Teacher then actions the next task.

The student is unaware of the relationship between the tasks and final product during the traditional online teaching and learning method.

Industry 4.0 SMART online teaching process

Majority of TUT music students hail from historically disadvantaged communities, low socio-economic background and lower quintile ranking schools. As a result, these students are underprepared for university education. The instructional design used a developmental approach to accommodate the deficiencies of their schooling system.

The majority of music students at the university are funded by the National Student Financial Aid Scheme (NFSAS). The students lack access to music instruments, smartphones, laptops, and the internet. A SMART (**s**pecific, **m**easurable, **a**chievable, **r**ealistic, and **t**imely) stepwise online lessons programme was designed to facilitate instrumental teaching during university closures and lockdowns. The SMART programme draws on the industry 4.0 manufacturing model in which the knowledge is decentralised, autonomous, and self-optimising, thereby promoting a stepwise student-centred learning approach.

[42] Notion 6, MuseScore, Sibelius, Finale PrintMusic, Forte Home, AnthemScore.

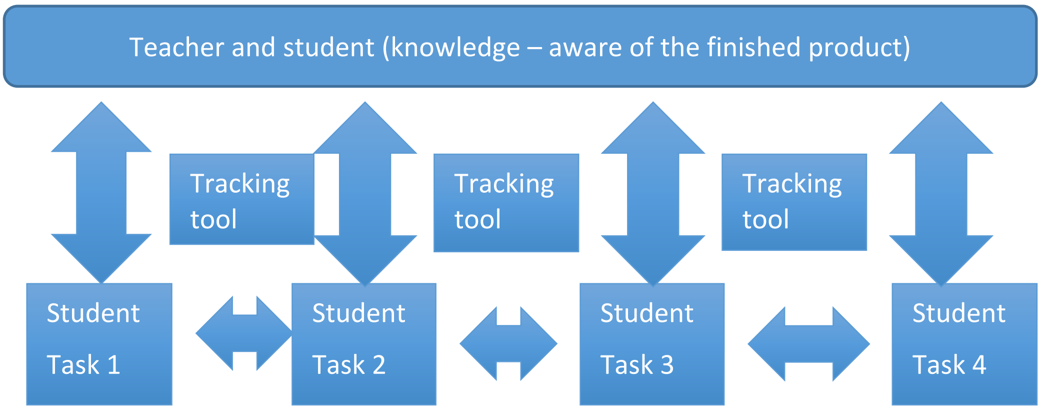

Figure 2: Industry 4.0 manufacturing model adapted and applied to a SMART online teaching and learning method

The industry 4.0 manufacturing model showed a student-centred learning approach. The student is included in the knowledgebase, is cognisant of the tasks, and how the tasks relate and work in conjunction with each other. The student-controlled the learning pace (self-learning) and teacher interaction. The tracking tool (Appendix 1, 2, and 3) serves as a feedback mechanism (teacher) for each task and leads to self-organised and self-regulated learning.

Self-organised and self-regulated learning process

- Teacher provides all the tasks in the stepwise lesson plan[43] (Appendix 1, 2, and 3) to the student; and
- Student uploads videos of various weekly tasks (as per the stepwise lesson plan) to a student portal (e-portfolio). Student uses mobile technology for asynchronous lessons and tracks their progress using the stepwise lesson plan and a feedback tool (Appendix 1, 2, and 3). Teacher provides feedback on the performance and suggestions for the next task. Teacher uses continuous assessment to evaluate student's progress based on weekly uploads to an e-portfolio, including using a feedback mechanism and peer assessment. The teaching and learning activities are based on the constructive alignment model, where the intended learning outcomes are clearly stated and aligned to teaching and learning activities, as well as the assessment method.

Traditional versus online music programmes

The literature reviewed outlined the best practices of online teaching and online learning music programmes to address the research question of whether an online music programme can address specific challenges of the university music student. These best practices addressed the specific challenges of the music students. In doing so, the best practices formed the basis of an online learning music programme.

The literature reveals that traditional synchronous music lessons are restrictive and time consuming. Synchronous online learning encourages one-on-one participation but requires the teachers and students to be available simultaneously. The asynchronous online learning[44]

[43] A stepwise lesson plan is provided by the teacher that consists of at timetable, learning material, demonstrational videos, and YouTube links.

[44] Asynchronous course content enables students to engage with the material several times regardless of internet connectivity (Schelesselman 2020).

approach is less dependent on technological infrastructure and internet technology than the synchronous approach.

Asynchronous student-centred learning enables students to be in control of their learning. E-portfolios are an effective tool for online learning and assessment for student-centred learning. Students record their lessons on Zoom, which serves as a reference tool for self-learning and practising.

Blended learning allows the students to continue learning, using various synchronous platforms and asynchronous tools (Milakovich & Wise, 2019).

SMART stepwise online lessons

The SMART (**s**pecific, **m**easurable, **a**chievable, **r**ealistic, **t**imely) stepwise online lessons approach enhances online learning by providing a graded stepwise approach to learning. Lesson plans (Appendix 1, 2, and 3) include short exercises uploaded as short video clips on mobile platforms.[45] These video clips and feedback tools (Appendix 1, 2, and 3) effectively monitor student progress and provide diagnostic feedback. Lecturers upload demonstrative videos to the zero-data-rated university online platforms and mobile platforms. Self-regulated, peer learning, and active learning approaches should underpin teaching and learning strategies.

The SMART stepwise online lesson approach can be applied to teaching and learning practical modules within various disciplines and programmes. Following consultation with jewellery design lecturers, the SMART model was adapted for designing a commercial jewellery range as part of a project in the Jewellery Design subject (Appendix 2). The stepwise lesson plan and feedback-tracking tool informs the student of the smaller tasks and provides background to the design process, culminating in the development of design principles and elements. The tracking tool outlines the five tasks, namely research, concepts, design development, technical information, and rationale. The weekly submissions and feedback ensure that the weekly learning outcomes are completed.

The SMART stepwise online learning model can be applied to the short learning programmes offered at a university of technology as part of entrepreneurship in the arts, namely batik, tie and dye, footwear design, and fundamentals of dressmaking/sewing skills. The SMART stepwise model was incorporated into the dressmaking process (Appendix 3) from the inception to completion stages of a garment. The stepwise lesson plan and tracking tool outline the five tasks required to design and sew an apron with a pocket.

The SMART model can also be adapted to photographic techniques and information technology modules. These modules include processes of problem solving, practical procedures, and the application of appropriate techniques to accomplish the given task. A projects and assignments e-portfolio will serve as a continuous assessment tool.

[45] Music students prefer using mobile technology platforms (WhatsApp, Google Drive, Dropbox, Zoom, and FaceTIme) at base level due to limited access to computers, music software, and recording equipment. Although these platforms are functional, they are limited for providing feedback on instrumental performance techniques.

Student reflections

Student feedback on the pilot project highlighted the flexibility and accessibility of the online learning approach. Exposure to various styles of learning approaches enhanced their learning experience. Students were able to integrate the teaching and learning approaches and develop their skills with constant lecturer feedback. Access and student success rates are improved when incorporating mobile technology as part of digital learning processes.

Conclusion

Online music-learning programmes provide an alternative teaching mode to ensure the continuation of academic programmes during times of closure, social distancing, and lockdown. Online learning music programmes provide a non-restrictive alternative to the traditional music lesson when students have sufficient access to technology.

The decentralised and self-optimising learning approach of online learning music-teaching programmes is relevant for addressing student challenges. The student learning experience is enhanced, as online learning requires student engagement and self-regulation. Online learning music-teaching tools, self-assessment, and e-portfolios contribute positively to programme delivery and assessment strategies.

Online learning music programmes must address the specific needs and challenges of students. The one-size-fits-all approach renders this learning mode irrelevant (Gillet- Swan, 2017). In the South African context, access to technological infrastructure is crucial for online learning programmes to be successful (Mhlanga & Moloi, 2020).

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Appendix 1: Sample lesson 1 – music

Lesson 1	
Tenor Madness – Sonny Rollins *Tranes Blues* – John Coltrane *Blue Monk* – Thelonius Monk	
Sonny Rollins Background: Musical (How did he learn to play his instrument? How many instruments did he play?)	
List the Instrument/s :	
Compositions:	
Recordings:	
Personnel (musicians in his band):	
Style/s:	
YouTube.com (private channel with demonstrative videos)	
What you will learn • Sonny Rollins • Blues history • Blues form • Melody	

• How to improvise using the blues scale	

Appendix 1: Tracking tool

Tracking tool – music							
Date	**Task 1 Melody 8 bars**	**Task 2 Chord 8 bars**	**Task 3 Chord tones**	**Task 4 Solo**	**Listening**	**Accompaniment**	**Student feedback**

Appendix 2: Sample lesson 2 – jewellery design

Lesson 1	**Commercial jewellery range**
Background: What is commercial jewellery? What are all the specifications? What type of pieces are in a jewellery range? Types of semi-precious stones?	
Research:	
Concept designs:	
Design development:	
Technical information:	
Rationale:	
PPT with images of commercial jewellery designs	
What you will learn • Gathering of sufficient and applicable research • Commercial design process • Wearability • Design specifications • Development of design elements and principles • Technical information • Writing a rationale	

Appendix 2: Tracking tool

Tracking tool							
Date	**Task 1 Research**	**Task 2 Concepts**	**Task 3 Design development**	**Task 4 Technical information**	**Task 5 Rationale**	**Submission**	**Student feedback**
Week 1							
Week 2							

Appendix 3: Sample lesson 3 – fashion design

Lesson 1	**Fundamentals of dressmaking/sewing skills**
Designing and sewing an apron	
Equipment selection:	
Pre-shrinking of fabric and removal of creases:	
Design of pocket:	
Design of apron:	
Cutting of pocket:	
Cutting of apron:	
What you will learn Correct use of sewing equipment Pre-shrink fabric Remove creases Cut different fabric pieces Stitch a patch pocket and apron	

Appendix 3: Tracking tool

Date	**Week 1**	**Week 2**	**Week 3**	**Week 4**
Task 1 Equipment				
Task 2 Pre-shrinking fabric				
Task 3 Cutting of pocket				
Task 4 Cutting of apron				
Task 5 Stitching				
Submission				
Student feedback				

DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Digital transformation of pedagogy in design education in the virtual learning environment

Christina Elgie, *Stadio*

Abstract

The urgent need for pedagogical change, made possible by Digital Transformation (DT), is indisputable in design education (DE). This study considers the relationship between the evolution of Virtual Learning Environments (VLE) and the need for modernised pedagogy suitable for learning DE online, particularly by African students. The focus of the investigation is on the methods used in delivering DE curricula in relation to these technological platforms. This is carried out using a qualitative research approach with a phenomenological analysis framework. A conceptual model is constructed to explain the phenomena of interest. The research process reflects a constructivist epistemological paradigm based on the direct experiences and perspectives of the participants. This conveys the insights, views, and perceptions of DE faculty regarding pedagogical practices in VLE. The data collection instrument was derived from the conceptual framework and consisted of a cross-sectional survey. Research in VLE has recently broadened due to the socially crippling pandemic COVID-19, which has forced educators across the globe to adjust their methods of curriculum delivery rapidly by venturing into VLE (International Labour Organisation, 2020). This has highlighted the need for greater insights in utilising three-dimensional (3D) platforms in DE. Knowledge creation and imagination have been presented in the past predominantly in two dimensions but new multimedia mediums for design and concept development allow an abstract interpretation of design themes and events evolving into a 3D VLE. Aspects of the pedagogical system to be investigated are DT of pedagogy in teaching methods, tools, digital platforms, modern IT, virtual reality (VR) and augmented reality (AR). Innovative methods of learning design and delivery are not yet fully developed and further development of a strong conceptual framework is an immediate priority for high-quality DE. Ongoing development of a model for delivering methods of teaching in VLE are likely to become a major research topic for education providers as it will help them to attract students and to remain relevant in the future.

Keywords: Design education, digital transformation, virtual learning environment

Introduction

This research addresses a moderately new area that arose from the evolution of the Fourth Industrial revolution (4IR). Gleason (2018) postulates that 4IR is rapidly leading DE towards the Fifth Industrial revolution (5IR). Recent theoretical developments in the context of VLE have resulted in repeated appeals for pedagogical change in DE (Gleason, 2018; Haywood, 2018; Bryant, 2018). This is a complex problem and specific solutions are required to match alternative approaches that have been developed over the last few decades (Greenhow, Sonnevend & Agur, 2016; Timmis, Bradfoot, Sutherland & Oldfield, 2016, p. 48). Previously proposed methods have been criticised (Bryant, 2018, p. 48); educators are facing many challenges affecting the value of applying innovative and envisioned pedagogical changes brought on by 4IR and these could lessen the credibility of DE teaching if DT is not addressed within DE learning design. The study contributes by developing methods of delivering curricula for teaching DE courses in VLE and examines how they are taught within an African university community. This study builds on previous work and proposes a new pedagogy to be implemented to support the effective dissemination of DE pedagogy using modern, virtual teaching tools and technologies. It is based on data regarding the modernisation of pedagogical techniques for DE, and the implementation of digital platforms to provide recommendations for future pedagogical practices in VLE.

DE is confronted with the challenge of using VLE domains productively and creatively as participatory practices, which is vital to facilitate artistic experiences. “Contemporary modes of communication are perhaps the biggest opportunity for new scholars to consider what is new about media and how new modes of communicating research can work” (Long & Wall, 2012, p. 487). Smal and Lavelle (2011) postulate that DE in South Africa should engage in a discourse which promotes research, emphasising issues of materiality combined with theoretical and historical constructs. Theorists hypothesise that design research is project orientated as the design process becomes the subject of design research. Smal and Lavelle (2011) explain that design practice and process of design research are interrelated. The golden mean is balancing theory and practice through the application of our designed world of images, objects, activities, and environments. Entanglement of perception, knowledge and reflection creates artistic experiences, and practical ways to initiate this into DE as competencies for reflecting, understanding and creating messages are essential. Long and Wall (2012) examine new ways of thinking about new media forms and challenge long-standing modes of thinking and communication in DE. The aim is to produce an account of personal and practical processes involved in adjusting to DT of pedagogy in DE and to develop modern pedagogy strategies.

Theoretical contextualisation of DT of pedagogy in DE

In this study, a rich body of literature was reviewed to document key contributions made to fields of DT of DE pedagogy in VLE. According to Penphrase (2018) the growing need for innovative DE online courses become evident; these include the hybridisation of Face-to-Face (F2F) learning and online technologies to facilitate the development of students’ learning skills and knowledge in an asynchronous learning environment. Spyropoulou, Pierrakeas and Kameas (2019) affirm that ground–breaking undertakings in distance learning involve Massive Open Online Courses (MOOCs) and this sparked great interest to incorporate MOOCs into DE. African DE curricula have the potential to reach a global audience and hence create a hybrid community for students and faculty from a variety of backgrounds.

Curriculum connotation

In asynchronous learning, the instructor and student do not engage in the learning process simultaneously. Asynchronous learning enables students to learn at their own pace and may mean less work for educators. Development of automatic tasks can lessen repetitious work, for example, grading exams and giving online classes. Previous studies investigating methods of study design using MOOCs (Zhang, Lu & Hu, 2019; Spyropoulou, et al., 2019) suggest paying special attention to the construction of curriculum connotation, selection of pedagogy and selection of educational strategies. Curriculum connotation is explained by Mulenga (2018) as viewing the curriculum as content of the syllabus, course outline and learning outcomes. If asynchronous learning is part of the teaching design, collaborative learning communities should be established to support the student.

Collaborative learning communities

An ongoing study by Abuhassna, Al-Rahmi, Yahya and Aman (2020) explores the construction of a new model to use in VLE and describes the use of purposeful interaction or dialogue. This view is supported by Bryant (2018) who agrees that communication should be constructive to support idea generation and exchange. This researcher determined that enabling communication between educator and students decreases the feeling of separation. Moreover, educators play vital roles by encouraging interaction, participation and communication. Good user experience (UX) of educational software and digital tools is crucial to ensure uncomplicated and manageable use. Well-designed software will make users feel more comfortable in engaging in VLE. Educators can reasonably effortlessly use tools and platforms without steep learning curves or excessively time-consuming training. Students should actively participate in the process of making information become knowledge; and communities involved with VLE can help students make sense of the content. A supportive and collaborative learning community helps students acquire and retain knowledge. This reduces isolation and imparts a sense of belonging and comradery to motivate and ensure engagement.

In contrast, various studies comparing formats (like F2F and blended and hybrid learning) show different results; this might indicate that factors other than the format alone influence the delivery of a purely online curricula (Israel, 2015; Northey, Bucic, Chylinski & Govind, 2015). To date, little agreement has been reached as to what leads to a better learning outcome among students in online and blended learning programs (Fletcher & Bullock, 2015; Israel, 2015; Joksimovic, Gaševic, Kovanovic, Riecke & Hatala, 2015). Traditionally, theorists have subscribed to the belief that an absence of F2F inhibits the development of learning skills and reduces in-person interaction between students and educators, affecting learning achievement (Israel, 2015). Theorists argue that the sense of belonging to a meaningful learning community is restricted in online and blended learning, disadvantaging students' learning experience as students struggle to make their social presence perceptible (Joksimovic, et al., 2015; Fletcher & Bullock, 2015).

This is debatable as social media and online communities have increasingly been shown to be able to form close connections, especially in areas of niche interests, connecting people from various social and economic backgrounds. Molteno (2017) states that true learning and engagement unify students, merging into an educational network, and the feeling of community in VLE develops a sense of mutual support and makes the experience more open, more human and more communal. Skinner agrees that participation through online discussions may be improved by harnessing Community Development Theory. This fosters multicultural awareness and an enduring appreciation for common liberties and opportunities. These strategies are appropriate for a comprehensive and global curriculum that can be adopted or reinvented for the African context in a setting which improves intercultural and interpersonal skills. Online educators play a critical role in creating the sense of community in VLE by augmenting this into the design of an online course and actively promoting it. During the OpenDoor webinar, Mitra (2020) emphasised the important role that instructors play in VLE by having a strong online presence, encouraging students to participate and validating students' discussions and, hence, creating online learning communities. "Personal development through VLE does not occur before but through participation" (Mitra, 2020).

Social interaction

In the context of social interaction among students, it is important to mention utilising gamification and animation. Vyas (2020) shows that game-based learning outweighs the benefits of conventional pedagogy as gamification delivers better learning impacts, increases learning inspiration and improves critical thinking skills. Traditional pedagogy, which is instructor orientated and concentrates on memorising knowledge, is considered to have become outdated when compared to implementing and understanding key concepts in gamification pedagogy as it is enjoyable and interesting. Positive outcomes are accomplished through game-based learning and its practical application, which provides immediate feedback that enhances student engagement (Vyas, 2020).

Mitra (2020), in his latest ground-breaking research on distance learning, states that “in order to change the way we express the modern VLE curriculum, it should be created as a question”. Curricula for VLE should be converted into questions so that students know why educators are teaching certain topics. Mitra (2020) urges educators to embrace and adapt to new technologies and to adopt a self-organising system where access to internet resources and collaboration between students and technology are allowed during assessment. Rather than recalling knowledge, future assessment methods would focus on measuring the student’s ability to predict knowledge accurately and be assessed on defending their findings. In addition, Abuhassna, et al. (2020) refer to student autonomy as the navigation of independence and motivation towards learning. Penphrase (2018) postulates that within modern 4IR curricula an integrated system of educational needs should be explored through emerging concepts of self and identity. This includes considerations of the student’s independence, individuality, and social context versus genetic determination. 4IR has seen a rapid change in social interactions and relations, making DT of DE pedagogy imminent.

Teaching and learning transformed by technology and social media practices

A modern approach should be developed which considers how teaching and learning are disrupted and transformed by technology and social media practices (Bryant, 2018, p. 48). Penphrase (2018) identified that the delivery of the modern curriculum in VLE needs to focus on social media and society, committing to identity groups in national and globalised learning environments. Active participation by students is vital, encouraging them to participate autonomously in line with their educational skills, objectives and former experience and background. Jandric (2017, p. 230) challenges our earlier notions of social interactions and argues that developing social media practices will enable new perspectives of our shared humanity, independent of geographic boundaries. This will directly impact the delivery of modern curricula required for DE operating in VLE. Tahir, Haron and Kaur (2018) explain that ubiquitous learning requires a new set of tools that can be implemented in the classroom and will enhance searching and collecting information online. Facebook groups can be used “to support the learning environment together with apps to provide students with real-time feedback from educators” (Mitra, 2016). Through Web 3.0 technology, social networks enable students to share their feelings, thoughts and ideas.

In addition, Tekdal, Sayginer and Baz (2018) postulate that Web 3.0 technologies enable the educator to design pedagogy using collective platforms and tools. This entails a combination of innovative course content, advanced search engines, virtual training laboratories, semantic web applications, 3D educational games, 3D encyclopaedias, semantic digital libraries, virtual worlds and avatars. Esposito, Sangrà and Maina (2019) explain that digital ecologies combine technologies and diverse ways of interaction, including virtually and F2F. Within the digital ecology, collaboration exists through organised social technology-based environments. With this evolution and with improvements notable in web technologies, educational materials have improved noticeably in recent years. Tekdal, et al. (2018) predict that future education will rely on VR and AR due to innovations in 4.0 and 5.0 web technologies. Web 5.0 technologies include the implementation of “artificial based intelligent systems, virtualisation and cloud storage systems” (Tekdal, et al., 2018). VLE programs will be operable without installing software and will be replaced by intelligent operating systems allowing access to information anywhere using online storage services. Web 5.0 technologies will advance the use of avatars, AI robots and 3D virtual environments in the future VLE. Theorists predict that Web 5.0 hologram systems will be used for meetings and interaction with web content will be done via headsets.

New strategies can be evaluated, designed and applied for the development of online curricula (Molteno, 2017; Vyas, 2020; Northey, et al., 2015; Skinner, 2016; Tomas, Lasen, Field & Skamp, 2015). This process involves structuring material in small, practical portions that are easy to follow and are appropriate for the specific skill needs of individual students. Quick access to resources should be possible for students to engage routinely, anytime and wherever needed (Canvas, 2020). Active engagement strategies deliver fun and creative content and enable interaction through gamification and animation. Scenario-based practical activities and sharp, short video content can be provided to keep students interested (Canvas, 2020).

Evidently there is a need to investigate a format that can support pedagogy of DE, using digital platforms in VLE. The solution is not as clear as these theories suggest as the 4IR is evolving rapidly, leading into 5IR. The most sought-after benefits of new pedagogical methods within VLE are the enhancement of a learning ecological system, highlighting the sense of community and the encouragement of asynchronous and independent learning.

Research design and methodology

Within the constructivist epistemology a phenomenological qualitative approach was followed to address the research question, namely, what delivery methods can be implemented to support Design Educators’ effective dissemination of pedagogy in VLE using modern virtual teaching tools and technologies.

Population

The research relied on local and global knowledge; the phenomenological qualitative approach assists in identifying what is happening or being experienced. In this study this was done by gathering data from faculty members of progressive fashion schools in DE. The population is homogenous in nature as the participants share the same traits in the DE field. This means that the participants might be of different age and race, but all have the knowledge required for the researcher to conduct the study. Creswell (2012) defines a population as a group of individuals who have the same characteristic. The characteristic that participants in the population had to possess in order to be included in the study was to be members of Design faculties in higher educational institutions (lecturers and academic managers of DE).

Non-probability sampling was applied. Purposive sampling entails the researcher intentionally selecting individuals and sites to learn or understand the central phenomenon (Creswell, 2012); this means that participants for the study need to be information-rich within the context of DE. A link to the survey instrument and a consent form was sent via e-mail to relevant participants.

The sample consisted of nine participants, three full-time lecturers, one part-time lecturer, one head of department and four academic managers.

The educational level of the participants are one participant graduated from a college, one graduated from an university, six completed postgraduate master's' degrees and one participant indicated their highest qualification is a PhD.

Data collection

The research question provided a vital conceptual framework for studying the data collected:

- What delivery methods can be implemented to support Design Educators effective dissemination of pedagogy in VLE, using modern, virtual teaching tools and technologies?

The qualitative paradigm best suits the reflective research approach and interactive re-examining of the main concepts and emergence of new directions and ideas during the data collection process (Meriam, 2009). The research design reflects a cross-sectional, qualitative survey. Data collected are in the form of words and sentences with underlying meaning, to describe applicable characteristics of the phenomena of interest from an individual-oriented perspective (Merriam, 2009). Gathering data, from the qualitative phenomenological perspective, relied on local knowledge to identify what is happening or experienced by faculty members in DE.

Kabir (2016) defines data collection as the "process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes". Creswell (2012) explains that the cross-sectional survey has the "advantage of measuring current attitudes or practices. It provides information in a short amount of time, such as the time required for administering the survey and collecting the information". Data was collected using Survey Monkey software. The research aims to explain the current situation. Therefore, the data collected is subjective as the aim was to collect reliable and credible information that would enable the researcher to answer the research question.

Data analysis

The inductive coding process was used – themes were derived from the responses of the open-ended questions (Merriam, 2009). Data analysis involved repeating, tweaking and improving the coding process through several cycles, ensuring a thorough, complete and unbiased look at the themes throughout the data (Saldaña, 2012, p. 8). Colour coded text in a written form obtained by "cutting and pasting" the data verbatim from the responses was done to find themes and develop categories. Once codes were identified they were transferred to a flat coding frame (Merriam, 2009). It is essential that data analysis involves coding on different levels, about both the phenomenon being described (modern pedagogy of DE curricula in VLE) and the perspectives influencing the account given.

Ethical considerations

Ethical considerations were considered ensuring trustworthiness, credibility, confirmability and transferability. To assure the confidentiality and anonymity of participants, consent forms stipulated that the open-ended survey answers would be transcribed. Ethically defensible research was attained through the transcribing of quality data during the data collection phase that is both valid and reliable (Rosenthal, 1994). Another ethical consideration was to acknowledge and state that participants might feel awkward if not knowledgeable in new technologies. It was communicated that the study would help participants identify gaps and opportunities for better preparation for the future in both pedagogy and in applying new technologies in DE curricula. Academic integrity and scholarly ethics are of equal importance. Hence research must be reported honestly, shared with participants, not previously be published, not be plagiarised, not be influenced by personal interest and be duly credited to authors that made a contribution.

Data analysis

Collaboration

Communication

Engagement

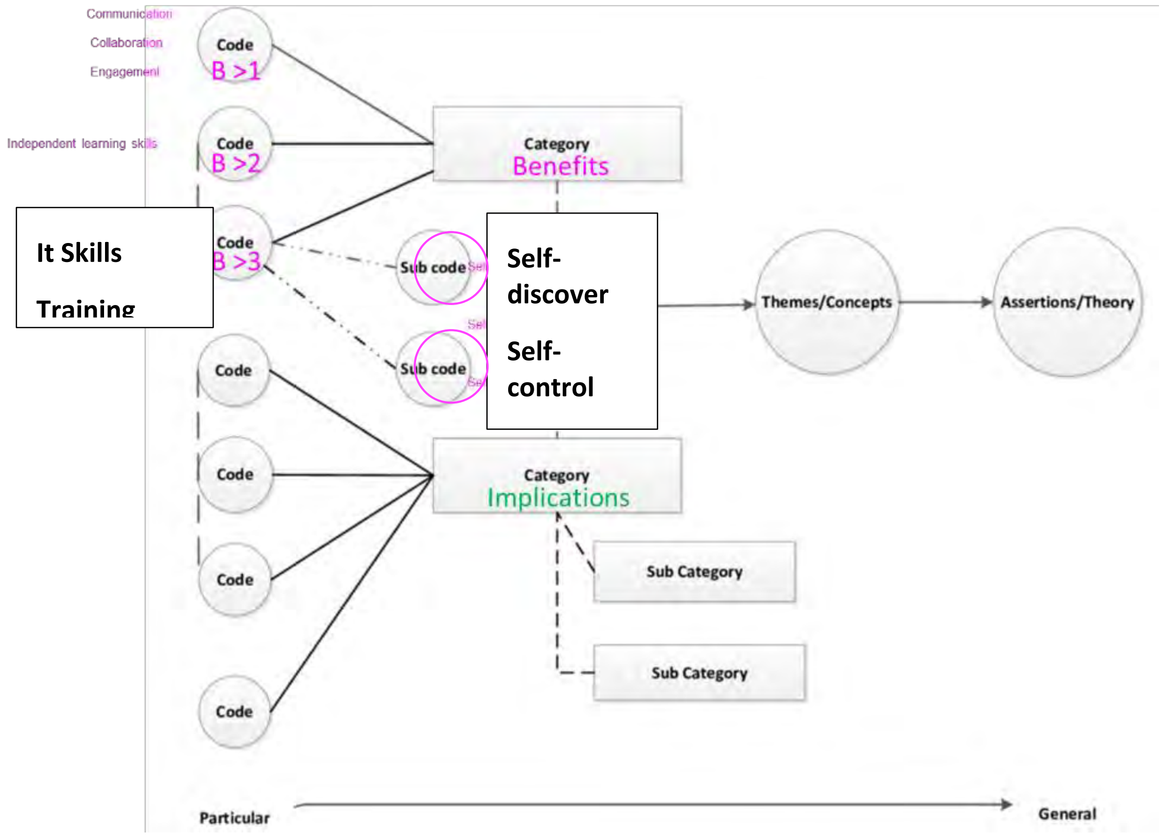

Figure 1: Saldaña's codes-to-theory model for qualitative research

The research question formed the foundation for developing the categories regarding this study. The survey data was analysed using systematic coding, resembling the method in Figure 1, proposed by Saldaña (2012).

The main categories identified using the code system (Appendix A):

- Benefits of digital learning tools and platforms in VLE (Pink B>);
- Implications of the impact of DT of pedagogical curricula in VLE (Green I>); and
- Development of practices of modern pedagogical curricula (Blue D>).

The third coding phase entailed developing subcategories or preliminary codes which were derived from the main categories (Saldaña, 2012). Patterns were identified by allocating qualitative codes (colour coded words) to capture the essence of connections of ideas and concepts through looking at similar and regular patterns that emerged in the final coding phase as seen in Appendix B.

The research question produced three main categories, 34 Preliminary categories and Core Ideas, and 14 Final Codes as seen in Appendix B.

Findings

Benefits of digital learning tools and platforms in VLE

The open-ended answers within the survey illustrate that digital platforms in VLE develop skills such as communication, self-confidence and independent learning in an asynchronous manner. Regardless of this, student motivation to participate is still a concern due to the student's lack of self-confidence. The key benefits of using digital learning tools in VLE include communication, collaboration, interaction, knowledge creation, diversity and flexibility. From the results it is evident that a strong relationship exists between communication, interaction and collaboration within VLE as substantiated in the literature. This relationship may partly be explained by the passive use of VLE rather than promoting active learning; participants listed forums as one of the least effective tools in teaching online.

VLE helps build a feeling of community, enhance communication and improve interaction as shown by the sub-category 'Interpersonal Relationships' between educator and student, and among students (Penphrase, 2018; Spyropoulou, et al., 2019; Molteno, 2017; Mitra, 2020; Skinner, 2016). This in turn supports collaboration and resource sharing (Molteno, 2017). The research substantiated that communication should be constructive as this lowers the sense of separation between learner and educator. Esposito, et al. (2019) shifts the focus to learning ecologies and context as these play an essential role in student participation in the community of practice. Knowledge creation is supported by the sub-categories of self-discovery and students' social skills by assisting them to stay up-to-date by honing information-seeking skills (Mitra, 2020; Skinner, 2016). Through diversity and flexibility, different learning styles can be accommodated. One interesting finding is that diversity within VLE assists in the creation of knowledge, as the quality of learning is enhanced by enabling educators to deliver information more effectively and by supporting the educators in meeting the needs of students' diverse learning styles in DE.

Implications of the impact of DT on pedagogical curricula in VLE

The major challenges that DE educators encounter in teaching are a lack of student motivation, confidence, participation, online access, pedagogy to incorporate different learning styles, lack of comprehension from students and time constraints. Within the 'Implications' main category, perceptions include both negative and positive notions.

The current study found that the most serious challenge of DT in VLE is students' lack of self-motivation which directly impacts participation, engagement and interaction (Molteno, 2017; Vyas, 2020; Northey, et al., 2015; Skinner, 2016; Tomas, et al., 2015). The delivery method used for DE course content could directly negatively influence the students' participation and motivation. Negative perceptions concerning technical difficulties are online access, internet connectivity, lack of equipment, time and ease (Esposito, et al., 2019; Lamprecht, 2020). This has a direct influence on the productivity of both students and educators. These views are supported in published research and theoretical concepts (Aoued, Hasnia & Mammeria, 2016; Canvas, 2020) as the learning outcomes of contemporary DE aim to enhance participation rather than isolation. Keeping students engaged and motivated was generally difficult. New strategies to motivate and engage students should be investigated (Molteno, 2017; Vyas, 2020; Northey, et al., 2015; Skinner, 2016; Tomas, et al., 2015). These methodologies should encourage autonomy for students, allowing them to act independently and increase motivation towards learning (Abuhassna, et al., 2020; Penphrase, 2018).

Development of modern pedagogy for DE online curricula

The development of modern DE online pedagogy depends on integrating course collateral characteristics. The educator's online skills, expertise and pedagogy (Zhang, et al., 2019; Spyropoulou, et al., 2019) depend on previously established competencies, knowledge, approach, instructional and pedagogical skills (Esposito, et al., 2019; Greenhow, et al., 2016). Support and training together with the earlier experience of the educator are necessary for change to take place at the wider institutional level (Tekdal, et al., 2018). In this context, enough room to manage and combine informed discussions, training workshops and UX of platforms are vital. Another important finding is that collaborative learning tools are not always effectively used. A possible explanation for this is that time constraints hinder the training process. These factors may explain noticeable links between the implications and the development of practices. Better general computer skills will be of value when using tools and resources to enhance the quality of learning. This study found that a combination of strategies should be employed to accommodate online and offline teaching using open source collaboration applications. As opposed to traditional pedagogy like F2F, creative design curricula include scaffolding of activities, combining various pedagogy and the interactive use of digital tools and platforms in VLE.

Recommendations

The results obtained from this research can be used to develop targeted interventions aimed at improving pedagogy of DE in VLE. In delivering a design curriculum, a combination of teaching methods should be used, such as, online discussion, online communication, online examination and online homework, including recorded educational material and assessments that contain multiple-choice quizzes or peer-review exercises. Studies suggest an "overarching pedagogical frame, explicit scaffolding of learning activities (through podcasts or online tutorials), appropriate use of media, hands-on assessment tasks, online forum discussions and student-staff communication is vital for students' learning experience" in VLE (Tomas, et al., 2015). Collaborative learning and communication should be adopted using various collaboration platforms for discussion and feedback (Abuhassna, et al., 2020). Interactive exercises will enhance motivation and keep the learning process interesting, creating a pleasant atmosphere.

From the results, developments in web technologies need to be considered in the context of DT pedagogy of online curricula. New horizons are possible using web technologies and 3D environments in VLE. Possible directions for future development can be attained by exploring the future of Web 4.0 and Web 5.0 virtual and augmented realities in DE. Recommendations supported by this study, both from the literature and participant feedback suggest that the development of targeted interventions aimed at practical processes should involve adjusting DE module structures. This includes careful selection of the most engaging lecturers to present the courses while those with the most engaging writing or editing styles develop the content.

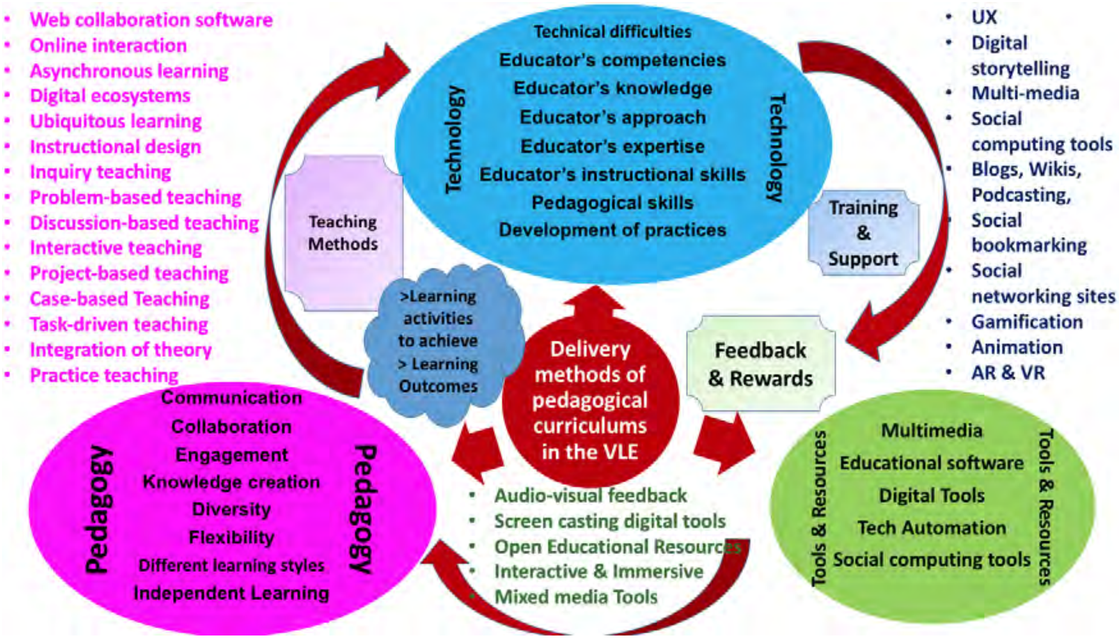

Figure 2: Proposed model for pedagogy of DE curricula in VLE

Technology provides an array of possibilities to use in DE and pedagogy in VLE. Esposito, et al. (2019) support the notion of VLE platforms that allow adaptation to students' learning styles so that content can be presented according to personal preferences (text-based, video/visual, auditory or interactive content, for example, gamification or practical activities through AR/VR, simulation, gamified or peer-reviewed feedback). Other important ways to keep learners engaged is through group work and social learning (social pressure to keep on learning), regular/formative assessment so the student gets continuous feedback as is made possible by tech automation. Lastly, an important way to keep students motivated is through positive reinforcement or regular reward scheduling where rewards can be as simple as encouraging words, praise, points accumulation or through gamification as the student progress through the work.

Regarding the implementation of pedagogy of DE curricula in VLE, the focus should be on the structure of course design and based on theories and previous literature relating to the subject matter (Abuhassna, et al., 2020). A constructive alignment design for teaching is recommended by Aoued, et al. (2016); this implies building on knowledge of how students learn. Learning activities should focus on achieving the intended outcomes rooted in instruction and assessment. The organisation of content should be according to the different characteristics of curriculum and chapter content. Emphasis on combining pedagogy should be based both online and offline to enable effective mixing of systematic teaching methods. Combining delivery methods including problem-based, inquiry, interactive, discussion-based, project-based, task-driven and case-based teaching and integration of theory will improve teaching efficiency and effect.

Conclusion

Experienced academic managers with clearly communicated vision are necessary for change to take place. For design curricula to evolve, communication, interaction and cooperation should occur at all levels within DE (between lecturers and students, students to students) through cooperative learning. The latter should occur between educators (for example, to learn cooperatively, share knowledge, develop teaching material and refining teaching methods), educator to students, student to student, educator to industry (to make certain that training topics address actual skills needs) and student to industry (to provide students with practical exposure, and to smooth the recruitment process for future employment).

VLE digital platforms may be considered a promising component of the teaching environment, allowing critical engagement when implementing changes of pedagogy and the design of modern DE curricula. This debate is not yet complete because the methodological approaches of existing studies are often qualitative and based on field observations or retrospective narratives. Hence, it is still in its infant stages of developing curricula that can support the relationship between DT in VLE and pedagogy of DE curricula. Bryant (2018, p. 37) and Haywood (2018, p. 117) validate these views speculating that modern DE can navigate and excel using vital platforms for pedagogical transformation and technology. Further research is required to investigate whether different learning methods have different impacts on pedagogy of DE in VLE. There is abundant room for research in determining which tools in VLE have the greatest impact on student learning. Future studies could investigate the association between the evolution of technologies used in design industries and the alignment of modern pedagogical curricula.

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Appendix A: Coding framework

Transcribed Verbatim	**Respondent (R)**	**Main Categories**	**Preliminary Codes = Sub-categories**	**Final Codes**	**Code Allocation**
		Benefits:			
Absolutely agree that navigating e-learning platforms is a skill in itself and student training on this is highly recommended if not absolutely prudential.	R9	Benefits.	Positive notion of perception. Problem solving skills. Self-discovery. Self-motivating. Self-control.	Independent learning skills. Engagement	B >2 B > 1
Online learning can enhance independent learning From observation, it seems that this platform is stronger suited to independent learning as students often opt for asynchronous learning.	R6	Benefits.	Positive notion of perception. Problem solving skills. Different learning styles. Ease of us.	Independent learning skills. Flexibility Diversity.	B > 2 B > 4 B > 4
Virtual learning environment enhance interpersonal	R2	Benefits.	Interpersonal Relationships. Self-discovery.	Communication. Collaboration. Engagement.	B >1 B >1 B >1

relationships between the lecturer and individual student. I do agree but as a qualifying factor again it depends on the circumstances, the personalities involved and the context.			Self-motivating. Self-control.		
From experience, I have had students with no prior computer training that have become accustomed to utilising the machine as a tool. I equally believe this can be achieved for online learning if a student is driven and has the correct aptitude.	R6	Benefits.	Personalisation. Problem solving skills.	Flexibility. Diversity. Independent learning skills.	B > 4 B > 4 B > 2
Online learning platforms provides powerful resources for gaining academic knowledge. Strongly agree	R1 R2 R3 R4 R5 R6 R8 R9	Benefits.	Social skills. Staying updated. Self-discovery. Self-motivating. Self-control.	Knowledge creation. Collaboration.	B > 3 B > 1
Due to the nature of its diversity, knowledge covered by industry professional from various parts of the world and cultural backgrounds can be accessed by learners. The width, depth, practical and theoretical spread strengthens its case as no faculty is diverse enough to satisfy these requirements.	R6	Benefits.	Information seeking skills. Social and Cultural Knowledge. General or new knowledge. Self-discovery. Self-motivating. Self-control. Problem solving skills. Different learning styles.	Knowledge creation. Collaboration. Independent learning skills. Diversity.	B > 3 B > 1 B > 2 B > 5
Strongly Agree, Online learning provides an opportunity for collaborative learning and activities for students. It is effective, but requires the facilitator to have strong Skills in online pedagogy and e-learning design.	R9 R1 R2 R3 R7 R9	Benefits.	Self-discovery. Self-motivating. Self-control.	Communication. Collaboration. Engagement.	B > 1 B > 1 B > 1
Online learning is helpful in developing student's problem-solving skills. It is certainly helpful	R9	Benefits.	Problem solving skills.	Independent learning skills.	B > 2
Virtual learning environment provides the best ways of giving	R4	Benefits.	Feedback.	Engagement. Communication.	B > 1 B > 1

feedback to students. Students can watch it over and over if they miss something.					
Online learning can accommodate learners having different learning styles Yes, this has been observed.	R9	Benefits.	Different Learning styles. Ease of use.	Diversity Flexibility	B > 4 B > 4
Transcribed Verbatim	Respondent (R)	Main Categories	Preliminary Codes = Sub-categories	Final Codes	Code Allocation
		Implications:	Perceptions: Negative notions Positive notions		
A lack of confidence in using the platform will in all likelihood result in lower engagement and worse results.	R9	Implications.	Negative notions.	Self-confidence. Confidence in own skills.	I > 1 I > 1
The caveat is that many students don't participate at all unless a mark is allocated. Therefore, the caveat is "depending".	R9	Implications.	Negative notions. Self-motivation.	Lack of Participation. Lack of Motivation.	I > 3 I > 3
Problem solving skills: In my experience students do not problem solve or try hard enough by themselves. Possibly due to the belief that a solution is always available on YouTube. In this sense it has become an unhealthy and habitual crutch.	R6	Implications.	Negative notion of perception. Self-motivation.	Lack of problem-solving skills Lack of Motivation	I > 3 I > 2
The pandemic lockdown policies resulted in full online teaching requirement. This requires a high degree of computer usage and as a rule requires reliable high-speed internet connectivity.	R9	Implications.	Internet connections.	Technical difficulties.	I > 4
Online access for both students and lecturer is hindering progress of students. This is a macro-problem for this industry and SA as a whole. We simply do not have the connectivity infrastructure	R9	Implications.	Internet connections.	Technical difficulties.	I > 4
Online access for both students and lecturer is hindering progress of	R4	Implications.	Internet connections.	Technical difficulties.	I > 4

students. Some students may have problems with connectivity, but online access is not a setback.					
Online learning can accommodate learners having different learning styles But students that have poor comprehension may seriously struggle with online learning. I have students that I have to explain their content in their own language for them to understand what is required.	R3	Implications.	Comprehension.	Different learning styles.	I > 5
This is dependent on the type of skill you want students to be able to demonstrate. We find that deep learning is still problematic in online spaces.	R9	Implications.	Comprehension.	Different learning styles.	I > 5
Online learning can accommodate learners having different learning styles Except for the students who prefer learning in person.	R4	Implications.	Comprehension.	Different learning styles.	I > 5
Lecture mainly theory so no pictures to share	R3	Implications.	Negative notion of perception.	Teaching methods.	I > 6
I found this area to be the most problematic: 5% – 10% of students would routinely participate. We observe low participation rates in these generally.	R9	Implications.	Forums.	Lack of Participation. Lack of Motivation.	I > 2 I > 2
If forced they will participate. Left to the students own devices it is completely dependent on the habits of the Student.	R6	Implications.	Forums.	Lack of Participation. Lack of Motivation.	I > 2 I > 2
Discussion forums are ineffectual.	R4	Implications.	Forums.	Lack of Participation. Lack of Motivation.	I > 2 I > 2
The context for my answer is based on timing (during COVID-19 pandemic) which effected students' confidence, emotional well-being, levels of anxiety, and practical impediments such as	R2	Implications.	Negative notions. Lack of equipment. Online Access. Time and ease.	Self-confidence. Confidence in own skills. Technical difficulties. Time Management.	I > 1 I > 1 I > 4 I > 7

connectivity and lack of equipment were all factors that hampered progress in the online arena, I do, however, feel that under favorable circumstances students would interact and respond in an online forum.					
While you can show a video of how to work with an over locker, it is not guaranteed that the student will develop the tactile ability to effectively problem solve using the tool. It slows down the learning cycle (sometimes learning requires quick mistake-solution iteration).	R9	Implications.	Positive notions.	Problem-solving skills. Teaching methods.	I > 3 I > 6
Depends on the nature of the vocation. It's easier to teach and provide feedback for some disciplines through contact.	R6	Implications.	Feedback F2F.	Lack of participation. Teaching methods.	I > 2 I > 6
There is enormous value in learning within a community of like-minded people. Strong disagree vocational subjects online	R4	Implications.	Positive notions.	Teaching methods.	I > 6
Sometimes it actually takes longer as educators must think about the learning process from a different perspective.	R9	Implications.	Hinder. Time and ease.	Technical difficulties. Time Management.	I > 4 I > 8
Peer-to-peer engagement and support. Anecdotally speaking, students simply do not interact as often as they would in class by quite a large margin.	R9	Implications.	Forums Feedback.	Lack of participation.	I > 2
Enhance interpersonal relationships between the lecturer and individual student. We observe that many students leave their microphones and webcams off. Body language and eye contact is absent. Most interactions are now	R9	Implications. Benefits.	Forums Feedback Self-motivation. Negative notion of perception. Lack of equipment. Time and ease. Online Access. Interpersonal relationships.	Lack of Participation. Lack of Motivation. Technical difficulties. Communication. Collaboration. Engagement.	I > 2 I > 2 I > 4 B > 1 B > 1 B > 1

typed instead of verbal. Students also have poor internet connections so even if they make the effort to engage, communication is often broken and students then prefer communicating by voice only.					
Transcribed Verbatim	Respondent (R)	Main Categories	Preliminary Codes = Sub-categories	Final Codes	Code Allocation
		Development of practices.	Quality of teaching.		
Absolutely agree that navigating e-learning platforms is a skill in itself and student training on this is highly recommended if not absolutely prudential.		Developments	Educator's competencies. Educator's knowledge. Educator's approach. Educator's expertise. Educator's instructional skills. Pedagogical skills. Student IT training.	Teaching methods. Skill development for students.	D > 1 D > 3
Gaining academic knowledge is effective, but requires the facilitator to have strong skills in online pedagogy and e-learning design.	R9	Developments	Educator's competencies. Educator's approach. Quality of teaching.	Educator's Skills and Expertise. Teaching methods. Support and Training.	D > 1 D > 1 D > 2
From experience, I have had students with no prior computer training that have become accustomed to utilising the machine as a tool. I equally believe this can be achieved for online learning if a student is driven and has the correct aptitude.	R6	Developments	Student IT training.	Skill development for students.	D > 3
This platform is stronger suited to independent learning as students often opt for asynchronous learning.	R6	Developments	Asynchronous learning. Educator's approach.	Teaching methods. Learning and teaching styles.	D > 1
Using virtual learning platforms saves a great deal of time in constructing online lessons. Depending on the content of the class it can either complicate	R6	Developments Implications	Educator's competencies. Educator's knowledge. Educator's approach.	Educator's Skills and Expertise. Teaching methods. Support and Training	D > 1 D > 1 D > 2 I > 5

of make the lesson easier. Whereas a virtual learning platform can lend itself to multiples issues (poor internet connection, outdated information, contradictory/false information, steep learning curves for productivity apps/platforms) the age-old contact-based lecture shows up trumps. The virtual learning platform should support not replace a contact modality.			Educator's expertise Educator's instructional skills Pedagogical skills Quality of teaching Internet Connections	Technical difficulties	
Scaffolding of activities is vital in the virtual learning environment. Absolutely. You cannot have an organic process as you would in class. You need to assume that most students will learn asynchronously and then you have to plan that learning journey.	R9	Developments	Educator's competencies. Educator's knowledge. Educator's approach. Educator's expertise. Educator's instructional skills. Pedagogical skills.	Educator's Skills and Expertise Teaching methods Support and training Educator's resources	D > 1 D > 1 D > 2 D > 4
Training, Satisfied. It could have been better, but let's be honest: for these platforms you learn by doing. A basic minimum of navigation and engagement is required and this training was provided.	R9	Developments Implications.	Educator's competencies. Educator's knowledge. Educator's approach. Educator's expertise. Educator's instructional skills Pedagogical skills. Time and Ease	Support and Training. Time management.	D > 3 I > 7
When training is done, they usually conflict with other important deadlines	34 R3	Implications. Developments	Time and Ease. Duties and training deadlines.	Time management. Educator's Skills and Expertise. Support and Training	I > 7 D > 1 D > 2
The time factor precluded in-depth training but there was support.	R2	Implications. Developments	Time and Ease. Duties and training deadlines.	Time management. Educator's Skills and Expertise. Support and Training.	I > 7 D > 1 D > 2

Educator, adequate support from your respective institution in order to effectively use the online leaning platforms in the virtual leaning environment. Satisfied. It could have been better, because it was assumed that everyone had a reliable high-speed connection and a strong device at home. Luckily, we were able to take work devices home	R9	Developments	Educator's competencies. Educator's knowledge. Educator's approach. Educator's expertise. Educator's instructional skills. Pedagogical skills. Quality of teaching. Duties and training deadlines.	Educator's Skills and Expertise. Teaching methods. Support and Training.	D > 1 D > 1 D > 3
Educator, adequate support from your respective institution in order to effectively use the online leaning platforms in the virtual leaning environment The time factor precluded in-depth training but there was support.	R2	Implications. Developments	Time and Ease. Educator's competencies. Educator's approach. Educator's instructional skills. Duties and training deadlines.	Time management. Educator's Skills and Expertise Teaching methods. Support and Training.	I > 7 D > 1 D > 1 D > 3
Recommendations to the learning program in Fashion Media Studies: Adopt a hybrid learning model. Don't underestimate the power of face-to-face instruction/pedagogy. There' a great need for experiential learning i.e. collaborations with industry. Better open source collaboration apps – all the good apps for work sharing and creative collaboration are few based and outside of scope of students and pinched university budgets I'm only involved with the higher certificate cohort. I believe that they can benefit from guest speakers and more application of knowledge. More industry collaborations. A strong portfolio of work should be	R9 R8 R7 R4 R1 R2		Educator's competencies. Educator's knowledge. Educator's approach. Educator's instructional skills. Pedagogical skills. Quality of teaching. Duties and training deadlines.	Educator's Skills and Expertise. Teaching methods. Support and Training.	D > 1 D > 1 D > 2

emphasised as a necessity from the onset and not only marked assessments but additional work that students have done in their own time as well.					
Online learning provides an opportunity for collaborative learning and activities for students. It is effective, but requires the facilitator to have strong Skills in online pedagogy and e-learning design.	R9 R1 R2 R3 R7 R9		Educator’s competencies. Educator’s knowledge. Educator’s approach. Educator’s instructional skills. Pedagogical skills. Quality of teaching.	Educator’s Skills and Expertise. Teaching methods. Support and Training.	D > 1 D > 1 D > 2

Appendix B: Final coding frame

Positive notion of perception. Self-discovery. Self-motivating. Self-control.	Communication. Collaboration. Engagement.	B>1 B>1 B>1
Positive notion of perception. Problem solving skills. Feedback.	Independent learning skills. IT skills. Training.	B>2 B>3 B>3
Information seeking skills. Social and Cultural knowledge. General or new knowledge. Staying updated. Social skills.	Knowledge creation.	B > 4
Different learning styles. Ease of use.	Diversity. Flexibility.	B > 5 B > 5
Negative notion of perception.	Self-confidence. Confidence in own skills.	I > 1 I > 2
Self-motivation.	Lack of Participation. Lack of Motivation.	I > 3 I > 3
Positive notion of perception. Self-discovery.	Lack of problem solving skills.	I > 4

Self-motivating. Self-control.		
Internet connections.	Technical difficulties.	I > 5
Comprehension.	Different learning styles.	I > 6
Negative notion of perception.	Teaching Methods.	I > 7
Negative notion of perception.	Time management.	I > 8
Development of Practices. Quality of Learning. Positive notion of perception. Educator's competencies. Educator's knowledge. Educator's approach. Educator's expertise. Educator's instructional skills. Pedagogical skills.	Teaching methods. Learning and teaching styles. Educator's Skills and Expertise.	D > 1 D > 2 D > 3
Development of practices.	Quality of teaching.	D > 4
Student IT training.	Skill development for students.	D > 5
Duties and training deadlines.	Student IT training. Skill development for students.	D > 6

SESSION 8: Physical spaces for 4IR functioning

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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

An educational interior design framework for promoting greater inclusivity of the aged living in multigenerational households

Shireen Govender, *Inscape Education Group*
Mary Anne Potter, *Inscape Education Group*

Abstract

Multigenerational households are inhabited by three or more generations cohabiting; however, homes are not always designed to accommodate multiple generations. Having been raised within a home filled with grandparents, aunts, uncles, cousins, parents and siblings, the personal experience of the primary researcher has been drawn on to frame the analysis of the challenges associated with multigenerational living. Multigenerational living requires functional spaces: space that efficiently includes all occupants to create a harmonious environment. As a prematurely ageing person with many physical challenges associated with degenerative spinal changes, the need for these spaces to be flexible and adaptable to changes related to physical and psychological development through age has been personally recognised. The understanding of the diverse physical and psychological needs of the users of the space features highly as a means of addressing how multigenerational spaces are designed. The paper follows both theoretical and functional standpoints. It draws on the social inclusion theory and empathic models to achieve a more in-depth understanding of people's motivations and spatial intentions. This understanding is then translated into a photorealistic interpretation via 3D renders to facilitate design decisions prior to finalisation of spatial plans and purchases. It highlights the use of the interior design 3D rendering process to extend existing interior design tools such as 2D sketching and physical samples. The 3D experience of spaces, as facilitated through technology, aligns with the characteristics of the fourth industrial revolution, where the merging of physical, digital and biological worlds is prioritised. Focusing on the potential interaction between generations, both as positive and negative experiences, this paper further aims to promote barrier-free living, self-care and aged care through design improvements and considerations. It takes the broad theoretical understanding gained from data collection methods, literary reviews, ethnographic and autoethnographic experience and serves as an educational function for both student, professional, and user usage when designing multigenerational households. The structure of the interior design guidelines for multigenerational living prioritises design for barrier-free living and self-care, with adjustment potential for changes associated with ageing by following an empathic educational model specifically designed for multigenerational households. This model provides an educational framework in the hope to alleviate anticipated tensions experienced in multigenerational households through interior design.

Keywords: Ageing population, inclusivity, interior design, multigenerational, social inclusion theory

Introduction

Aged living arrangements differ and are not always determined through choice but also through consequence. Whether through choice or consequence, multigenerational living is a reality in Africa. Based on statistics provided by Statistics South Africa (StatsSA, 2017), there has been a tendency for the aged to rely on family support. The move from a nuclear household that comprises a husband, wife, and children can move towards a single person living or multigenerational living as the need arises. The effects of COVID-19 show an increase in multigenerational living. Designers must design with the notion that we are designing our future selves as an empathic gesture. We are going to get old – this is one of our few certainties in life. “The grey burden” is the term used to describe the aging population (Harper, 2013). It is a term that could be received negatively depending on the personal perspective of the receiver.

As a design-focused study, the environments in which the aged live, and how and with what the aged interact within the environment, are prioritised. The research aimed to identify and highlight the value of interior design tools as providing an educational framework for both designers and users and also to consider how this framework may alleviate foreseeable tensions experienced in multigenerational households.

Multigenerational households defined

Multigenerational households are households that have more than one or two generations living under one roof. In the later years, a home is where most adults are destined to spend most of their time (Harper, 2013). It is in the best interest of the aging population of Africa to begin thinking of their future living environments in advance. Multigenerational living is one of the cohabiting options available to the aged.

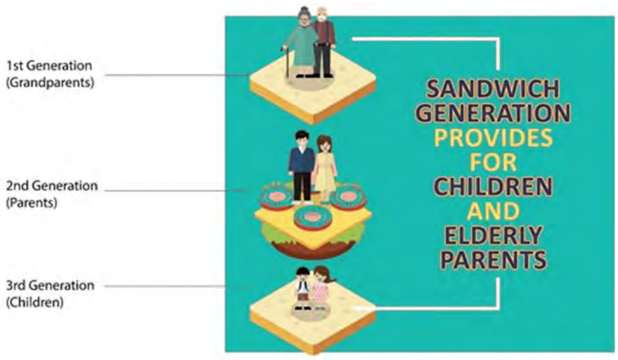

Figure 1: Structure within multigenerational households

Within this study, multigenerational households have been categorised as including grandparents (identified as first generation), parents (identified as second generation), also referred to as the 'sandwich generation, and children (referred to as the third generation) (Louw & Louw, 2019). It is understood that a grandparent could be as young as 40 or as old as 90. However, for ease of understanding, chronological ageing will be used.

Dependency tends to increase with age (Baltes, 1989). Physical and psychological decline increases reliance on others for the ageing population. As the ageing population become more dependent on the other generations within the household, there is a tendency for their 'voice' within the household to be relegated. It is the professional responsibility of designers to foresee these changes and provide sensible solutions to benefit all generations of the home.

Benefits of living in multigenerational households

Multigenerational living is challenging, but studies reveal the benefits outweigh the challenge (Williams, 2016). Some of the benefits are as follows:

Economic benefit

- Unemployment – 37.2% of the multigenerational households comprise the unemployed (Williams, 2016);
- Affordability – Students are staying longer at home for the financial benefit; and
- Shared resources – Sharing of food, rent, and utilities provide financial relief (Muenniga, et al., 2018).

Social benefit

- Companionship – the aging population have the benefit of having people around them;
- Intergeneration parenting – the second generation are aided with parental duties, for an example, fetching the children, homework, and general care taking (Louw & Louw, 2019); and
- Assisted living – the provisions of assistance during times of need.

Psychological benefit

- Security – Living alone provides a sense of security to all three generations.

Aims and objectives of research

The research undertaken identified gaps in theory and research concerning barrier-free living associated with self-care and aged-care. It used qualitative methods such as interviews and questionnaires, ethnographic and autoethnographic research. The aim was to explore the challenges of the aged populations living in multigenerational households and propose ways to improve the quality of living for all generations through design improvements and considerations through the creation of a harmonious environment. The research, therefore, had an educational function for design students and professionals whose interests were directed towards multigenerational living. The objective was to produce an interior design guide for designing multigenerational households through theoretical methodologies, and data collection sampling.

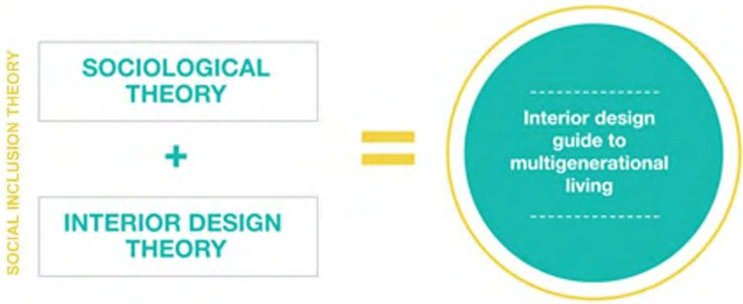

Figure 2: Approach from theory to outcome

Approach of study

A user-centred design approach was adopted, and qualitative methods used to collect data. A theoretical framework was developed in response to desktop research. Interviews and questionnaires were administered to first generation and second generation users of multigenerational living spaces. Medical professionals outside of the design field were also interviewed to draw on expertise regarding the experience of the aging populations. This data, coupled with ethnographic and autoethnographic knowledge, was used to formulate design guidelines to assist with designing multigenerational living spaces.

Limitations of study

This study intended to show merit for further exploration and investigation, as time constraints and low sample size. The practical validation of theories highlighted showed immediate results and, therefore, are intended to remain hypothetical and within the constraints of educational theory until the processes has been tried and tested. The proposed guidelines are flexible and customisable to the challenging circumstances for the household being designed.

The data collection method of interviews and surveys were intended as a self-reporting method which may be subject to participant bias. The proposed sample size further showed an underrepresentation of male participants.

Sample size of data collected

The following samples were drawn on for each data collection method:

1. Survey from first generation participants: 3
2. Interviews from first generation participants: 1
3. Survey from second generation participants: 6
4. Interviews from second generation participants: 1
5. Interviews with professionals
6. 1 x occupational therapist
7. 1 x professional caregiver in an aged care facility and nurse at a hospital in Pretoria.
8. Ethnographic and autoethnographic research of researcher.

Figure 3: Researchers experience in multigenerational households.

Based on the years of experience within multigenerational households, the reflective journey of the researcher served as an integral part of the data collection method.

Research methodology adopted within the study

For the researcher to conduct research using observations, perceptions and experiences, the interpretivist paradigm was used to conduct the study. The interpretivist paradigm allows for the collection of various and personal perspectives and a final interpretation of these perspectives by the researcher (Williams & Babbie, 2006).

Overview of research conducted

The study followed both theoretical and functional perspectives on ageing. Within the theoretical perspective, a theory was sought to help navigate the learning process within strict control measures in order to ensure authenticity. Ethnographic and autoethnographic research was a fundamental aspect of the study but had a risk of selective observation, illogical reasoning, and inaccurate observations (Williams & Babbie, 2006). Social inclusion theory was the moral and ethical compass identified and used.

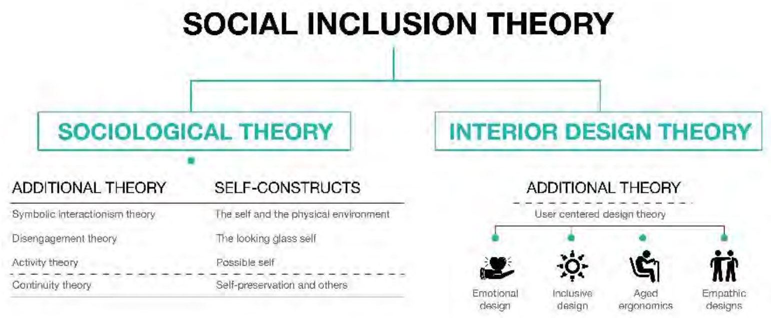

Figure 4: Breakdown of social inclusion theory

Sociological research

An understanding of sociological research played an essential role in the literature review. Before reviewing existing literature, the researcher needed to recognise the pitfalls associated with sociological research.

Science is not expected to centre on moral and value issues. It is based on facts and data. Sociology helps us understand what we observe in a scientific manner. Only after this understanding is achieved can we then use this understanding to formulate a solution (Williams & Babbie, 2006).

Selective observation, illogical reasoning, and inaccurate observations must be avoided during the data collection process (Williams & Babbie, 2006). 'Snapshot' views have been discouraged: this refers to once-off observations of users within multigenerational households.

Overgeneralisation and the assumption that personal experience is the same for all was a pitfall that the researcher had to be cautious of. The researcher had to be mindful of qualifying all observations to find patterns in behaviours of users within multigenerational living spaces and the challenges faced within the environment. As such, a strong theoretical foundation was developed to counter these two potential limitations, and the literature review provided the means through which this was achieved. Identifying challenges is the basis for finding solutions.

Social inclusion theory

This study is contextualised within the social inclusion theory, which refers to interior design and sociological contexts. According to *The Practice of Social Research* by Earl Babbie, social science combines logic and observation (Williams & Babbie, 2006).

Dan Allman expanded on the theory of social exclusion by David Pocock (1957) to include social inclusion from a sociological perspective. How people function within a society, and the need for inclusivity to benefit psychological satisfaction (Allman, 2013).

Social inclusion theory serves as a rational motivator towards creating a functional multigenerational living environment. Both theoretical and functional perspectives have been drawn on to formulate an educational framework for multidimensional living spaces.

Theoretical perspective on ageing – sociological theory

Objective 1: -
To explore literature and conduct field research to better understand the challenges faced by the aged population in South Africa.

Challenges experienced by the ageing populations are encapsulated within sociological theories and create a foundation for further exploration. The following approaches have been selected based on their expected contribution to the study. Each theory has also been equated with a self-construct related to the user-centred focus of the approach taken.

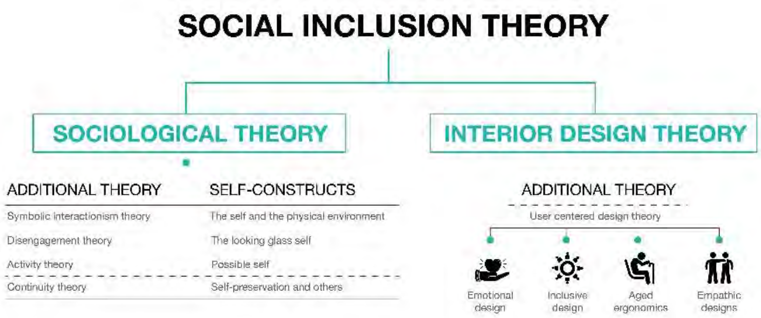

Figure 5: Breakdown of social inclusion theory

Symbolic interactionism theory
Self-construct: The self and the physical environments

The application of symbolic interactionism within this study provides insight into how people interact within the symbolic environment. The primary symbol is the home, and secondary symbols are the objects within the home. The user's interaction with the space in which they inhabit is essential in the design decisions of the space (Blumer, 2013).

As a designer, empowering people to take care of themselves and having environments that promote a self-care environment moves reliance from object-focused to people-focused. It reduces the risk of being a "grey burden" and the feeling of having to deal with the "grey burden" (Harper, 2013).

Disengagement theory
Self-construct: 'Looking glass self'.

Disengagement theory refers to the notion that it is expected for the ageing population to distance themselves as they reach the sunset years of their life (Coleman, 2008). It is the way the aged perceive themselves as they grow older. This suggests that the ageing population expect to be excluded. This expectation within a multigenerational living household may have negative connotations to the harmony within the home. A household that suits the needs of the ageing population will provide a contradiction to this theory. Even though the aged expect exclusion, the physical environment shows inclusion (Coleman, 2008).

Activity Theory
Self-construct: Possible selves

Activity theory, coined by Robert J. Havighurst, was a theory that responded to the disengagement theory. The importance of staying active in ageing and maintaining a strong social network contributes to a healthier and happier ageing life (Louw & Louw, 2019).

Activity theory feeds strongly into the self-construct of the possible self—the way a person wishes to be when they are older.

Ageing comes with the loss of family and friends. Deteriorating health issues also challenge social interaction. Economic challenges may also surface during this later stage of life. Promoting social engagement with interior design choices within multigenerational households will benefit the well-being of the ageing populations.

Continuity theory
Self-construct: Self-preservation and others

Continuity theory refers to maintaining lifestyles that the aged were accustomed to (Louw & Louw, 2019). This continuity addresses the importance of preserving the lifestyle but is criticised for not providing how this would be done. Within this study, continuity could be encouraged through the implementation of interior design theory. An environment that is adaptable to suit changes in mobility and spatial needs will promote continuity. A flexible custom fit environment will feed into the self-construct of self-preservation and others. Self-preservation will ensure that the aged maintain independence and are free of reliance on others.

Functional perspectives on ageing – Interior design theory

Objective 2:
To explore and conduct field research to provide guidelines on adapting multigenerational households in South Africa.

Interior design theory was selected to maximise design outcomes for the benefit of the ageing population. Literature on the user-centred design provided an extension to the views absorbed from the case studies via surveys and interviews. International gerontologist and industrial designer Patricia Moore's empathic model, the teachings of Donald A. Norman and the identifiable tension points and solutions exposed using the teachings of VUCA/VUCA 2.0 has been leaned upon.

Empathic model

User-centred design theory

User-centred designs place the users at the centre of the entire design process. The users are involved in design decisions and solutions (Norman, 2013).

User-centred design informed the process followed in addressing the problem on both a practical and theoretical level. The best way to explain user-centred strategy regarding the aged population is to look at it from the point of view of one of the people who was instrumental in coining the term. Donald A. Norman is an American writer, professor and director of The Design Lab in the University of California, San Diego. The now octogenarian is most known for his book, *The Design of Everyday Things*: a book regularly consulted by psychologists and designers at large (Norman, 2019).

In one of Norman's most recent online articles in *Fast Company*, he expresses his dissatisfaction with the designs created for the older generation. He passionately spoke about his active self that is also getting a little slower and a little weaker as he gets older. He speaks of how the older customers are an untapped market. Individuals that are willing and able to spend to make their quality of lives easier (Norman, 2019). He coined the term 'Crystalised intelligence', and defines this as intelligence that comes with age and experience (Norman, 2019).

Designs for the aged should be functional, aesthetically pleasing, and stylish. He promotes 'inclusive design', designs that takes everyone into account, as opposed to designs that stand out and point out incapabilities. If designed correctly, designs that are designed for the aged should be beneficial to people of all ages (Norman, 2019).

User-centred design, particularly in the ageing population, is as relative as age itself. The way a person handles ageing, and the concerns that come with it, is also relative (Louw & Louw, 2019). Progressive designing that can be adapted according to the bespoke needs of the aged is essential.

User-centred design has been described as design philosophy that begins with a solid understanding of the user and the user's expectations. The users' experience with the design is the decider of the good or bad design (Norman, 2013).

Design is not only about solving a problem; it should not start with trying to solve a problem but rather finding the core issue (Norman, 2013). For example, if an aged person complains that their legs are painful walking up the stairs, adding a rail may not solve the problem. It may be a medical condition that requires medical assistance.

A rail or a stairlift may assist in providing mobility, but the designer needs to understand the user's expectations. By adding a stairlift or a railing, does the user expect to have no pain at all or merely to enjoy the view from the top floor?

Emotional design

The human factor in multigenerational living is fundamental in creating a harmonious environment. Norman (2013) states:

> *Emotions are inseparable from and a necessary part of cognition.*

Norman – a researcher, writer, and designer – professed that emotion and design could not be separated. Feelings are connected to designing (Norman, 2013).

The social self-constructs and emotional designing provide an understanding of user behaviour of the ageing population. Therefore, this study intended to encourage a sense of the self and confidence in the connection to the self, leading to empathy for others.

Inclusive design

Multigenerational living needs to cater for the needs of all the users of the household.

Aged ergonomics

Ergonomics refers to the design of spatial environments and products concerning the intended use to ensure efficiency and safety. (Merriam-Webster, n.d.)For example, the dimensions of the human fingers when designing a glove. The following are recommendations made by experts in the care of the elderly:

- Ergonomics for the aged must be tailored to suit the individual. There are not many instances of spaces and products that have "one size fits all" solutions;
- Ergonomic seating ensures both comforts and allows for inclusions within households. Sofas and chairs with high backs, lumbar support, and comfortable cushioning that is firm and encourages correct posture are advisable. Low seating and chair that do not have armrests should be avoided;
- Accessibility is key. Placing needs and wants within proximity of the aged will provide added comfort and reduce mobility challenges. Objects placed in places that require the aged to bend down or stretch should be avoided;
- The capabilities of the aged should be considered when purchasing products. Items that require added strength must be avoided due to the medical challenges faced by the aged; and
- It is modifying existing furniture and objects to adapt to growing needs instead of bespoke items, usually at a higher cost (Meigs, 2018).

Empathic design

Empathic design refers to understanding the user's emotions and subjective experiences (Gibbons, 2018). The empathic design relies on the ability to analyse the user using signifiers. Signifiers refer to signposts that exist beneath what is just said and is specifically related to semiotics, as proposed by Ferdinand de Saussure. The researcher is required to look at significant words that provide a greater understanding of the needs and wants of the user (Batagoda, 2017).

Empathic designing within the ageing population context is crucial in understanding the user and their needs. Design empathy is a design tool necessary in conducting both ethnographic and autoethnographic research. It extends the designer's obligation to include design decisions that promote empathy between the different generations.

Multigenerational challenges as identified from data collection

Common threads, pain points and anchor points – as identified from surveys, interviews, ethnographic and autoethnographic data – are as follows:

- Economic factors left little or no room for interior design as such;
- The bedroom under the staircase left no room for privacy even though it was closer to the bathroom;
- Stricter care of medication and meal provisions;
- Grab handles are rejected due to them being portrayed only for the aged, universally designed features may be more acceptable;
- Necessary essentials like umbrellas, garden wear, hats, and jackets should be easily accessible;
- Night visibility should be increased;
- Climbing up and downstairs;
- Inserting and removing meals from the oven;
- Hanging out washing;
- Inserting and drawing meals from the oven;
- Difficulty in removing laundry from washer;
- Exhaustion after bathing;
- Bending to pick up items;
- Not finding items when needed; and
- Personal grooming due to ailments.

VUCA/VUCA 2.0

VUCA aligns strongly to social inclusion theory and neatly organises the tensions with possible solutions, according to Bill George from Harvard Business School's response with VUCA 2.0.

The tensions in multigenerational households, according to Caredda (2020), are as follows:

- Volatility
- Uncertainty
- Complexity
- Ambiguity.

As the family dynamics change and evolves, so does the role-play between the different generations. These role changes could easily result in a volatile environment should the role be reversed due to consequences beyond one's control like unemployment or ill-health. It could result in uncertainty over duties and expectations. One of the first generational participants mentioned how tension set in once the two younger children could no longer share a room. The first generational participant felt conflicted, happy to have the companionship, while disappointed at the loss of privacy.

In response to VUCA, VUCA 2.0 was positioned by Bill George, Harvard Business School (Caredda, 2020), as encapsulating:

- Vision
- Understanding
- Courage
- Adaptability.

Technology has, therefore, recently played a vital role in reducing predictable tensions in home renovations. Envisioning a design outcome using technological resources proves beneficial in simulating design ideas through photorealistic 3D renderings. 3D renderings can showcase ideas and get approval from the various members of the household before incurring any costs. These visuals remove the risk of assumptions and provide visual reference points for design concepts. It allows the various generations to make risky suggestions, with the comfort of knowing that finalising decisions is limited to paperwork and not subject to significant cost implications. 3D renderings assist in adapting spaces in a digital format for approval before finalising decisions.

Multidimensional solution for multigenerational living

The learning combination of the theoretical and functional perspectives positions a multidimensional solution as an educational framework for designing multigenerational living spaces. A multidimensional proposition involves understanding sociological aspects associated with multigenerational living, with physical needs of multiple generations sharing a single living environment.

Using the acronym MSML, this empathic model is being proposed as encompassing the following values:

User-centred design

User-centred design, particularly in the ageing population, is as relative as age itself. Designs with multigenerational households must be customised according to the needs of that household.

If a designer's services have been engaged, there is usually a reason for this engagement. Indecisiveness, time constraints, economic limitations, pre-existing tensions could be reasons for consulting a professional. As a professional, understanding the designer's role and executing that role professionally is vital in creating a harmonious setting within a multidimensional household.

Inclusivity

Due to the dynamics that exist between generations, using design solutions that promote inclusivity is necessary. For example, solutions could include a dining area that provides seating to meet the needs of all members of the household.

Usability

The designer should propose design elements that are user friendly for all generations. For example, a mirror with a tilt function will serve someone in a wheelchair and someone attending to their grooming necessities.

Self-care

Promoting self-care encourages independence and reduces tensions caused by dependence.

Empathy

Design decisions that promote empathy between the different generations are vital. Finding a balance between shared and private living areas is one of the ways to encourage kindness. It is respecting the need for privacy without compromising on the need for inclusivity.

Predictability

Designers need to predict foreseeable tension points among the generations.

Respect

As mentioned earlier, living spaces are personal and require a personal approach. Maintaining professionalism as designers is key. Even though a personal approach is required, personal involvement in family affairs must be avoided and family boundaries respected.

Adaptability

Designers should provide adaptable solutions for emotional, psychological, and physical growth: not just the changes expected within the ageing population, but also growth among all family members in general. Multigenerational households, therefore, become a multidimensional evolving design project.

Design solutions that promote self-care are imperative—self-care not only from the perspective of the aged but from all the generations. An organised environment with a place for everything will reduce tension points.

Compromise

Designers should respectfully find compromises among family members: using technology not only to sell the concept but, more importantly, the realise the vision of all the users of the space. This may require many spatial rearrangements and material changes. Technology – that is, 3D renders – assist in finding that compromise before incurring costs of construction. The conversation of, for example, discarding an old piece of furniture may go easier if supported by a visual representation of what the space would look like with a mixture of the different styles of furniture.

Selling vision – not design

Designers are selling a vision and not just selling designs. Multigenerational spaces are personal; therefore, tensions arise when members of the households handle the conceptualisation of these spaces by themselves. Design decisions go much smoother when facilitated by a professional. Using design tools, design professionals can encourage collaborative conversations that will showcase the needs and wants of the users of the space visually before finalising any design decisions.

Patricia Moore, a gerontologist and industrial designer, speaks of revisioning, advocates for seeing change as opportunities (Moore, 2015). Projecting proposed spatial changes visually for the approval of all participants within the household reduces dynamic tensions usually associated with change.

Conclusion

Social inclusion theory, VUCA/VUCA 2.0 and the empathic model have enacted theoretical and functional perspectives in designing multigenerational living spaces. The use of design tools, such as 3D renderings, facilitates design conversations between the various generations and formalises the design visions for the area before finalisation. The proposed empathic multidimensional solution for the multigenerational educational framework highlights key touchpoints for designers, design students, and users of multigenerational spaces to alleviate dynamic tensions often associated with multiple generations living under one roof. As design professionals, knowing that we are designing for our future selves serves as the motivator in designing respectfully and responsibly, guiding both designers and users through an educational framework that is multidimensional and adaptable.

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DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

The role of student-staff partnership and collaborative learning in interior design education

Alexandra Balkanska, *Greenside Design Centre*

Abstract

This paper aims to propose and motivate further research in the sphere of Interior Design education in a private college environment in South Africa. The study focuses on finding strategies that motivate for student-staff partnership and collaborative learning in the theory subject of Critical Studies (CS) within a hybrid/online learning environment. The discussion takes the reader on a journey of analysis and discussion starting with traditional method of education and alternative pedagogies; the value of critical thinking skills in the twenty-first century and research based-education. The emphasis is on Critical Theory in Higher Education (HE) as a valuable drive in stimulating self-reflection that produces graduates that are contributing members to our society.

Furthermore as we approach the fourth industrial revolution (4IR) as well as the present challenges we face in the midst of a pandemic, educators need to re-evaluate current methods of lecture delivery especially when hybrid/online learning is fast becoming the 'new normal'. The focus remains on learning rather than just teaching. Student-staff partnership, collaborative learning, and reciprocal peer tutoring (RPT) are identified as potential strategies that may be used to engage and stimulate students. The author of this paper is also the researcher and a practising academic in the field of Critical Studies in a private college environment.

The inquiry relies on developing pilot lectures informed by interviews with colleagues and conducting focus groups with students in an effort to identify recurring themes and strategies that maybe used in order to develop ways of integrating student-staff partnership and collaborative learning within a hybrid/online learning environment. Those will be implemented during academic year 2022 (Second Phase). Throughout this process, it is important to note that students are continuously involved and consulted.

Keywords: collaborative learning, critical thinking, radical pedagogy, reciprocal peer tutoring (RPT), research equals teaching (R=T), student-staff partnership

Abbreviations

AUB	Arts University Bournemouth
CS	Critical Studies
4IR	fourth industrial revolution
GDC	Greenside Design Center
HE	Higher education
HoD	Head of department
ID	Interior Design
OEB	Online Educa Berlin
PP	PowerPoint
R=T	Research equals teaching
RPT	Reciprocal peer tutoring
TUTS	Tutorials

Introduction

Since the 1784 industrial revolution, often described as a development and in some instances a 'revolution', has radically changed society and the way people live on a daily basis. Currently we live and move towards the fourth industrial revolution of cyber-physical systems. According to Online Educa Berlin (OEB), the annual global, cross-sector conference and exhibition on digital learning and training, a digital revolution has remodelled the way people and especially youngsters "access information, communicate, learn and even play" (OEB Insights, 2019, p. 1).

According to Klaus Schwab (2016), the founder and executive chairperson of the World Economic Forum, humanity is about to enter unprecedented times of radical change. In his article titled *The fourth industrial revolution: What it means, how to respond,* he argues the effect on all industries will be unparalleled. One such industry is education.

Education and the fourth industrial revolution (4IR)

Advancements in technology and the potential of billions of users having access to smart devises with unlimited access to information and the internet are some of the concerns in the sphere of academia. How is that affecting teaching and learning in a world of fast development and infinite possibilities? How do we adapt our current methods of lecture delivery in order to empower and support a future generation of leaders and proactive citizens?

This progress also comes with exciting new opportunities for the education system to change and adapt with a possibility of attracting a wider and more varied audience. With online and hybrid learning students are becoming more proactive and in charge of their own education. At the same time, it is important for educators to provide the right tools and strategies in order to facilitate this transition (OEB Insights, 2019).

In my professional capacity as a lecturer, I have witnessed this transformation already been enforced by the COVID-19 pandemic as most institutions are currently implementing online and/or hybrid learning. As the world is moving forward, education has an important role to play and although that may be true, many would argue that radical change calls for radical methods. Is it time to finally forget about traditional pedagogies and radically transform the educational system, from syllabus, lecture delivery, and grading? This paper focuses on exploring new ways of lecture delivery that may be more fitting to the current challenges faced with hybrid/online learning such as student interaction and participation. The focus remains on the importance of teaching theory to Interior Design students as a way of developing critical thinking skills.

Traditional method of education

The traditional teaching approach at university level relies heavily on lecture delivery. In this case there is a lecturer (one person) instructing a passive audience (students). Also known as the instructional method of education, a type of pedagogy, which assumes that there is a "fixed body of knowledge" that learners accept, memorise and reproduce (Khalid & Azeem 2012, p. 172). Activities such as student interaction, questioning, critical and independent thinking are discouraged and very often completely ignored due to time constraints (Khalid & Azeem, 2012).

As claimed by Braa & Callero (2006) this approach to education can only lead to passive, easily manipulated, and apathetic society. Furthermore according to research published by MIT's Media Lab, student's cognitive function is practically absent during lectures, equating it to sleep time (OEB Insights, 2019). Consequently, professionals in the field of education have been looking for the right strategies and answers in order to counteract and address the above.

Student-centred classrooms and collaborative learning is one such approach. It encourages peer and tutor interactions and as a result stimulates independence of thought, meta-cognition and critical thinking. However, have those been critical or radical enough to mirror societal changes and needs? More importantly, how do we adapt and implement those strategies to *online* and *hybrid learning*?

Alternative pedagogies: from teaching to learning

Education and learning in a postmodern world are not about transmitting knowledge to a passive audience who is expected to memorise and transmit the information acquired. Educators need to acknowledge the postmodern world of today and the ramifications this may have on creating a learning society (Jarvis, 2006). Creating a *learning society* is paramount to the wellbeing of a country, and higher education (HE) is at the centre of a learning society (Wildman 1995). We need intelligent, confident, independent, and *critically thinking graduates* who will defend democracy and the commonwealth (Marginson, 2016).

Postmodern theory questions traditional knowledge and authority upon which a traditional classroom is based (Jarvis, 2006). Currently we are experiencing a radical transformation from teaching to learning and a shift of control from the educator to the student (Marcum, 2006).

Critical or radical pedagogies is one such approach which aims to empower learners by interrogating "traditional forms of social and political oppression" (Jarvis 2006: 53). The aim of a classroom is to stimulate a conversation and to encourage student interaction and deep self-reflection. For this to happen, the traditional role of educator and learner is challenged, and the educator in this case is in no position of power, but is rather seen as a facilitator (Jarvis, 2006).

Critical theory in higher education

According to Dell'Angelo, Seaton and Smith (2012, p. 1) Critical Theory is concerned with matters of "inequality and oppression" and strives towards achieving social change in an effort to build a more equitable world. Power imbalances are understood through debates and communication in order to involve people from all walks in life to participate actively in an effort to achieve empowerment and drive social change (Dell'Angelo, Seaton & Smith, 2012).

Unfortunately in education we have continued to re-establish the same kind of circumstances that Critical Theorists question and insufficient progress has been made. According to the authors, we need to reconsider both the curriculum and ways of teaching or pedagogues (Dell'Angelo, Seaton & Smith, 2012).

We should rather strive for democracy in education where teachers and students work together and students are equally valued. Educators in this case encourage students to self-reflect, and understand their position in society in order to become active drivers for social change (Dell'Angelo, Seaton & Smith, 2012).

Critical thinking

Educators should aim to encourage critical thinking in their classrooms, as it can be applied to any subject or activity, "Critical thinking is clear, rational, logical, and independent thinking" (Global Digital Citizen Foundation, n.d.). Critical thinking is also analytical, has a purpose, and encourages self-reflection. It involves problem-solving and making clear non-partial judgements. The aim of critical thinking in education is to leave students empowered, being able to argue objectively various theories, and feeling like experts in a field (Ritola, 2012).

Ways of stimulating critical thinking, life-long and independent learning:

> *A. Collaborative learning can be recognised in both peer and tutor interactions. "By regulating peers' learning and cognition, students question, reconstruct, and control their own cognitive processes and strategies" (De Backer, Van Keer & Valcke 2012, p. 560).*
>
> *B. Reciprocal peer tutoring (RPT) is a kind of collaborative learning which aims at gaining "knowledge and skills" while working in small peer groups. The authors distinguish two important roles, that of the tutor and the tutee (De Backer, Van Keer & Valcke, 2012, p. 562).*

James (2017) speaks about the importance of research in higher education in helping to develop competent professionals of the future. By learning about research, students become proficient in problem solving and making sound judgements based on evidence. In other words, research cannot be made exclusive to students who only want to pursue a career in academics. Also, people learn best by doing and giving students real life problems closely related to various communities can also prove beneficial (James, 2017).

Research-based education

According to Tong (2018, p. 5), "research-based education" is an ongoing topic in higher education that brings together various discussions about the practice of teaching and learning. The aim of research-based education is to empower learners to become independent thinkers and creators by encouraging student and staff collaboration. Students are seen as "partners" (Tong 2018, p. 5) and equal contributors to knowledge.

The author advocates research equals teaching (R=T) approach to higher education (HE) where learning is seen as the link between teaching and research, student and staff. In the process, students are seen vital to giving feedback and shape HE to move beyond the traditional classroom. Lecturers are motivated by their students and see the sharing of experience and knowledge vital in developing more efficient teaching methods (Tong, 2018).

In their publication, Tong, Lauren, Clark, Standen and Sotiriou (2018) discuss ways student-staff partnership and research-based education can inspire change. In fact the authors view student-staff partnership as being "instrumental in inspiring change" especially when dealing with research-based education and (R=T) leadership (Tong, Lauren, Clark, Standen & Sotiriou, 2018, p. 314).

According to the authors, students and staff should work together as equal partners, while researching, creating, and exploring. There are many obstacles in achieving this change, one being resistance to change both from staff and students. Educators who have not previously worked with students and are not aware of their potential may feel that students are inadequate and unable to make meaningful contribution. While students may feel intimidated by having to work with staff and see themselves as less capable and intelligent (Tong, et al., 2018).

The authors conclude of the importance of involving students in research, as it will teach them the process and the value of research. At the same time, it will give students an opportunity to make valuable contribution towards generating new knowledge. Furthermore, the emphasis remains on problem solving, "teamwork and collaboration" as a way to better prepare students for entering the workforce (Telfer & Oliver 2018, p. 247). The authors also speak of the term "double-looped learning" which is learning from making mistakes (Telfer & Oliver, 2018, p. 247). R=T can be seen as a strategy and drive at instigating change in HE pedagogy.

Student-staff partnership

Clark (2018) reflects on her enriching experience with research-based education as a student, an approach to education she considers life altering. She speaks about ‘praxis’, a practice that involves “theory, action, and reflection” (Clark, 2018, p. 87). Some of the benefits of this kind of education include "increased retention of knowledge, development of research skills and preparation for the workforce” (Clark, 2018, p. 88).

Most importantly research-based education inspires students and educators "to question the traditional power dynamic in education" (Clark, 2018, p. 88). The focus is on the student, and creating a "more equal dynamic between staff and students” (Clark, 2018, p. 89). The aim is to involve students in the production of knowledge and research, and discourage passive accumulation of knowledge. This will lead to empowerment and taking control of their education, instead of simply accepting it as a given (Clark, 2018).

Mistakes remain part of this process and even prove essential to learning. Student-staff partnerships are seen as beneficial to both parties. Furthermore, students involved in research-based education were more "empowered to take on leadership positions and challenge the status quo" (Sharp, et al., as cited in Clark, 2018, p. 94).

Staying critical at all times remains important especially in a world overwhelmed by information. As a result, critical pedagogy has a big role to play in HE. This will inevitably involve a radical change of thinking in the way things are done in HE by both staff and students. In her article Marie (2018) talks about the value of research-based education and student-staff partnerships in strengthening student learning. A process that is known as R=T. Research-based learning centres around students as "active participants" during the research process and work together with educators in a partnership (Marie, 2018, p. 30).

Both research-based education and partnership question traditional education methods and the relationship between staff and students. At the same time, both processes are consistent with the "concept of participatory democracy" were citizens are encouraged to take part in making serious decisions. Which in turn challenges the power of the elite (Marie, 2018, p. 34).

Research-based education also involves critical thinking and helps students cope with challenges and make decisions in the real world. Both research-based education and student-staff partnership increase student ambition, inspiration, and self-assurance. It also encourages students to do some self-reflecting and mature as adults. It involves working with local communities and developing a social conscious (Marie, 2018).

Problem statement

The importance of developing critical thinking skills and independence of thought empowers students and may results in graduates who have the potential to become contributing members of our society. Although most view learning in the Arts and Design as "experiential" (Gray & Malins, 2004, p. 1), as people learn most effectively by doing, both practice and research are powerful tools that can be used in tandem to stimulate deeper learning and reflection.

As the world is moving towards the 4IR, and perhaps even enforced by the current pandemic, education has been compelled to make changes and adapt to a hybrid-learning environment. How do we ensure that educators adapt their lecture delivery methods in order to reflect those changes and provide an environment for their students that is critical, engaging, and stimulating?

The paper focuses on the subject of Critical Studies (CS) as a potential forerunner in investigating and potentially implementing changes. A theory subject required for the completion of a Bachelor degree and part of the syllabus for all three years of studies.

The question that is being asked is how to encourage student interaction and participation when facilitating the theory subject of CS within a hybrid/online-learning environment in the ID department of a private design college (GDC) by applying collaborative learning, reciprocal peer tutoring (RPT) *and* student-staff partnership*?*

Aims

- To explore and critique collaborative learning and RPT within a hybrid/online learning environment of a private design college;

- To identify ways in which student-staff partnership, collaborative learning and RPT can be implemented successfully within a hybrid/online learning environment of a private design college; and
- To further investigate the potential connection between *student engagement and class interaction* within a hybrid/online-learning environment that encourages collaborative learning, RPT, and student-staff partnership.

Objectives

A. Primary data collection (2021):
   1. Private interviews with colleagues (October 2021)
   2. Preliminary focus groups with students (October 2021)

B. Second Phase: Pilot lectures and observations (academic year 2022)
   3. Surveys with students (academic year 2022)
   4. Focus groups with students (academic year 2022)

C. Data analysis

D. Method of triangulation

Research methodology

According to Gray & Malins (2004, p. 3), "practice-led or practice-based research" is still grounded in sound research practices and yet affords some flexibility especially needed in the fields of art, design, and teaching. This research proposal follows a constructivist paradigm of enquiry identified by a:

> *'[R]elativist' ontology (multiple realities exist as personal and social constructions) and the epistemology is subjectivist (the researcher is involved); and as a consequence, methodologies are hermeneutic (interpretative) and dialectic (discursive) (Gray & Malins, 2004, p. 19).*

Here the practitioner becomes the researcher having identified issues fostered by practice that become the starting point of this kind of research. Therefore, subjectivity using this kind of paradigm is acknowledged, and transferability is not the main goal or the end result (Gray & Malins, 2004). The advantages of the practitioner-researcher as defined by Gray & Malins (2004, p. 23) are extensive, from "insider-knowledge" to "enquiring as a reflective practitioner" and the possibility of "self-evaluation and self-improvement"

Furthermore, according to Hofstee (2006, p. 127) action research or "participatory research" as a "form of research whereby the researcher actively involves the participants in order to solve a problem or achieve a learning objective". The point of this kind of research is to turn "participants into co-researchers" (Hofstee, 2006, p. 127). The author further encourages the use of this kind of research in a small group classroom setting similar to the context and case study that was chosen.

The focus of this research is on the practical and a case study approach of teaching theory to Interior Design (ID) students in a private college environment, where the author of this research teaches Critical Studies (CS) to first and second-year Interior Design students. Classes are small between 30 and 40 students per class that make it appropriate for this kind of practice-based and participatory research.

The research relies on developing pilot lectures with a focus on student-staff partnership, collaborative learning, and RPT that are applied to first and second-year Interior Design students taking the theory subject, Critical Studies (CS). Pilot lectures are carefully planned, informed, and developed from private interviews with colleagues, a preliminary focus group with students and secondary data analysis prior to commencement of the study in 2022. Over the course of one academic year in 2022 pilot lectures are implemented, primary data collected, stored and analysed (Second Phase).

At the end of each term (eight weeks), a student survey and focus groups with students are conducted. Parallel to the above the researcher aims to conduct class observations, in order to identify certain patterns of behaviour such as participation in class discussions and display of critical thinking. Data is collected, stored, and analysed accordingly.

A colleague who teaches third-year CS in the ID department has agreed to participate in the study by applying the pilot lectures, student surveys, and focus groups at the end of each term. Provided those are discussed, evaluated and applied to a third-year level prior to commencement of academic year 2022. That may provide a sense of objectivity to the study and maybe another angle that may not be observed by the researcher.

The proposed methods of this research are inherently qualitative using the method of triangulation, i.e. collecting and analysing primary data from pilot lectures, observations, student surveys, and student focus groups.

Target population

The target population comprises most students between the ages of 18 and 21, as well as five fellow lecturers identified for their interest and experience in student-centred classrooms and research-based education. The researcher has access to both parties and an agreement to conduct the research.

Ethics in research

Fundamental principles of research ethics that are considered include consent, anonymity and confidentiality, right to withdraw, vulnerability, and debriefing. All participants (students and staff) are required to sign ethics form informing them of the aim and objectives of the research as well as the ways the research will be conducted. The researcher, who is also the lecturer, has applied for approval from the institution to go ahead with the study that provides access to primary data collection. Focus groups and surveys involve all ID students from the first, second and third year, ensuring justice and fairness.

Sources

Interviews with colleagues, 2021

In order to develop pilot lectures with a focus on student-staff partnership, collaborative learning and reciprocal peer tutoring (RPT) that can be used towards generating reliable and dependable research that answers the main research question, personal interviews with fellow lecturers were conducted in October 2021, digitally recorded, transcribed and stored safely (Appendix A).

Here is a complete list of interviewees (five in total):

Marina Hendricks, architect, lecturer and HoD of the ID Department at GDC; A supervisor to honours students, research report fourth year). BA Honours in Psychology.

Suzanne Erasmus, artist, senior lecturer for CS first and second-year Graphics and Multimedia students at GDC; a supervisor to honours students, research report (fourth year) and in charge of the CS department at GDC.

Rhett Martin, artist, lecturer in the Design Thinking & ID Department at GDC; a supervisor to honours students, research report (fourth year).

Steffen Fischer, architect and lecturer in the ID Department at GDC, third-year CS lecturer; A supervisor to honours students, research report and studio (fourth year).

Franziska Conrad, senior lecturer in design, course leader for the BA and MA Design and Innovation, School of Arts, Design & Architecture, Arts University Bournemouth (AUB)

Preliminary focus group with students, 2021

Separate online focus groups with ID1, 2 & 3 were conducted on 30 September (ID2) and 15 October (ID1 & 2) with about 70% participation. All sessions were recorded, transcribed and stored safely. The discussion was about students' experiences during online/hybrid learning throughout the last academic year. Appendix B was used as a rough guide in guiding the discussion. Students were engaged, and appeared interested in giving their feedback. What needs to be acknowledged, however, is that although there was good attendance, not all students participated actively in the discussion. Similar to the classroom experience throughout the last year.

Pilot lectures – second phase

Based on the interviews with colleagues, preliminary focus groups with students and secondary data analysis, pilot lectures were developed and used as one of the main sources of data collection with an aim of answering the aims of the research.

Over the course of one academic year (2022), pilot lectures are implemented with an aim to create a classroom environment that encourages critical thinking, class participation, teamwork and collaboration. Students are empowered to learn and become in charge of their own education by being actively involved in the process of teaching and learning.

As previously mentioned the pilot lectures are shared with another colleague responsible for third-year CS who has agreed to participate in the study. In this way, the researcher can ensure transferability of this kind of lecture method, as well as objectivity in data analysis.

Focus groups with students – Second phase

The same process as seen above is repeated at the end of each term in 2022. The aim of the focus groups at the end of each term in 2022 is to gather student feedback and/ or any other student input regarding this method of education.

Student surveys – second phase

Digital student surveys are conducted at the end of each term in year 2022 using Google Forms. The purpose of those surveys is to ensure that each student can express an individual opinion regarding this method of education. In order to ensure confidentiality and encourage honesty in replies, the surveys are anonymous. Those consist of both specific and open-ended questions in order to ensure students are given a voice and are seen as a vital part to the research (Appendix B).

Observations – second phase

During the pilot lectures in terms 1, 2, 3, and 4 (academic year 2022), the lecturer who is also the researcher will observe, note and analyse student behaviour in terms of attendance, critical thinking, problem solving skills, class interaction, teamwork, and collaboration.

Analysis and discussion

Educators need to assume a more practical approach to theory education based on project based learning and student-centred classrooms where students are empowered to take charge of their own education. Furthermore, integrating collaborative learning & student-staff partnership may be even more successful in preparing confident learners who are resilient in the future work environment.

The following discussion was generated after conducting interviews with colleagues and separate focus groups with students (ID1, 2 & 3). A framework for facilitating the subject of CS was developed (Appendix C) which provides the foundation for developing pilot lectures commencing in 2022. Those will be moderated by the HoD of the ID Department, Marina Hendricks, a third-year lecturer for CS, Steffen Fischer, and studio lecturers in the ID department at the beginning of academic year 2022.

The main concern with online/hybrid learning is the struggle with student engagement. It is agreed that theory can indeed be taught mostly online and lectures recorded. "Theoretical subjects are advantaged by online learning. However, I don't know if some of the students are viewing all of this. They are very often on their phones, so are they even looking?" (Colleague D). Switching on cameras can help, but most lecturers do not enforce that for now. Students acknowledge the above along with some of the advantages with online learning like being able to "interact with people around the world, as well as you can always go back and re-listen to the lecturer if you have missed anything" (student).

It is important to consider students' mental health, especially when they "are constantly glued to their screens, and there is no disconnect" (Colleague C). Many struggle with "lack of motivation, depression, anxiety" (Colleague B). We can force students to switch on their cameras, however, that brings about other issues such as social anxiety (Colleague B). Both students and lecturers were in agreement that **regular site visits, group work, and guest lecturers may help address some of those concerns.**

On the subject of collaborative learning, most colleagues agree that the strategy extends beyond the classroom, i.e. it includes various lecturers and departments, as well as encouraging lifelong learning. At GDC, we have the 10% initiative community project, where students get to collaborate with their peers from various departments and years for a period of four weeks and work on a real life community project. **Perhaps for the subject of CS, we can offer more of that hands-on community engagement, that is more aligned to research?**

There needs to be a **gradual transition** from year one to three, perhaps this kind of student-staff collaboration is reserved for mature students, year three to honours. And if that is aligned to a specific local context, students and staff may collaborate in order to generate research on relevant and engaging topics. Year one and two primary focus lies in mastering academic writing including essay writing, referencing, understanding the theory, deductive reasoning and visuals analysis. In year three, students are given the freedom to explore their interests and apply their knowledge in a more practical manner.

On the subject of **collaborative learning** all colleagues acknowledged the value of group work and peer review. They also implement those strategies to their teaching and the assignments given in class. For example, the final essay submission was sometimes peer reviewed, where students assess each other's work (Colleague A). The essay exchange prior to submission was also appreciated by students.

Although student-staff partnership was generally not applied, it was agreed that it is a valuable tool to use during hybrid/online-learning. "I definitely think it would be something interesting to do in the future, it could promote thinking about theory and practice…the practical component … is where learning happens" (Colleague C). Also, students and lecturers can help each other in potentially publishing papers that deal with local issues, and that in turn "creates an interesting relationship between staff and students, students will feel more involved in the class than what it is right now…showing students something real, that relates to their lives" (Colleague C).

Conclusion

The approach of the 4IR offers unprecedented opportunities in many professional and non-professional spheres. One such affected industry is tertiary education. With the continuous pressure from industry for more proactive, critically thinking, and employable graduates we as educators need to ask the question, are we still providing the best learning environment and hybrid platform for our learners?

The primary aim of the above research was to come up with strategies that support both students and staff within a hybrid/online learning environment. With a focus on student-staff partnership, collaborative learnin*g* and reciprocal peer tutoring (RPT*)* within the theory subject of Critical Studies (CS)*.* The study concludes with a framework for facilitating the subject of CS in the ID department of a private design college (GDC), for 2022 (Appendices C and D):

- Shorter lectures;
- Cameras on for the first 15 minutes and during presentations;
- Class discussions (actively engage with the lecture content);
- Use more visual examples from various sources (images, videos, movies, interviews and examples from social media);
- Mini weekly deadlines;
- Teamwork – group projects and presentations;
- Flipped classrooms;
- Miro;
- Site visits;
- Guest lecturers; and
- Learning from mistakes.

The study proposes pilot lectures developed by conducting interviews with fellow colleagues and focus groups with students in order to identify recurring themes and strategies that maybe used to develop ways of conducting lectures within a hybrid/online-learning environment. The **Second Phase** to be conducted during academic year 2022 (terms 1, 2, 3, and 4) having collaborated with the HoD of the ID department, Marina Hendricks, Steffen Fischer, the CS lecturer for third year, and studio lecturers. It is important to note that students are continuously involved in the research process with the help of digital student surveys and more focus groups as discussed in the Methodology section above.

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Appendix A: Interviews with colleagues

1. Name, position, and department
2. Years of experience in higher education
3. What strategies do you use in order to encourage student participation and engagement in a hybrid learning environment?
4. What strategies do you use in order to challenge students in a hybrid learning environment?
5. What is your understanding of student-staff partnerships and collaborative learning?
6. Do you use the above strategies in your lectures and if yes, provide more explanation?
7. In your opinion, would you say we need to implement more of those strategies when teaching theory in a hybrid learning environment?
8. What are some of the challenges that you have experienced with hybrid learning?
9. What are some of the advantages?
10. Do you encourage students to learn from their mistakes? Do you feel you have sufficient time to allow for that?
11. Any other comments?

For each statement given below, circle the number that bests describes your opinion.

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

1	The objective of the course was made clear at the start of the term.	1	2	3	4	5
2	The content and structure of the course did accommodate that objective.	1	2	3	4	5
3	I feel encouraged to participate in class discussions and respond to others.	1	2	3	4	5
5	Lectures kept me adequately engaged in the subject of the course.	1	2	3	4	5

6	Lectures made me feel adequately challenged by the subject of the course.	1	2	3	4	5
7	I see the value in peer review and collaborating with my fellow students.	1	2	3	4	5
8	Making mistakes is part of the learning process.	1	2	3	4	5
9	I have a better understanding of the role of research in design education.	1	2	3	4	5

Appendix B: Student surveys

What do you like best about this course?

What would you like to change about this course?

Appendix C: A framework for facilitating the subject of CS in the ID department, year 1 & 2, 2022

1. Shorter Lectures – 20 minutes with a change of activity followed by a short break

2. Cameras on can help with engagement.

I received mixed messages from students, some saying they are dealing with “anxiety or nerves”, however, the overall agreement was pro-camera use, because that may help with engagement as well as concentration when there are distractions at home (Students). One student mentioned a project they worked on during 10% during which they agreed as a team to have their cameras on throughout the project and final presentation. According to them, “this early, really helped…bring back that human connection, we need to have it on!!”(Student). Although staff are not enforcing camera use for now, perhaps having them on for the first 15 minutes of every online/hybrid session may help with student engagement?

3. Class Discussions (TUTS) during which students actively engage with the lecture content.

Students were enthusiastic about sharing their experiences of the class discussions during TUTS sessions. “I think the tut session helps with participation, mainly for me because it feels like having a conversation with friends as suppose to sitting in a big hall” (Student). “We especially liked the group discussions, that we could voice our understanding of the theory”; “you as a lecturer have taken an approach to listen more that dictate” we feel comfortable talking to you and participating in class, you listen to us” (Student). “Definitely yes, helped us to think about the theory and understand it and not only write it on a piece of paper” (Student). “I got to learn about stuff from how everyone else engaged with the topics” (Student).

Colleagues are also in agreement and use similar methods especially when teaching theory: “for me, you are in the class when you engage with the reading” (Colleague A). There are no right or wrong answers, it is more about participating and some colleagues give up to a week for students to reflect and respond to posed questions during those discussions. “I do encourage for them to engage in the session, but theory is difficult and it takes some time to digest it)” (Colleague A). Also both verbal and written engagement is accepted. Another interesting point raised by a student was perhaps if we do not record those sessions more people will participate and speak up? The argument was made that students feel intimidated they will say something wrong that is recorded (Student).

4. Use more visual examples from various sources

Include more images, videos, movies, interviews and examples from social media. The emphasis is on visual analysis and a “multilayered approach to projects that are not necessarily all about words, but also images, infographics, diagrams…they get to indulge in a kind of visual experience” (Colleague D). One colleague’s strategy is for shorter lectures followed by a workshop during which we look at images and “analyse them in terms of the theory” and “sometimes I give them a little task at the end of a lecture – find a visual that relates to the theory discussed in class” (Colleague A).

Author’s note: Visual essays, Infographics, Research Presentation -T4 (Group Presentations)

5. Mini weekly deadlines

Both staff and students agree that encouraging weekly engagement on a regular basis (weekly?) helps with participation as well as time management. One student suggested we use an assignment tab in Teams to show a calendar of all due submissions for the term. A concern raised by a student was as long as those deadlines did not increase the current workload.

6. Teamwork (Group Presentations)

According to students “helps you to get used to working with other people and you learn from others” and can also be fun (Student). It also “..helps us interact more as classmates because we don’t really have something that brings us together like being on campus”. “Working with others allows you to combine your thoughts and look at problems from several angles” (Students).

“However I don’t necessarily believe that the above mentioned is achieved through online leaning when group members communicate on screen and not interactively” (Student). Group work is also seen as”… tough and tricky” by some students because “everyone has a different life and schedule” At the same time it helps reduce the workload (Student).

Colleagues share a similar view: “working in teams is important to prepare them for real-life scenarios academic writing is important but they also need to explore different methods of expressing” (Colleague E). Smaller peer groups work better, two to three maximum four students per group. One colleague suggested for students in each group to sign off a code of conduct which includes a group leader, a project plan and delegated tasks (Colleague E).

“I’m no longer doing PowerPoint (PP) presentation with tons of slides talking for one, two or three hours, just doesn’t work; it exhausts me, they are bored, just doesn’t work. What works is small breakaway groups, getting them to do a small project” (Colleague E).

Author’s note: Visual essays, Infographics, Research Presentation -T4 (Group Presentations)

7. *Flipped classroom*

The reverse of a traditional classroom, and a type of blended learning, where students are given time prior to the lesson to go over the content and prepare for class independently. This strategy may encourage student engagement and participation because students come prepared for the session and there is more time for class discussions. Also, by encouraging more independence may result in more proactive students who do not sit in class and wait to be told what to do. “when you give them work to do prior to the lesson; the honour is on them to make the next session as interesting as possible; if no one has done anything you send them home early” (Colleague E).

8. Miro

A Miro board is an online whiteboard that you can use to visualise your ideas, work on projects either individually or with a team.

“I use Miro excessively now…don’t use PP to prepare lectures…Spending time to put PP slides is a complete waste of time…all my course information is in Miro…instead of me having to share actual lecture notes the students have active element of engagements with their lecture notes” (Colleague E).

“Students can work together using Miro…Students can also review text, comment, as a lecturer you can also join in the process. Although it may seem wacky and off centre, they engage in a completely different way” (Colleague E).

Educators support students and provide them with a basic structure, which encourages them to explore further, and do the work. That is one way to encourage student engagements and participation.

9. Site visits

Site visits can help with engagements and add a more practical dimension to teaching theory. “I really enjoy learning about something and then being able to see it” (Students). According to colleagues site visits encourage student participation especially when those become the case study for the essay. It is also beneficial to students because they get to meet and engage with their peers.

10. Guest speakers

Both students and lecturers agree that one of the advantages of hybrid learning is the ease and flexibility in inviting various people from all over the world to engage in a class discussion. According to colleagues it is important to have guests speakers who can add another dynamic, and “change the monotony” (Colleague C) by presenting another viewpoint and engaging with students. Anything between 20-40 minutes.

11. Learning from mistakes

Students learn from making mistakes and although lecturers agree with the statement, it is not much of an option for the subject of CS at GDC. Students are only able to re-submit if they have failed, but not in order to improve their marks. Also lecturers teaching theory do not have the capacity to welcome more re-submission opportunities. On a few occasions when I have allowed for more re-submissions for better marks, few take the opportunity. Students get a detailed mark sheet with each submission, but generally few would go over the comments resulting in similar mistakes for the next submission.

Setting mini deadlines throughout each term may help with monitoring progress as students get continuous feedback as opposed to only at the end of the final essay submission (where they get a detailed mark sheet). In term four, I give students (ID1 & 2) a project to do consisting of two (2) parts. They present each part to me and the rest of the class throughout the term. When it comes to the final submissions, students are confident and prepared.

A college records the feedback and students are only able to access the marl unless they have listed to the recording (Colleague E). Also, students associate making mistakes with failure, which is a mind set that needs to change.

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BIM as an alternative architectural teaching device

Jean-Pierre Basson, *Nelson Mandela University*
Chris Allen, *Nelson Mandela University*

Abstract

Are traditional architectural studio-based teaching methods and tools still applicable, or are they causing a communication barrier between a student and a lecturer? In architectural design studios, promptly submitting projects is a problem. The paper is based on a study conducted by the author between 2016 to 2018 and aims to determine whether information technology (IT), such as building information modelling (BIM), opposed to the conventional method (CM), can improve informed design communication during conceptual design critique sessions. Therefore, contribute to prompt studio-based design project submissions. The research's objectives include understanding BIM as a design tool compared to a visualisation tool to facilitate early design decision-making. Also, to understand how BIM can improve conceptual design information. A rubric was used to evaluate critique sessions based on qualitative attributes of design intention, function, aesthetics, and sustainability. Quantitative and qualitative data were collected from a comparison study between two postgraduate cohorts. One cohort used the CM in the design studio, while the second cohort used the BIM method in the design studio. A framework was created using a literature study to establish the BIM method's capability to improve communication. After completing the cohort comparison study, four themes become apparent: competencies, relationship, time and non-participation. Findings include improved drawings, availability of different drawing types, accuracy and reduced time spent on redundant work and reduced costs. Based on the findings, it can be concluded that BIM can improve design communication between a student and a lecturer during the conceptual design stage, leading to prompt submissions. It is recommended that the current teaching pedagogy in the design studio be revisited to incorporate BIM as a design tool as early as the undergraduate programme.

Keywords: Architecture, BIM, communication, conventional method, conceptual design, design studio, education

Introduction

> *My students don't 'connect' to me, so I must be doing something wrong. In addition, my students aren't submitting their projects on time, which influences my pass rate. I don't understand why this is happening, as the project briefs and instructions are similar every year.*

These comments reflect the concerns of a colleague who has been teaching the same design module in architecture for the past few decades. The question to be asked might not be "what did I do wrong?" but rather "are my teaching methods and tools still relevant and applicable in the ever-changing technological global teaching environment?" In other words, are traditional teaching methods and tools still applicable to the current student, and can they relate to these, or are these approaches causing a communication barrier between the student and the lecturer?

The architectural studio is designed around the creative nature of engaging with design projects, real or hypothetical. Why are students struggling to submit studio-based design projects on time using traditional tools and teaching methods? The literature established that the blame is so easily placed on poor time management to explain the lack of submitting completed studio-based projects on time (Shen, Shen & Sun, 2012). The problem, however, appears to have a deeper explanation, which can be traced to communication between the lecturer and the students during the design's different stages, as described by Basson and Allen (2018). Due to the dialogic nature of the design studio, communication plays a vital role in studio-based education. According to Saghafi, Nozffar, Moosavi, and Fathu (2015), the method currently used in architectural studio-based design education is the conventional method (CM) which uses two-dimensional techniques.

The core concern relates to the lack of communication between the student and the lecturer during conceptual design critique sessions. The lack of available information produced by the CM is believed to hinder students from submitting design projects promptly.

However, the question is: What alternative method is available to improve communication? Building information modelling (BIM) is a new approach that is an interactive and information-rich intervention in contrast to the CM (Eastman, Teicholz, Sacks & Liston, 2012; Joannides, Olbina & Issa, 2012). Using IT as a design tool in architectural education, instead of its current use only as a production and visualisation tool, can lead to a more efficient design process. BIM in Architectural, Engineering and Construction (AEC) practice is well-known and established globally. However, the influence and application during the conceptual design phase in architectural education have not been fully explored. Furthermore, using IT in the design process is one of the most controversial issues in architectural education, but very little scholarly research has been done. It raises questions such as "how is the use of the computer going to influence our creativity or problem-solving abilities?" or "are architects embracing the full potential of IT design tools?" as noted by Bertol (1997).

This paper reports on a study exploring using the BIM method as an alternative tool within the design studio to improve how students and lecturers communicate during critique sessions and its direct influence on student submission rates. This paper argues that for architecture students to communicate well-informed design knowledge requires a rethink of the current traditional CM of design studios by implementing the BIM method that promotes efficient design transformation and will improve student submissions.

Literature review

Architectural education was shaped by combining the Beaux-Arts approach established around the studio (also known as the atelier) and the Bauhaus approach that showed the idea of the set curriculum. However, the model most frequently used in contemporary architecture schools is based on the traditional model. The design is regarded as a process instead of a product in the design studio (Salama, 2005). Green and Bonollo (2003) further underscored the statement by Salama by defining the design studio as the heart of architectural design education. The studio is where students visualise and conceptualise their projects and visually represent the proposal to the problem. Furthermore, the studio teaches students to engage critically with architectural knowledge (Green & Bonollo, 2003; Boyer & Mitgang, 1996).

Due to the dialogic nature of the design studio, **communication** is the critical factor to the success of studio-based learning in architectural education. Schön (1984) stated that the pedagogical value of the studio is centred on communication and conversation between the student and the lecturer. Unlike many other learning pedagogies, this allows for a more significant learning experience. The success of a project depends on effective communication. Ineffective communication is thus detrimental to the AEC industry. Therefore, integrating communication skills within the education system offered to architects plays a crucial role in sustaining the future of the architectural profession.

With the development of the personal computer, traditional pen and paper drafting procedures were replaced with computer-aided drafting. The CM can be described as traditional design methods where architectural students use 2D drawings to represent their projects—using manual creation (drafting), updating, processing, and analytics. All relevant professionals must re-enter data manually, which is time-consuming, error-prone, painstakingly slow, and leads to misinterpretation (Sanguinetti, 2015). The designer uses individual lines to represent building components, such as windows, doors, and walls, with no detailed building information, such as what type of glass is used or thermal properties of a specific material.

In studies conducted by Green and Bonollo (2003), Sachs (1999), Salama (2005) and Ostwald (2008), the CM holds limitations when used in the design studio and can be summarised as follows:

- Students' progression to the next year is based on their drawing skill;
- The decision-making process is complicated for students to master, as it requires expertise not yet learned;
- Moving from an initial concept diagram to design development is an area within the studio-based education where students become stuck and fall behind;
- Repetition forms a significant limitation of the design studio where students must redraw the same action without resolving the real issues or without time to be able to solve the real problems; and
- The design studio is expensive due to the resources required in paper and model-building materials to complete projects.

There is a paradigm shift within the AEC industries due to the rapid pace of changing technologies working towards integrated IT projects (Joannides, et al., 2012; Gu & Vries, 2007; Takim, Harris & Nawawi, 2013). **BIM** plays a significant role in leading this transformation to enhance communication and sharing of information (Ahn, Cho & Lee, 2013). Using BIM allows the exchange of data using an information-rich digital or virtual model, of the design project.

When introducing BIM into the curriculum, graduates with BIM training and expertise are more employable than students without or with little BIM expertise. Secondly, BIM holds the possibility of bridging the traditional silos of teaching in AEC education (Rooney, 2013). As stated, BIM has advantages to the education programme, but three challenges were identified that hinder BIM education implementation into architectural education. The first is the lack of BIM expertise, followed by the resistance from academics, and lastly, the existing curriculum holds little or no space for introducing new content (Eastman, et al., 2012; Ahn, et al., 2013; Kim, 2012).

As the AEC industries move towards integrating more BIM technologies into their fields, there is a need for both fully trained graduates and those who will work closely with these BIM technologies and processes. The processes include three, four, and five dimensions instead of two dimensions (Kim, 2012). BIM is mainly used for construction drawing purposes and is not fully exploited in the design phase. This paper focuses on the design phase instead of the documentation phase regarding the use of BIM as a design tool in establishing the relationship between student-lecturer and design communication.

Methodology

The larger research projects sit within the mix-method paradigm. The study used a student questionnaire as a quantitative data collection tool to collect data about a student perception around the traditional design studio and BIM. This paper will focus on the qualitative data collected from an observational study in the form of a cohort comparison study. Figure 1 explains the logical process followed in conducting the research.

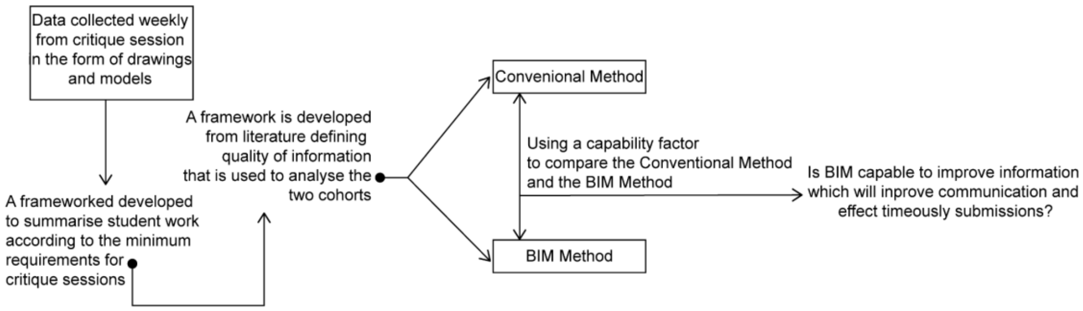

Figure 13: Logical process is taken to conduct the research

The participants in the research were the 2016 and 2014 first-year postgraduate Master of Architecture students. The entire class received the training, but nine students of each year were observed, which represents a third of the class. The data collected for observation was in the form of drawings and models using scans, digital copies or photographs of physical models at each critique session. The 2016 cohort used only the CM in the design studio, whereas the 2017 cohort used the BIM method in the design studio to complete design projects. During the 2016 cohort, the concept of BIM was taught in the Architectural Computer Usage module towards the end of the second semester with no integration into the design studio. In the following year (2017), the content was moved to the early part of the first semester, and students were required to implement their BIM knowledge in the studio-based design project. Thus, the same design project was used during both cohort years.

> *A framework was created which formed the basis for establishing the kind of drawings and information students supplied during each critique session. The framework was established by referencing the competencies of an architectural student as outlined by the government body, the South African Council for the Architectural Profession (SACAP), the client/architect agreement produced by the South African Institute of Architects as well as the design module outcomes as seen in Table 1 (Mashabane, 2012; SAIA, 1999).*

Table 2: Framework for weekly critique session observation modified from the competencies of architectural students and the client/architect agreement compiled during the research study

Evaluation framework			
Design	**Function**	**Appearance**	**Sustainability**
Layout relationships diagrams Use of massing	Construction type Accommodation schedule Site plan	Floor plan(s) Section(s) Elevation(s)	Physical Models Digital illustrative material Calculations Simulations

Descriptive analysis, using deductive coding, was used to analyse the data obtained from the critique evaluation framework. The research was focused on the quality of information that students present to communicate, and therefore, a literature study established six attributes that define quality in communication using only drawings. Table 2 outlines the six attributes defining quality.

Table 3: Defining quality in architectural design by establishing attributes from a literature study

Responsiveness	Establish requirements for the project using critically engaging with all the issues about the building type, accommodation and site issues. Responsiveness furthermore relates to the massing response to the information gathered during the information development stage (Bednar, 2016; Smart, 1995).
Relationship	The ability to associate, link and connect not only different building components and spatial planning (1) but to connect the design in different design platforms (2) and communicate building placement relationship, orientation and site relationships (Bednar, 2016; Eastman, 2012, Smart, 1995).
Modification	To what extent the design can be modified with ease or difficulty to explore design possibilities (Doumbouya, 2016; Shourangiz, 2011; Azhar, 2007).
Accuracy	The exactness or closeness of representing the building design information (Bednar, 2016; Eastman, 2012; Smart, 1995).
Intelligence	The ability of an object to know and identify the real-world building the component is representing (Doumbouya, 2016; Shourangiz, 2011; Azhar, 2007).
Representation	The ability to define and communicate the design process (Doumbouya, 2016; Shourangiz, 2011; Azhar, 2007).

To establish whether the BIM method can enhance informed design communication compared to the CM, a capability factor was used to compare the two cohorts. The capability factor scoring ranged from 1 (no capability) to 4 (completely capable).

Results and findings

The findings are discussed according to the six attributes described in Table 2. The attribute **Responsiveness** established four themes after assessing the work from both cohorts. The first theme of the relationship includes the lack of engaging critically with the project parameters and setting the issues of the design project. The second theme talks about establishing the accommodation schedule, followed by spatial relationships, and selecting the material or construction methods for design communication as seen in Figure 2. The results of the framework used to establish a capability factor for the attribute responsiveness are summarised in Table 3.

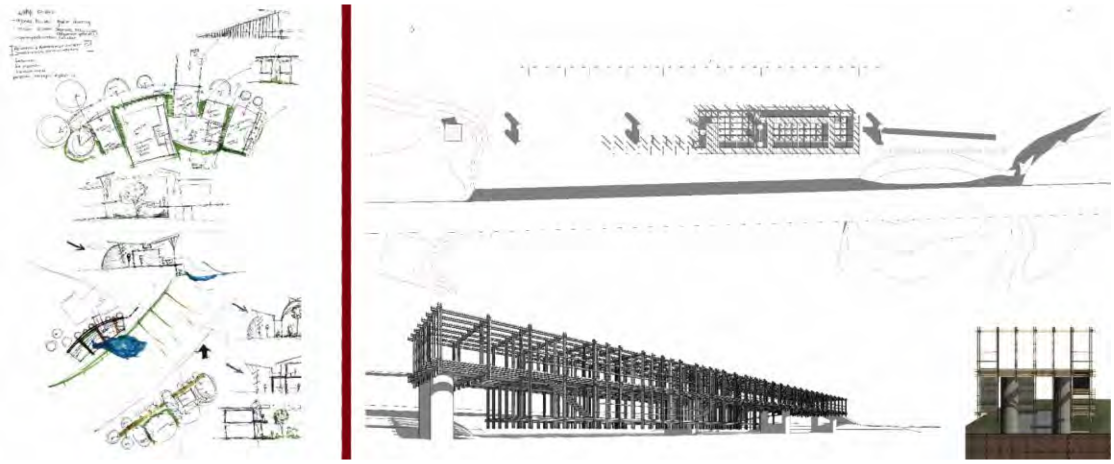

Figure 14: Responsiveness indicating setting up project parameters and deciding on construction techniques and material (CM left, BIM right)

Table 4. Results pertaining to the attribute responsiveness

Capability matrix for responsiveness	**CM**		**BIM**	
Requirement criteria to meet the attribute	Yes	No	Yes	No
Accommodation schedule: Establishing both qualitative and quantitative information.		X	X	
Use of 3D conceptual massing as opposed to 2D massing.		X	X	
The use of site-specific data about sustainable principles and approaches.		X	X	
The use of a site plan to discuss the project in its context.		X	X	
The use of architectural drawings (plans, section, elevations, or illustrative material) to scale (note diagram) showcases response to materials and construction techniques proposed for the project.		X	X	
Capable %	0% 0/5*100		100% 5/5*100	

	Cohort 1: Conventional Method		Cohort 2: BIM Method	
Responsiveness	1	No Capability	4	Complete Capability

The lack of engaging critically with the project's needs and requirements was the first concern established by the CM cohort. Students struggled to produce work for the first critique session by not specifying an accommodation schedule, which resulted in students not attending the critique session. This was also evident in later critique sessions where students were still uncertain of what their project was about due to not establishing the project's requirements. On the other hand, students who used the BIM method established an accommodation schedule with physical restrictions and a qualitative position on what is required for the different spaces as quantitative and qualitative information is required beforehand. One-dimensional isolated communication was observed from the CM cohort due to the lack of varying drawing types produced compared to full three-dimensional discussions around the critique table observed by the BIM cohort, which had various drawing types.

For the CM to produce drawings, it was confined or limited to the particular student's ability. Furthermore, the CM used generic sustainable principles obtained as a general rule of thumb in another module. In contrast, the BIM cohort used site information that was factually based on geolocation abilities. In summary, the CM cohort indicated 'no capability', whereas the BIM cohort has the capability to affect design information to a full extent.

Within the **Relationship** attribute, five areas were outlined. Table 4 summarises the criteria for evaluation.

Table 5: Results pertaining to the Relationship attribute

Capability matrix for relationship	**CM**		**BIM**	
Requirement criteria to meet the attribute	Yes	No	Yes	No
Architectural drawings must correlate between different drawing types (plans to sections to elevations to 3Ds).		X	X	
Architectural drawings should explain/communicate the understanding of both the relationship between interior spaces and exterior spaces.	X		X	
Architectural drawings must be clear, precise and legible.	X		X	
The relationship between construction technique and spatial planning must be indicated.		X	X	
The use of different platforms to complete the design process without redoing work in any platform.		X	X	
Capable %	40% 2/5*100		100% 5/5*100	
	Cohort 1: Conventional Method		Cohort 2: BIM Method	
Relationship	2	Minimum Capability	4	Complete Capability

The main issue experienced is the drawing techniques used by the CM cohort were not legible compared to the universal BIM standards that promote legibility as indicated in Figure 3. The BIM cohort produced information-rich drawings that facilitated discussion about internal and external relationships. The CM cohort had little information on their drawings that were cross-referenced and made conversations impossible. Due to the manual drafting method used by the CM cohort, drawings were error-prone and did not correlate to each other. The digital modelling that the BIM cohort followed allowed for constant cross-reference of drawings that eliminated any upfront errors.

The parametric manner of working with BIM allowed for the ease of modification. BIM models have rich information about the object, whereas the CM represents objects with no relevant, intelligent information. With the lack of structural or material information available from the CM, discussions dealing with the relationship between structure and spatial planning did not occur. BIM allowed students to work between different platforms without redoing, reworking, or redrawing, which assisted in discussion to develop around the relationship between space and structure. The ability to link to multiple platforms was not evident in the CM. As a result, a minimum capability rating was achieved using the CM compared to a BIM cohort that received a complete capability rating.

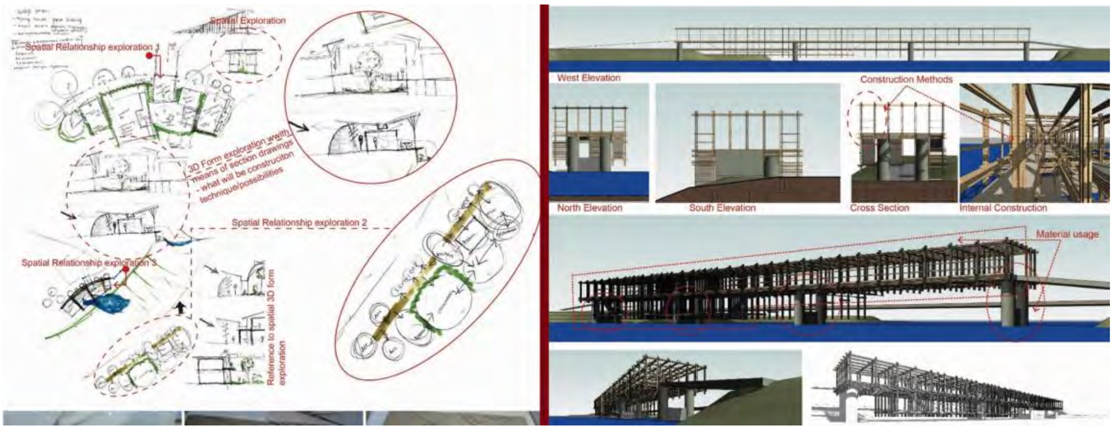

Figure 15: The BIM (right) promotes universal drawing standards compared to CM (left)

Modification can be regarded as the extent to which the design can be modified and explored. Table 5 outlines the criteria for modification.

Table 6: Results pertaining to the Modification attribute

<table>
<tr><th>Capability matrix for modification</th><th colspan="2">CM</th><th colspan="2">BIM</th></tr>
<tr><td>Requirement criteria to meet the attribute</td><td>Yes</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td>Any component of the work presented can be modified with ease without redrawing, modelling, or physically rebuilding a component</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>Ability to modify components in both 3D and 2D simultaneously</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>Ability to provide sequential process work</td><td>X</td><td></td><td>X</td><td></td></tr>
<tr><td>Low time-consuming process to modify objects</td><td></td><td>X</td><td>X</td><td></td></tr>
<tr><td>Capable %</td><td colspan="2">25%
1/4*100</td><td colspan="2">100%
4/4*100</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">Cohort 1: Conventional method</td><td colspan="2">Cohort 2: BIM method</td></tr>
<tr><td>Modification</td><td>2</td><td>Minimum capability</td><td>4</td><td>Complete capability</td></tr>
</table>

BIM models were easily modified to meet critique sessions, whereas the CM did not promptly modify the requested changes. By using pen-and-paper or basic computer drafting, modification of any proposal is a manual process in nature. Any new submission required the students to redraw a great volume of the existing content to make the selective changes in one part of the design. Not only is it time-consuming, but it also creates room for error in the redrawing process that can easily not be picked up by the student. BIM produced a range of different drawing types and improved the quality and legibility of the project by reducing the risk of drawing errors.

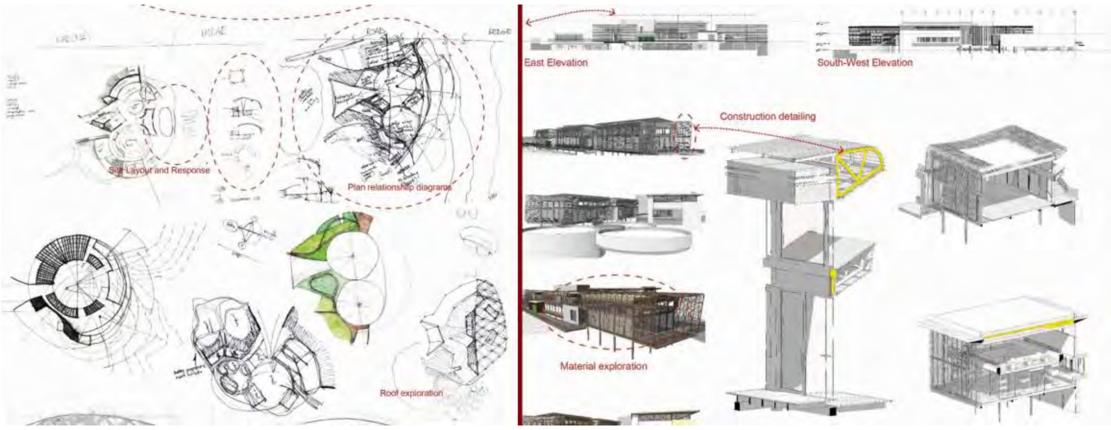

Figure 16: Using BIM allowed students to easily modify their proposal and engage in critique compared to the manual process (left)

While working holistically (BIM), it assisted the students in identifying problems as early as the conceptual stage. Now that the problems are recognised and established upfront, students can develop their design in more detail. Thereby the level of **accuracy** improved, as outlined in Table 6.

Table 7: Results pertaining to the attribute Accuracy

Capability matrix for accuracy	**CM**		**BIM**	
Requirement criteria to meet the attribute	Yes	No	Yes	No
There is no need to redraw/trace work to reproduce or modify work		X	X	
Components are seen as identifiable objects rather than as individual line components		X	X	
Representation of building elements to scale, dimension, and thickness		X	X	
The project is situated on a site plan		X	X	
Capable %	0% 0/4*100		100% 4/4*100	
	Cohort 1: Conventional method		Cohort 2: BIM method	
Accuracy	1	No capability	4	Complete capability

Using parameters within the BIM cohort, accuracy was achieved. Parameters stay constant and evident throughout the whole project duration. In the CM, the student's limitations and skills prohibited the student from producing accurate drawings. Using the CM, objects are seen as simple drawing components, such as four lines labelled a wall with no fixed relationship. Due to the limited time, CM students limited their drawings to plans only, not showing sections, elevations, and site plans. The BIM method allowed students to create parametric models, which assisted in speeding up the process, eliminating redrawing or modelling objects. Therefore, BIM scored 4 and CM 1.

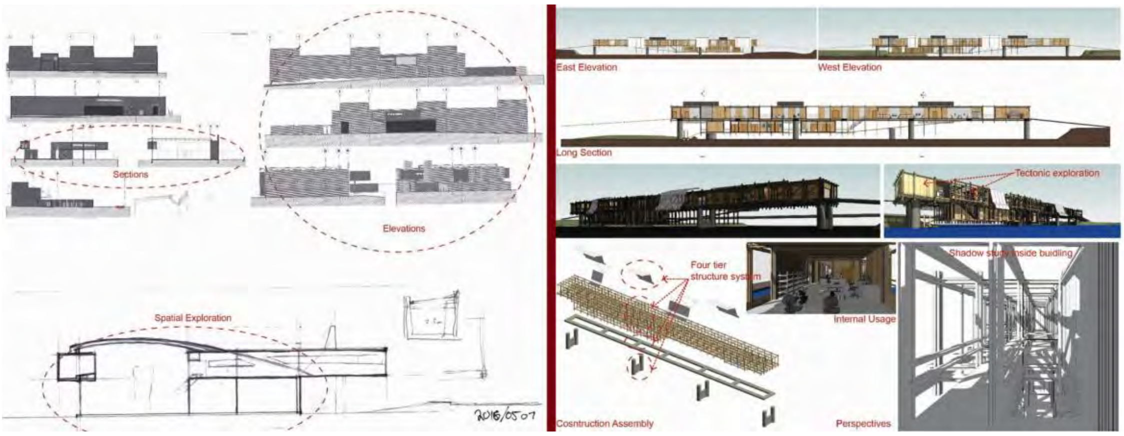

Figure 17: CM (left) restricted accuracy based on the students' ability

Under **Intelligence**, which refers to the ability of an object to identify real-world building components, CM holds no capability to indicate intelligence, as indicated in Table 7.

Table 8: Results pertaining to attribute Intelligence

Capability matrix for intelligence	**CM**		**BIM**	
Requirement criteria to meet the attribute	Yes	No	Yes	No
Can the architecture component react in an intelligent manner to a real building component?		X	X	
The project is located to a specific geographical relation and site-specific information is obtained		X	X	
Capable %	0% 0/2*100		100% 2/2*100	

	Cohort 1: Conventional method		Cohort 2: BIM method	
Intelligence	1	No capability	4	Complete capability

Firstly, sustainable factors were not factual and accurate in work presented by the CM cohort. For example, generic information was used for a region, or sometimes students did not manage to source information for that region. As this is a crucial initial design step, students started conceptual design using the wrong information, which resulted in students returning the drawing board later in the design project. The BIM cohort used intelligent information from the global mapping service embedded in the software with accurate weather data, updated in real-time. Secondly, when the students used mass models to investigate possible building orientation and building shape, the CM cohort used the manual calculation compared to using the global mapping solar information, updated as the model updated. The BIM cohort used the solar information during each step of the process, monitoring each move to ensure that their building reaches the most efficient sustainable rating, resulting in an accurate passive design approach. Therefore, BIM had the complete capability (4) and CM no capability (1).

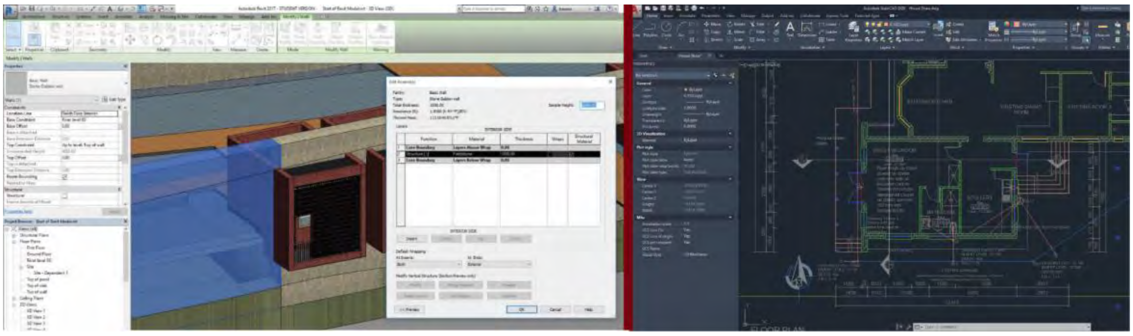

Figure 18: BIM allows for objects to be seen as real-world objects containing information (left) compared to line-based drawings

To communicate to a range of clients, architects rely highly on **Representation** techniques, and it requires specific criteria as outlined in Table 8.

Table 9: Results pertaining to the attribute Representation

Capability matrix for representation	**CM**		**BIM**	
Requirement criteria to meet the attribute	Yes	No	Yes	No
Representation is retrieved holistically, not drawn as individual elements		X	X	
Includes representation material from 2D plans, section and elevation and 3D illustrations	X		X	
Expressing materiality in illustrative material.		X	X	
Capable %	33.3% 1/3*100		100% 3/3*100	
	Cohort 1: Conventional method		Cohort 2: BIM method	
Representation	2	Minimum capacity	4	Complete capability

The CM cohort used various representation techniques, including sketches, drawings, physical models, and basic line drawings, as highlighted earlier. In most of the work, no 3D material was provided and engaging with the proposal is problematic. It led to miscommunication and frustration by both the lecturer and the student. Therefore, CM scored a minimum capability (2). BIM assisted students in producing a variety of different drawing types, including illustrative 3D material. Communication was easy to follow with no misinterpretation. The BIM models also allowed for linking to other printing platforms, such as 3D printing, which saved students time. Therefore, BIM achieved a complete capability factor rating of 4.

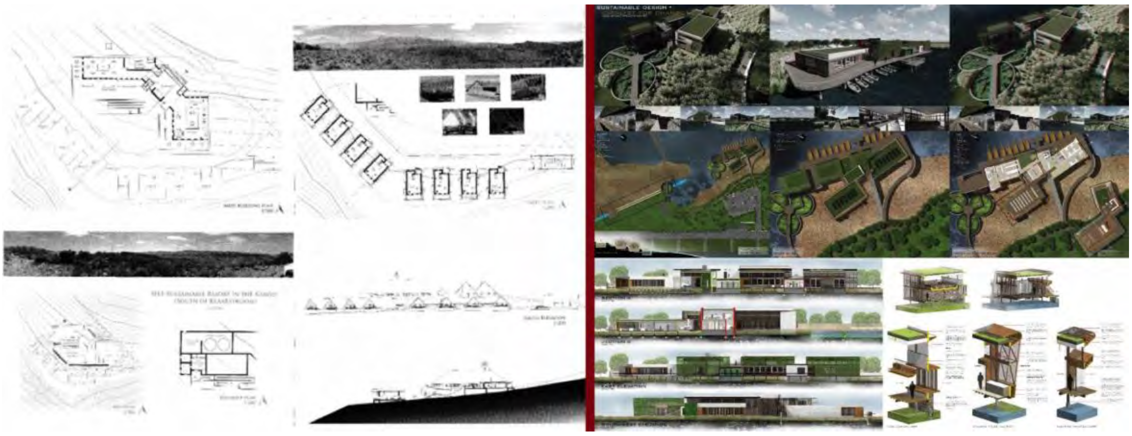

Figure 19: BIM allowed students to represent their design proposal using different illustrative material as well as the opportunity to link to other platforms, such as 3D printing

From this research, the following four themes are prominent:

1. Competencies: Signs include the quality of the drawing technique, accuracy and the availability of a drawing range;
2. Relationship: Signs include project information that is not prior defined by the student, the lack of understanding of spatial relationships between structure and internal space;
3. Time and cost: By implementing the BIM method, the research has shown that students spend an estimated 94 hours (47%) less time on a project than using the CM, and
4. Non-participation: Due to the complex nature of the design approach and not fully exploring "What if?" scenarios, students tend to stay away from critique sessions.

Conclusion

Students seem to struggle to submit their studio-based design projects on time using the CM. Compared to the CM, the BIM method improved communication between the student and the lecturer based on the capability to improve the information by meeting the design quality attributes of responsiveness, relationship, modification, accuracy, intelligence, and representation. The CM limited the ability of students to exchange information during critique sessions with the relevant staff members; it also hindered the production of information sets in the form of drawings and, therefore, did not improve communication between the student and the lecturer. Four early signs to detect miscommunication were identified as a guideline, and these include competencies, relationship, time and cost, and non-participation.

It is thus evident that the CM did not improve communication, whereas BIM improved communication between the student and the lecturer. A 47% time-saving by students using the BIM method shows a greater level of efficiency, which directly impacted their submission rate, as they submitted complete projects on time.

Implementing IT such as the BIM method in the design studio, efficiency, communication of well-informed design knowledge and improved submission rates instead of the traditional CM are promoted. Innovation and research into teaching methods could contribute to effective teaching and communication among millennials in the architecture profession.

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SESSION 9: The human side of 4IR – shaping design education for the future

DE+AFRIKA+4IR+

DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

Exploring the potential of design thinking in the age of fourth industrial revolution in South Africa

Itunu Ayodeji Bodunrin, *University of Johannesburg*

Abstract

Design thinking (DT) has recently re-emerged as an essential mindset and skillshift for modern organisations seeking to improve innovation performance in the fourth industrial revolution (4IR). However, despite recent popularity and success especially in the tech industry, DT has lacked critical academic engagement and scholarly enquiry especially in Africa. Hence, this paper sets out to provide empirical evidence on how DT can help create opportunities and innovation in an AI/Algorithm-driven 4IR era, and why the design curriculum in higher education should be updated to include DT competencies. This paper argues that in the era of 4IR (characterised by rapid automation and high demand for technological, social and emotional and higher cognitive skills), there is a greater need for DT and similar methods that positions immediate human/societal needs at the centre of critical technological innovations. This is even more crucial in the South African context where the longstanding socio-economic inequality is being exacerbated by COVID-19 pandemic, which will have long-term impacts on people's needs and wants, and fundamentally change the traditional ways of being. The paper concludes that DT presents an opportunity for design educators to adapt their core to meet the rapidly shifting societal needs and identify and quickly address new opportunity areas being created by the COVID-19 and the emerging technological landscape. The presentation reviews existing empirical studies, with the aim of helping design educators make sense of the emerging 4IR landscape, while providing them with evidence of how DT can be an essential tool to drive innovation-led growth that addresses human needs in the era of 4IR, and amidst the precarity of the global pandemic in contemporary South Africa.

Keywords: 4IR, design for educators, design thinking, ideation, innovation

Introduction: Design thinking as a method for humanizing 4IR technologies

Design Thinking (DT) is a human-centred, cognitive, and iterative ideation process for identifying and addressing stakeholder needs and solving wicked problems via a bottom-up design process. This contrasts the traditional top-down design processes that rely on "experts" within organisational boundaries and ivory towers to curate and design for the needs of others. In essence, DT opens up the design space for dialogue among all stakeholders (designers, end users, managers, among others) as a means to enhance the possibility for creative imagination and innovation (Johansson-Sköldberg, et al., 2013).

Initially pioneered by the private sector players, the DT approach has gained prominence is being used by some national governments as well as supranational organisations such as the European Commission, the United Nations Development Programme (UNDP), and the World Bank as a way to tackle complex human issues and deliver public service solutions (Elk, 2020). The shift towards tackling fundamental societal problems (wicked problems) through human[46] engagements or re-framing design problems in human-centric ways comes amidst the increasing permeation of data-churning smart machines and cognitive computing technologies such as machine learning, artificial intelligence, which promises to solve human problems through collection and analysis of volumes of computer-generated data.[47] DT expert, Liedtka (2018) argue that despite these arrays of technologies, only a deep immersion in the real world of human experience can produce high-quality data that can be transformed into insights, and which can help stakeholders agree on design criteria that can be used to proffer relevant solutions.

It is said that DT has in the last decade evolved to become one the main approaches to understanding, enhancing and augmenting the impact of contemporary technology of the fourth industrial revolution (4IR) (Pitsis, et al., 2020). The emergence of COVID-19 and subsequent government-enforced lockdowns around the world since the early 2020 further accelerated digital transformation, deepened the digitisation of marketised and domesticated social structures, leading to unprecedented levels of global online and digital use. According to a McKinsey report, the pandemic forced many organisations and businesses to change their go-to-market model since the pandemic hit. An overwhelming majority of 96% of businesses were said to have turned to multiple forms of digital engagement with customers. The report further positions “technology” as the biggest opportunity in the post-COVID-19 era (Figure 1). Indeed, studies have shown that companies that embrace digital transformation generally outperform their peers and are known to be more profitable (MIT, 2013).

One may therefore conclude that digitisation and 4IR technologies are rapidly impacting the traditional ways of being and doing business (Jordan, 2020). Hence, there is a dire need to critically reflect and rethink the place of humans (in relation to machines) in solving humanity’s most wicked problems and other post-digital societal issues. Stanford design scholar and the founder of global design firm IDEO, Tim Brown, is credited to have defined DT as a human-centred approach to innovation that explores and integrate the needs of people and the possibilities of technology as requirements for business success. His definition reiterates that a key aspect of the DT is the designer’s ability prioritise human needs ahead of technological solutions and business viability, through abductive reasoning known to produce new solutions for future situations.

This contradicts the tenets of technology determinism theory and model of modernisation, where it is assumed that technology should primarily determine the development of society’s social structures and cultural values (Hallström, 2020). DT and related methodologies assumes that the problem of humanity lies within the human realm, and one cannot rely exclusively on technology alone, which continues to contribute to the problem in the first place (Hallström, 2020).

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[80] By humans, I mean student, employee, consumers, among others.

[81] Here, I refer to the business intelligence (BI) and advanced analytics, whereby computers run algorithms to analyse data to identify patterns and then use those patterns to generate insights into past and current events and, later, offer insights on what would happen and what could happen if certain future actions were taken (http://www.interaction-design.org)

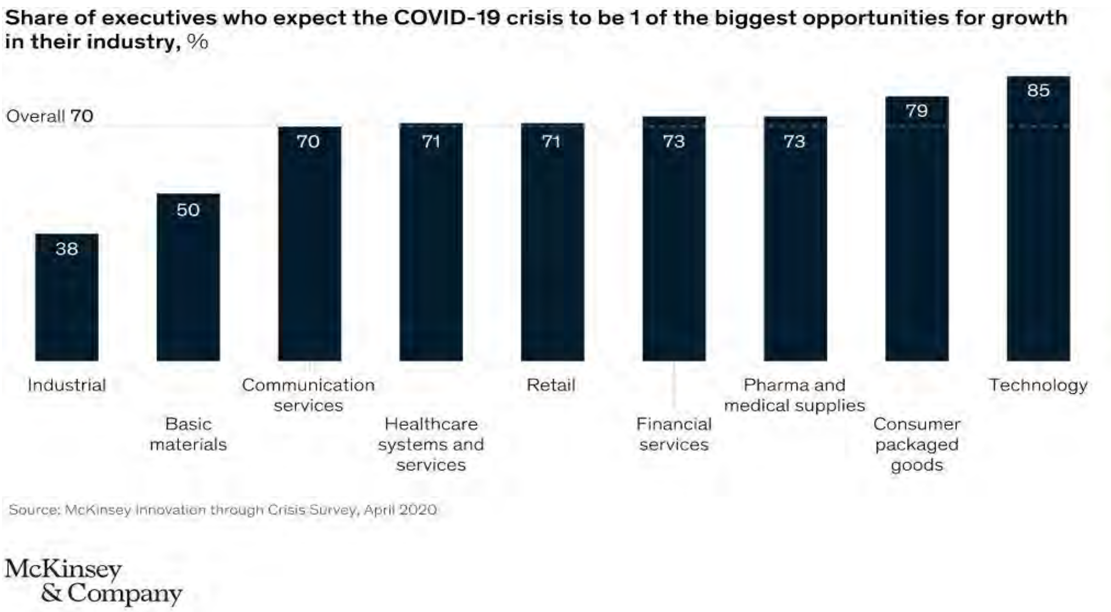

Figure 1: A graphic presentation of study published by McKinsey & Company which showed 'technology' as the biggest opportunity during and after the pandemic (AM, et al., 2020)

While the current fourth industrial revolution and its accompanying disruptive technologies have delivered many positive developments, for example, advances in health and sciences as well as boundless new opportunities to innovate and create new directions for businesses through optimisation of users' data to create personalised products and services, in an instant on-demand manner, there remain ethical concerns on how the vast amount of data generated are captured, manipulated and (mis)used by organisations and brands. This is already generating debates around what is known as data colonialism and surveillance capitalism (Allen, 2017). Others have cautioned against an ongoing prioritisation of these technologies over the immediate fundamental human and social needs (Hallström, 2020), and that these advancements tend to further alienate the poor and the digitally excluded in spaces such as Africa (where digital access remains a privilege of some), despite continued imagining of a post-digital world.[48] Additionally, a recent research conducted by Giaccardi and Redström (2020) suggests that the current era of 4IR intelligent of machine to machine interaction, machines are in fact the "stakeholders who design and curate realities for us" How then can one make sense of a setting where the so-called stakeholders are almost exclusively machines?

The current paper thus argues for the need to re-insert human at the centre of the technological innovation or humanise these 4IR systems to ensure that humans can influence technology (rather than vice versa), in order to be able to navigate the 4IR era with responsibility and responsiveness to deep human needs. Design-thinking embodies the skillset ideal in counteracting above mentioned issues associated with the 4IR including machine biases, flawed data sampling which causes over or underrepresentation in the training data and contestation of data use by organisations and other ethical concerns (Giaccardi & Redström, 2020). DT emphasises engagement, dialogue and involves end users and other

[82] The post-digital era as an age of digital ubiquity with pervasive sense ennui, when our excitement of a novel technology will be replaced by the possible anxiety of knowing its future burden (Hallström, 2020).

stakeholders in the definition of the problem and the development of solutions, design thinking garners a broad commitment to change".[49]

Globally, DT has become a standard part of the curriculum in many business and design schools, and a primary means of innovation for many top companies worldwide, including Apple, SAP, Google, Siemens, Intel, IBM, Arup, and NASA, Coca-Cola, Versace, Samsung, IBM and Microsoft.[50] The growing interest and stronger strategic emphasis on DT is embodied in the emergence of specialised DT schools (such as the famous d.school Stanford University and d.school University of Capetown, South Africa). Although DT has existed for decades, it has only recently begun to gain wider popularity and currently being institutionalised in academia.

DT has been explored not just for product and strategic design, it has been used to explore new areas that shifts the frontiers of human understanding of their environments including the adaptability of people to new technologies. Hence, some scholars have noted that the use of DT should not be geared only at producing results or an end product, rather it should be positioned as the process which creates and uncovers patterns likely to lead to excellence. According to Brian Ling from Design Sojourn (2014):

> *Design thinking has not produced the results that many organisations have been hoping for, because design thinkers that have not been classically trained in design "doing" will likely not realiz\se that great innovative solutions do not come at the end of the process; they come from any part of the process. Design is an iterative activity that only has broad guidelines but no fixed process. What's more important is that critical insights, sensitivity to consumer needs and beautiful solutions come from the creative chaos encouraged by an open design process.*

Studies have shown that organisations that make DT a central strategic focus are more likely to develop a sustainable advantage for the future.[51] DT presents new ways of tackling problems via a radical shift away from the traditional convergent thinking (of making best choices out of available alternatives) to divergent thinking (creating choices by exploring new alternative and ideas that were not available before).

The DT process is made up of several practical participatory and collaborative methods that are used to iteratively empathise, define, ideate, prototype, and test. Essentially, DT may be regarded as creative and analytic creative process that engages all stakeholder is the design process which includes experimenting, (re)create, rapid prototyping models, gathering of feedback, and possible redesigning (Pitsis, et al., 2020). While there are numerous versions of DT, they all seem to point to the fact that DT is neither simple nor linear. A model proposed by the Hasso-Plattner Institute of Design at Stanford (also known as d.school) seems to present the most basic tenets of Design thinking. This five-stage is presented below:

Empathising: Understanding the human needs involved.

Defining: Re-framing and defining the problem in human-centric ways.

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[83] https://hbr.org/2018/09/why-design-thinking-works

[50] https://cmr.berkeley.edu/2020/02/62-2-pitsis/, https://futurelondonacademy.co.uk/en/course/design-thinking-and-innovation?utm_source=zoe-comments

[51] https://journals.sagepub.com/doi/10.1177/0008125620907163

Ideating: Creating many ideas in ideation sessions.

Prototyping: Adopting a hands-on approach in prototyping.

Testing: Developing a prototype/solution to the problem.

It is important to note that the DT process is neither non-linear nor a sequential step-by-step process as depicted in the diagram. Hence, some have criticised the way DT has been presented like a linearly step-by-step gated process, when in practice, the process ought to be carried out in a non-linear and more flexible fashion (Pitsis, et al., 2020). For example, different groups or individuals in a design team can concurrently conduct more than one stage. In other words, it is possible for designers to collect information prototype during an entire project in a bid to visualise solutions and bring ideas to life. The results from the testing phase can reveal insights, which in turn may lead back to the process of ideation. Alternatively, the need for the development of new prototypes. Creativity is bound to be stifled if design thinkers are required to make DT to have rigid structures and repeatability (Ling, 2014). Figure 2 depicts the non-linearity of the DT process:

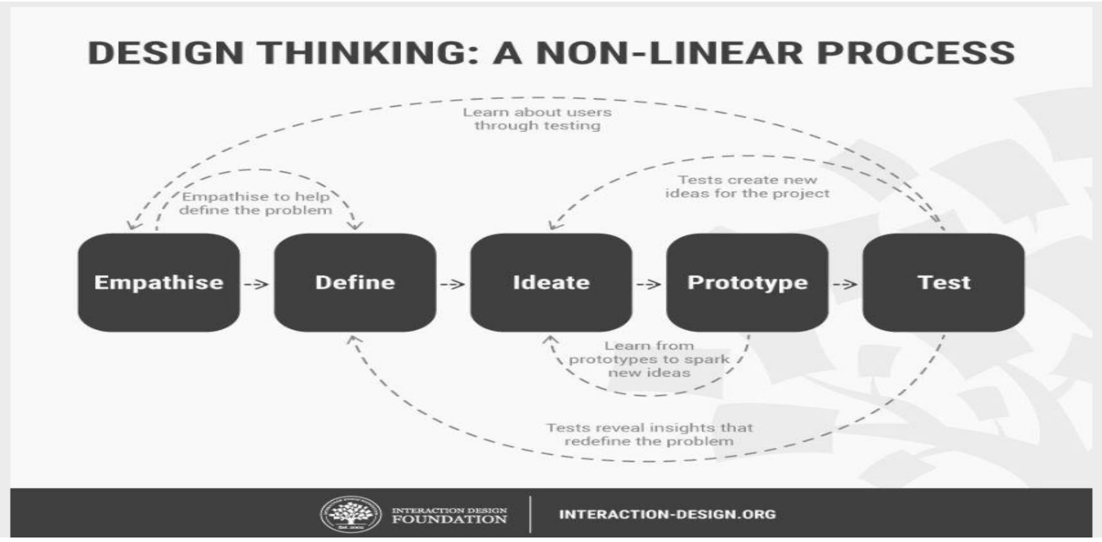

Figure 2: A diagram showing the flexibility and non-linear nature of the DT process
https://www.interaction-design.org/literature/topics/design-thinking

It is important to note that there have been varying definitions, methods, and models that have been described as DT in the last few decades. The one discussed and depicted in Figure 2 seems to be the basic that can be amended to fit the design needs in various fields such as product design, psychology, and anthropology. While many are aware of the various tools and methods of DT, Braun, et al. (2014) notes that the mastery needed to use these methods and theories remained a major problem. They therefore advocate for a designer to lead the DT process by navigating, leveraging, and managing opportunities from the creative challenge.

While DT training is offered across various disciplines and modified to meet varying disciplinary demands, several authors have suggested that the core of DT with its complexities and nuances ought to be situated in the academic field of design. They argue that a design mastery is needed to excel in the DT process, and that design schools should remain the main custodians of the core knowledge on DT, as a trained designer is more likely to offer a clearly unique thinking approach to the complex practice of DT (Johansson-Sköldberg, et al., 2013; Braun, 2014). They conclude that disciplines and business schools who claim to offer DT outside the design discipline are merely practising “designerly thinking” – the borrowing and adaptation of design toolkits, methods, and innate competencies of a designer (Johansson-Sköldberg, et al., 2013; Braun, 2014).

In similar vein, this current presentation advocates for a discipline-based mastery of DT as an essential tool for negotiating the complex fourth industrial revolution (4IR) and the African social realities. As earlier alluded, the 4IR is currently confronted with new problems and new issues related to ethics, accountability, responsiveness and other undiscovered issues that will require heuristic techniques to solve. I therefore propose that DT can become the ideal heuristic technique to deal with these issues that may emanate as a result of the increasing dependency on smart machines, artificial intelligence and other elements of 4IR especially within the contest of South Africa and Africa. Despite South Africa's recent funding and positioning as a leader in 4IR in the continent, there remains a need to use these technologies to solve longstanding issues related to socio-economic disparity, race relation, corruption and other issues that continue to blight the country.

Criticism of design thinking and why designers must take the lead

Like any design strategy, DT has been subjected to numerous criticisms. For example, Natasha Iskander (2018) notes that the claims that DT encourages innovation is untrue, instead, she argues that DT uses strategies that seek to limit participation, preserve and defend the status-quo, thus privileging designers above the people they claim to serve. Other critics have noted that DT as a method is defined poorly, and that "it is little more than basic common sense, repackaged and then marketed for a hefty consulting fee" (Vinsel, 2018). In fact, Iskander (2018) further argues that DT is simply a "dumbed down" — version of the methods that designers use, which has now been enthusiastically embraced by managers and policy makers, government and various disciplines in higher institutions. However, irrespective of the view core designers, DT has re-emerged and is increasingly embraced as one of the most sort after interdisciplinary approach for social innovation in South Africa and across the globe. In the fourth industrial revolution, there has been a great deal of emphasis on interdisciplinary or need for multi-disciplinary teams to come together to solve real-world problems (WEF, 2018). DT seem to be taken the lead in this regard. However, for it to thrive in South Africa, the Design curriculum must be reworked to emphasise DT or at least there has to be a level of commitment from design schools in South Africa and Africa towards providing the conditions for DT to flourish.

The state of design thinking and 4IR in contemporary South Africa

The COVID-19 pandemic struck at a time when South Africa government and the private sector had begun a concerted partnership towards digitising and re-positioning its economy towards the fourth industrial revolution. On 9 April 2019, the South African President, Cyril Ramaphosa established a 30-member Presidential Commission on 4IR to develop an integrated national response strategy and determine areas of development in the short, medium and long-term within the 4IR.[52] This was followed by an inaugural fourth industrial revolution (4IR) Digital Economy Summit of July 2019 where the president declared that "South Africa had chosen to be a country of the future at a time when the world was changing at a pace and in a manner

[52] http://www.thepresidency.gov.za/press-statements/president-appoints-commission-fourth-industrial-revolution.

that was unprecedented in human history”. In an address on January 10 2020, the president also reiterated that:

> *[T]he fourth industrial revolution (4IR) represents the great tectonic shift of our time. It is creating new possibilities for improving people’s lives. Disruptive technologies like machine learning, artificial intelligence, and big data are changing the way we live, the way we work and do business, and the way we govern.*[53]

This speech highlights the radical shift towards the 4IR by the SA government like most governments and industries around the world. The government swung into action when it launched the “4IR Skills Programme”, a programme aimed to upskill and build capacity for the SA’s economy of the future. As part of the programme, the South African Department of Communications and Digital Technologies and Partnership through the Media, Information and Communication Technologies Sector Education and Training Authority (MICT SETA) partnered with private technology companies Microsoft to train over 1000 learners, skills that are key in fourth industrial revolution. This includes, data science, 3D printing, cloud computing, drone piloting, software development, cyber security, digital content production.[54]

Interestingly the MICT-SETA recently updated under its 4IR qualifications menu that it intends to develop and register qualifications that align with the fourth industrial revolution.[55] It listed the following

- Artificial intelligence
- Cyber security
- Cloud computing
- Data science
- Software development
- Internet of things
- Robotic processing automation
- Design thinking
- Quality engineering automation
- eWaste.

From above list, one can observe that DT is recognised as a crucial component of the fourth industrial revolution (4IR) and an important skill in a digital economy. This means that businesses can adopt DT for socio-technological and product innovations while actively participating in the South Africa government’s National Development Plan. More importantly, there is a need for design educators in South Africa to begin to develop a more unified locally-relevant DT frameworks to train students to be active participants in the digital economy and the fourth industrial revolution.

A number of South African educational institutions (mostly private) have emerged in the last few years awarding DT degrees and trainings across the country. A few of them are listed below:

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[53] https://www.brookings.edu/blog/africa-in-focus/2020/01/10/a-national-strategy-for-harnessing-the-fourth-industrial-revolution-the-case-of-south-africa/

54 https://www.mict.org.za/4ir-skills-programme/

55 https://www.mict.org.za/the-fourth-industrial-revolution/

- Hasso Plattner Institute of Design Thinking at the University of Cape Town (d.School);
- The Design Thinkers Academy South Africa (https://www.designthinkersgroup.co.za/);
- The Design Center (https://designcenter.co.za/tcp-2_30_508-higher-certificate-in-design-thinking-nqf5.html). This private institution awards an NQF 5 Higher Certificate in Design Thinking;
- The Design Thinkers Group (https://www.designthinkersgroup.co.za/designthinkers-academy-1);
- Design for Change (DFC) South Africa Design for Change (http://www.dfcworld.com/SITE); and
- Craft & Design Institute (CDI) (https://www.thecdi.org.za/).

While DT training is offered across various disciplines and modified to meet varying disciplinary demands and business needs, several authors have suggested that the core of DT with its complexities and nuances ought to be situated in the academic field of Design. They argue that a design mastery is needed to excel in the DT process, and that design schools should remain the main custodians of the core knowledge on DT, as a trained designer is more likely to offer a clearly unique thinking approach to the complex practice of DT (Johansson-Sköldberg, et al., 2013; Braun, 2014). They conclude that disciplines and business schools who claim to offer DT outside the design discipline are merely practising "designerly thinking" – the borrowing and adaptation of design toolkits, methods, and innate competencies of a designer (Ibid).

DT is also relevant and in tandem with the broader calls for decolonisation of knowledge and the South African higher institutions of learning. The design field can be at the forefront of decolonisation when it refocuses its mandate from seeing design in terms of functionality or aesthetics to positioning itself and providing students with methods such as DT as a powerful ontological tool capable of transforming the social and cultural reality, and modelling human experience, subjectivity, and lifestyle. This is because as Tlostanova (2017, p. 1) notes "design is clearly one of the few spheres in which ontology, epistemology, and axiology intersect in a dynamic and creative way". Globally, decolonisation in the field and practice of design has largely emphasised the need for people-centred co-design processes that allow anyone and everyone participate in design process irrespective of their expertise or socio-economic, gender and racial identities or positions in the society. DT embodies this principle. DT when adapted in the global South context has the capacity to allow people critically reflect and contest frames of normalised modernity/coloniality. Studies such as Rashied and Bhamjee (2020) have shown that for the Global South to reap the benefits of the fourth industrial revolution and avoid renewed (economic) coloniality in the hands of the more developed Global North, it needs to decolonise the 4IR technology.

Hence, in this precarious era of 4IR, DT can be a critical facilitator around coloniality and other complexity associated with accompanying new technologies. DT has thus been regarded as a technology in its own right—a social technology that encourages more productive innovation conversations that are strategically valuable for dynamic capability building. DT can accelerate progress on critical imperatives: allowing innovators at all levels to sense new opportunities; seize them by overcoming cognitive biases and aligning stakeholders; and transform and reconfigure resources. It accomplishes this through a set of well-recognised practices (Pitsis, et al., 2020). It emphasises human-centred principles that focus on an empathetic understanding of people and their specific needs. In an era of rapid social, environmental, and technological change, orienting the innovation process around human-centred design principles can provide a much-needed focal point. DT and similar approaches remain stubbornly analogue in seeking solutions that place human needs at the forefront. It asks questions of how with technology we can examine the emotional engagement of the clients and most importantly to the question of customer self-esteem. When Businesses adopt a DT as a user-centred approach, their evolution happens in ways that are both tangible and experiential. Products will be tailored and formulated to exact specifications based on lifestyle, usage, and even genetics of the end users.

According to DT expert at IDEO, Tom Kelley, Design Thinking Brief in 4IR poses the following question:

- What if everyone in the organization help innovate?
- How do we get better at divergent thinking?
- How do we balance the needs of people, technology, and business?
- How do we expand innovation beyond technology?
- How might we manage innovation portfolio?
- How might we (re)create essential services that we use?
- How might our customers help us innovate?
- How might we redesign large-scale systems?
- How do we make products that have minimal environmental impact?
- Where might the next destructive innovation come from?
- How does design help people move out of poverty?
- How might we make health care cost less?
- How do we educate future innovators?
- How do we impact through innovation?
- How do I make myself more creative?
- How do I have more impact through innovation?

The COVID-19 pandemic disruption of familial face-to-face interactions means that the entire process of the DT may be coordinated via electronic means of communication. Platforms such as Zoom, Microsoft Teams, and Slack can be used to facilitate the various stages of the DT process while connecting to various stakeholders (between employees, management, customers, investors, among others). Empirical studies have shown that prioritizing innovation during crisis (such as pandemic) is the key to unlocking post-crisis growth (Am, et al., 2020). As we await normalcy or are compelled to accept the idea of a “new normal’, it is important for organisation and businesses to commit to innovation and innovative solutions using DT methods. This will allow them connect deeply with the customers and stay ahead of the curve. DT has proven to lead to sustainable benefits for all stakeholders (internal and external).

Conclusion: A call for a unified South African design-thinking curriculum

The DT approach has been used effectively in the private sector to innovate and create solutions for competitive advantage. In today’s globally competitive world, design schools themselves ought to be at the forefront of DT education and research and this should be encouraged in South African design education system. In addition to being a vital resource in the fourth industrial revolution, DT also immerses students and teachers (i.e. the designers) in real-world problem solving, allowing them to contribute meaningfully to the society. It encourages interdisciplinary in its aim to solve humanity’s daunting problems

While DT training is offered across various disciplines and modified to meet varying disciplinary demands and business needs, there are calls for real designers and the design schools to take the lead as custodians of the core knowledge on DT. This is against the backdrop of the perception that a trained designer is more likely to offer a clearly unique thinking approach to the complex practice of DT. There is therefore a need to incorporate DT into design curriculum to produce trained DT facilitators who may be able to work outside the design space to help innovate and solve some of the daunting challenges in the era fourth industrial revolution.

This current presentation advocates for a discipline-based mastery of DT as an essential tool for negotiating the complex fourth industrial revolution (4IR) and the African social realities. As earlier alluded, the 4IR is currently confronted with new problems and new issues related to ethics, accountability, responsiveness and other undiscovered issues that will require heuristic techniques to solve. South Africa's concerted effort towards positioning its economy for the 4IR presents an opportunity for design educators to design a locally relevant DT methodology and framework to address the many complex problems that accompany the technology and add value to peoples' lives. As discussed throughout this paper, empirical studies have shown that indeed, DT makes the difference in terms of enhancing or augmenting the impact of technology. DT has the potential to identify longstanding societal problems (in areas such as healthcare, education, urbanisation, housing, among others), as well as new opportunity areas being created by the changing technological landscape. Despite numerous criticisms from designers and other academy-based scholars, DT has evolved into a 4IR essential skills. Hence, Design educators ought to begin to reflect on how best to integrate DT into the design curriculum.

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SPOT, the 4IR soft skills strategy for South African interior design graduates: An integrative literature review

Leana Scheffer, *Inscape Education Group*

Abstract

The 2020 South African Presidential Commission on the fourth industrial revolution (4IR) presented five development pillars for the South African 4IR strategy, with the People and Skills pillar emphasising the role of the education sector in South Africa's successful global participation in the 4IR. The report identifies a lack of soft skills such as creativity and problem solving in new graduates, adversely affecting their work-preparedness and employability. The World Economic Forum's 15 top skills for 2025 also placed soft skills as the top six future workplace skills. Tertiary educators have the opportunity and responsibility to prepare graduates for this shift to the 4IR-workplace by developing soft skills relevant to their discipline.

Soft skills literature is obscured by differences in terminology and definitions across disciplines and locations. The lack of consistency hampers educators in identifying soft skills relevant to their field and the appropriate pedagogy to teach them. This paper employs an integrative literature review to synthesise soft skill categories relevant to the current and 4IR-adapted interior design workplace while also identifying sources that include pedagogy to facilitate teaching these skills. Findings include two approaches to soft skills specific to interior design and interior architecture, namely an individual skills approach and a skills category approach.

The study's contribution includes an increased awareness of soft skills in the context of 4IR and interior design, but also design disciplines in general. The identified pedagogy-related sources can support educators in preparing South African interior design graduates for the current and 4IR-adapted workplace. This study proposes a conceptual 4IR-soft skills model that expands on the existing CORE model by Parlamis and Monnot. The strategy encompasses four integral relationships needed for 4IR soft skills development, specifically the individual-to-Self, individual-to-Organisation, individual-to-Person, and individual-to-Technology relationships, called the SPOT model. The study concludes with an application strategy for the model to assist educators in determining context-specific and discipline-specific soft skills that can be developed in the classroom.

Keywords: 4IR skills, design pedagogy, employability skills, interior architecture, interior design, soft skills, twenty-first-century skills

Introduction

In March 2020, the South African Presidential Commission on the fourth industrial revolution (PC4IR) presented five development pillars for South Africa's 4IR strategy: "Technology, Invention and Innovation; People and Skills; Infrastructure, Resources, and Natural Environment; Economic Growth and Inclusivity; and Stakeholder Relations and Governance" (PC4IR, 2020, pp. 90-91). This report's *People and Skills* pillar emphasised the education sector's role in South Africa's successful global participation in the 4IR, specifically by nurturing technical, digital, and soft skills (PC4IR, 2020, pp 117). Xing, Marwala and Marwala (2018, p. 173) supports this by emphasising access to quality higher education as integral to adapting to a South African 4IR future. Educators have the opportunity to prepare South African interior design graduates for the shift to a 4IR-workplace by developing their technical, digital, and soft skills. This study prioritises the soft skills category in relation to 4IR by proposing a conceptual model and approach to a holistic 4IR education strategy.

Education and 4IR in South Africa

For South Africa to contribute to the global 4IR movement, we need to be mindful of our current educational challenges (Moloi & Mhlanga, 2021; Xing, Marwala & Marwala, 2018) and work towards the South African 4IR strategy by leveraging our current position. A study by Moloi and Mhlanga (2021, pp. 3-4, 17-18) demonstrates that despite increasing government budget allocations and enrollment numbers in basic education, student performance remains poor, and a lack of technical competency training and technical infrastructure is a significant challenge for educators. The lack of technical competency in basic education affects tertiary educators, who need to address the skills deficit. Further education challenges include country-wide access to higher education for all economic classes; quality education with regular intake of new academics; and funding (Xing, Marwala & Marwala, 2018, p. 179). This paper acknowledges the complexities of the existing education system briefly introduced here but agree with Oke and Fernandes (2020, p. 19) that incremental steps towards a holistic 4IR education strategy will help guide the efforts of educators.

A study of the perceptions of the South African education sector on 4IR highlights mixed sentiments of unpreparedness, excitement and fear of redundancy due to limited knowledge of 4IR's place in the classroom and future workplace (Oke & Fernandes, 2020, p. 21). This study points to educator 4IR literacy as a critical development point. The effects of 4IR on the future South African workplace are also integral to a holistic 4IR education strategy but are beyond this study's scope.

The South African 4IR strategy emphasises developing students' technical, digital and soft skills (PC4IR, 2020, p. 117). As technical- and digital access fall primarily under government and institutional policies and budgets, these are out of educators' sphere of influence. Therefore, this paper will investigate the skills development aspect of a 4IR educator's strategy and focus on soft skills. Joynes, Rossignoli and Amonoo-Kuofi (2019, p. 11) support this approach by demonstrating that industry-relevant soft skills development facilitates better student workplace integration. Tertiary education curriculum aims to develop industry-ready graduates with a predetermined set of hard and soft skills that meet industry expectations of competency (Gale, et al., 2017, p. 50). Hard skills are defined as being industry-specific technical skills (Gilyazova, Zamoshchansky & Vaganova, 2021, p. 242), in contrast to soft skills, which combine "cognitive and meta-cognitive skills, interpersonal, intellectual, and practical skills" (Gilyazova, Zamoshchansky & Vaganova, 2021, p. 243).

Methodology

This paper employs an integrative literature review that evaluates and integrates literature with the aim of synthesising a preliminary conceptual approach to a new topic (Snyder, 2019, pp. 335-336).

The search method used the Google Scholar platform with topic keywords. Keyword combinations formed sets, and the Boolean operator "AND" was used to ensure both keywords were included. The quotation marks search modifier was used to create compound keywords for exact search results. Data gathering was conducted using consecutive keyword sets summarised in Table 1. Duplicate results were only captured once in the set where they appeared in the search results the first time. The review included search dates from 2011 to the present, with the date selection being based on the first mention of the fourth industrial revolution or 'Industry 4.0' at the 2011 Hannover Fair in Germany (Schwab, 2016, p. 12). Results were sorted by relevance, not by date. The search results were reviewed at least up to page five of the Google search results or until 30 consecutive entries did not yield any results (approximately three result pages of a Google search set on ten results per page). Results that did not relate directly to interior design or interior architecture were omitted; for example, some positive matches were due to a reference entry with the term 'interior design' in it, i.e. Journal of Interior Design. Only literature with the abstract and main text in English was included – acknowledging the exclusion of a possibly relevant Russian study with an English abstract and Russian main text investigating the relationship between soft skills and educational programs (Tsalikova & Pakhotina, 2019).

The need for the study was tested using the above methodology, using the keyword set: "soft skills" AND "interior design" AND "South Africa". The test search resulted in only one source by Cilliers and Smit (2014), which compares the work-integrated-learning management models of South African and international universities (Table 1). This study's only reference to soft skills is in the literature study section and about the twenty-first-century skills graduates need, including "information, technical skills, and soft skills" (Cilliers & Smit, 2014, p. 14).

Preliminary reading and the data gathering process highlighted several terminology variants related to the term soft skills, identifiable in each text's keyword section or title. Variants include 'employability skills', 'pervasive skills', 'life skills' (Joynes, Rossignoli & Amonoo-Kuofi, 2019, pp 15), 'non-cognitive skills' (Goodspeed, 2016, p. 2), 'interpersonal skills', 'people skills', 'twenty-first-century skills', and '4IR skills'. Touloumakos (2020, p. 4) and Alrifai and Raji (2019a) confirmed these observations, who found that literature sources use different terms and definitions to describe the same soft skills and that terminology use differs between locations and study fields. The terminology variants were evaluated to determine if they warranted inclusion in subsequent search sets. 'Interpersonal skills' and 'people skills' are types, or categories, of soft skills and not a soft skill synonym, so they were excluded from future keyword searches. Terminology such as 'pervasive skills', 'life skills' and 'non-cognitive skills' is not commonly used in South Africa and was therefore excluded. Due to the study's focus on 4IR industry-ready graduates, 'employability skills', 'twenty-first -century skills', and '4IR skills' terminology variants were added to the subsequent keyword set searches. The final data set included 25 sources, with the results from each search set summarised in Table 1 and organised by source type.

Table 1: Data gathering keyword sets and results

Sequence and keyword sets	Search results* by source type
1. “soft skills” AND “interior design” AND “South Africa”	One article (Cilliers & Smit, 2014)
2. “soft skills” AND “interior architecture” AND “South Africa”	None *(even with an unlimited date range)*
3. “soft skills” AND “interior design”	Nine articles (Alrifai & Raji, 2019c; Cho, et al., 2015; Gale, et al., 2017; Galford, Hawkins & Hertweck, 2015; Huber, 2018; Omar, Bakar & Rashid, 2012; Weng, 2017); two master’s dissertations (Chappelear 2019; Guevera, 2019)
4. “soft skills” AND “interior architecture”	Three articles (Kahn, Brinner & Gibson, 2018; Limwongse & Chattarakul, 2012; Venter & Van Der Wath, 2014); One master’s dissertation (Johnson, 2018)
5. “employability skills” AND “interior design”	Five articles (Alrifai & Raji, 2019a; Alrifai & Raji, 2019b; Billau & Stirling, 2016; Huber & Waxman, 2019; Manoj, 2020); two master’s dissertations (Hedrich, 2011; Ntinyari, 2014); one book (Bridgstock & Tippet, 2019)
6. “employability skills” AND “interior architecture”	One article (Teczan, et al., 2020)
7. “twenty-first -century skills” AND “interior design”	Two articles (Jewpairojkit, Rattanolarn & Ekwuttiwongsa 2019; Tansiri, et al., 2018)
8. “twenty-first -century skills” AND “interior architecture”	No new sources
9. “4IR skills” AND “interior design”	None *(even with an unlimited date range)*
10. “4IR skills” AND “interior architecture”	None *(even with an unlimited date range)*
11. "fourth industrial revolution skills" AND “interior design”	None *(even with an unlimited date range)*
12. "fourth industrial revolution skills" AND “interior architecture”	None *(even with an unlimited date range)*
TOTAL	25 SOURCES

Findings

Single skill approach vs category approach

The majority of the identified sources compile lists of different soft skills relevant to interior design or interior architecture in the location of the study (Table 2). Studies are based on previous literature and primary research such as surveys and interviews (Alrifai & Raji 2019a; Alrifai & Raji 2019b; Alrifai & Raji 2019c; Billau & Stirling, 2016; Chappelear, 2019; Cho, et al., 2015; Gale, et al., 2017; Guevera, 2019; Hedrich, 2011; Huber, 2018; Johnson, 2018; Kahn, Brinner & Gibson, 2018; Limwongse & Chattarakul, 2012; Manoj, 2020; Ntinyari, 2014; Omar, Bakar & Rashid, 2012; Tansiri, et al., 2018; Venter & Van Der Wath, 2014; Weng, 2017).

Fewer studies follow a category-based approach (Table 2), which groups the individual skills into themes or categories (Gale, et al., 2017; Huber & Waxman, 2019; Jewpairojkit, Rattanolarn & Ekwuttiwongsa, 2019; Ntinyari, 2014; Omar, Bakar & Rashid, 2012; Teczan, et al., 2020). The category approach is similar to the WEF report's reference to the O*NET Content Model (2020, pp. 155-156).

Pedagogy

Initially, a second data-gathering phase was planned to identify appropriate pedagogy related to the keyword sets, i.e. soft skills, employability skills, twenty-first-century skills, and 4IR skills. Surprisingly, the initial data-gathering phase contained a significant number of sources specific to pedagogy and teaching practice (Billau & Stirling, 2016; Bridgstock & Tippet, 2019; Chappelear, 2019; Cho, et al., 2015; Cilliers & Smit, 2014; Galford, Hawkins & Hertweck, 2015; Hedrich, 2011; Huber, 2018; Johnson, 2018; Kahn, Brinner & Gibson, 2018; Limwongse & Chattarakul, 2012; Manoj, 2020; Ntinyari 2014 Venter & Van Der Wath, 2014). The results meant the second data-gathering phase was unnecessary (Table 2).

Table 2: Summary of topic keywords and approach in relation to sources

Topic keyword	**Sources with a single skill approach**	**Sources with a skill category approach**	**Pedagogy-related sources**
Soft skills	Chappelear, 2019; Cho, et al., 2015; Gale, et al., 2017; Guevera, 2019; Huber, 2018; Johnson, 2018; Limwongse and Chattarakul, 2012; Venter and Van Der Wath, 2014; Weng, 2017	Gale, et al., 2017; Huber and Waxman, 2019	Chappelear, 2019; Cho, et al., 2015; Cilliers and Smit, 2014; Huber, 2018; Johnson, 2018; Limwongse and Chattarakul, 2012; Venter & Van Der Wath, 2014
Employability skills	Alrifai & Raji, 2019a; Alrifai & Raji, 2019b; Alrifai & Raji, 2019c; Billau & Stirling, 2016; Hedrich, 2011; Kahn, Brinner & Gibson, 2018; Manoj, 2020; Ntinyari, 2014; Omar, Bakar & Rashid, 2012; Weng, 2017	Huber & Waxman, 2019; Ntinyari, 2014; Omar, Bakar & Rashid, 2012; Teczan, et al., 2020	Billau & Stirling, 2016; Bridgstock & Tippet, 2019; Galford, Hawkins & Hertweck, 2015; Hedrich, 2011; Huber, 2018; Kahn, Brinner & Gibson, 2018; Manoj, 2020; Ntinyari, 2014; Teczan, et al., 2020
Twenty-first - century Skills	Limwongse & Chattarakul, 2012; Tansiri, et al., 2018	Jewpairojkit, Rattanolarn & Ekwuttiwongsa, 2019; Joynes, Rossignoli & Amonoo-Kuofi, 2019	Limwongse & Chattarakul, 2012
4IR skills	None relating to the interior design or interior architecture discipline		

In summary, the study's main findings include two approaches to classifying and representing soft skills and the terminology variants specific to interior design and interior architecture, namely an individual skills approach and a skills category approach, and identifying sources detailing the pedagogy supporting soft skill development.

Although some studies focus on industry perceptions (Gale, et al., 2017; Huber, 2018), none have been done in South Africa. There are currently no studies on student perceptions of soft skills. Future studies should address these gaps and could also elaborate on more specific pedagogic strategies.

Discussion

Inconsistent approaches to soft skills

A critical starting point for this study was a semi-systematic literature review by Touloumakos (2020), who reviewed soft skill-related texts up to 202. The study demonstrated how the meaning of the term ‘soft skills’ has evolved from knowing how to perform an action to include cognitive processes, employee descriptions, and work activities. The literature study culminated in the identification of nine soft skill categories: “qualities and values, attitudes, problem-solving and creativity, leadership and self-management, interpersonal skills, communication skills (interpersonal communication and communication of work), emotional labour (self-regulation), professional appearance, and cognitive abilities and planning” (Touloumakos, 2020, pp. 3-4). Both Touloumakos (2020, p. 4) and Chalkiadaki (2018, p. 3) critiqued the use of inconsistent definitions and characteristics, combinations of single skills and categories, and decontextualising of skills where studies did not elaborate on successful skill demonstration, which in turn impedes its effective integration into curriculum design.

Touloumakos’ critique on lack of uniformity in approach is evident when comparing the South African 4IR strategy (PC4IR, 2020) with two of its primary sources, the World Economic Forum’s 2020 Future Jobs report (WEF, 2020) and the McKinsey Global Institute’s (MGI) Skill Shift discussion paper (MGI, 2018). Firstly, the South African 4IR strategy proposes 12 critical soft skills, but has no accompanying skill categories (PC4IR, 2020, p. 118).

The 2020 Future Jobs report (WEF, 2020, pp. 36) lists the survey results of the top 15 skills for 2025 and the changes in the perceived importance of eight skill groups over time. The WEF 2020 Future Jobs report uses the government’s [USA] Occupational Information Network (O*NET) content model to classify skills into competency bundles and synthesise them into four competency types, namely ‘Skills and Knowledge’, ‘Attitude’, ‘Abilities’, and ‘Cognitive’. The competency types include subcategories (WEF, 2020, pp. 155-156), tiered relationships between skills and skill groups, and skill definitions. The four competency types do not align with the survey’s eight skill groups, except for the cognitive competency, which points to a possible disconnect between industry needs and institutional definitions of occupational competency. There are five exact terminology overlaps between the WEF top 15 skills and the SA 4IR strategy’s 12 critical soft skills, namely Complex Problem-solving, Critical thinking, Creativity, Emotional intelligence, and Negotiation (WEF, 2020, p. 36; PC4IR, 2020, p. 118).

The McKinsey Global Institute’s Skill Shift discussion paper identifies 25 workforce skills which include hard and soft skills, categorised under five categories, i.e. ‘Physical and manual skills’, ‘Basic Cognitive Skills’, ‘Higher Cognitive Skills’, ‘Social and Emotional Skills’ and ‘Technological Skills’ (MGI, 2018, p. 5). There are six exact terminology overlaps between the MGI 25 workforce skills and the South African 4IR strategy’s 12 critical soft skills, namely Critical thinking; Creativity; People management; Empathy; Communication, and Negotiation (MGI, 2018, p. 5; PC4IR, 2020, p. 118).

Comparing these overlaps shows only three soft skills present in all three reports: Critical Thinking, Creativity, and Negotiation. This comparison confirms and demonstrates the previous critique on approach inconsistencies (Chalkiadaki, 2018, pp. 3; Toulamakos, 2020, pp. 4). The single skill approach provides specific skills but cannot accommodate regional or interdisciplinary terminology differences.

Existing conceptual models for soft skills

The 21st-Century Skills report identified several existing models for general soft skills categories, namely the 4Cs model [critical thinking, communication, collaboration, and creativity]; the *3Rs* model [Rigour, Relevance and Respect]; the Other 3Rs model [reasoning, resilience and responsibility]; and the 3Ps model [passion, problem-solving, and producing] (Joynes, Rossignoli and Amonoo-Kuofi, 2019, pp. 12-13). This source was not identified during this study's data-gathering phase but provided an introductory overview of different soft skill category models. The terminology used to describe the model categories provides flexibility and the opportunity for regional or interdisciplinary interpretations, but the exact terminology and model goals do not match up.

Parlamis and Monnot (2019, pp. 226-227) suggest a substitution for the term 'soft' skills, with the acronym 'CORE' or **c**ompetence in **o**rganisational and **r**elational **e**ffectiveness. The CORE acronym embodies two skill categories integral to being a successful participant in the work environment, the relationship between the individual and the organisation, i.e. *organisational effectiveness*, and the relationship between the individual and the people linked to the organisation, i.e. *relational effectiveness*. Examples of organisational effectiveness are proposed as the "ability to influence others, read and manage others' emotions, manage conflict, negotiate, coach and mentor, understand organisational contexts, and develop meaningful networks" (Parlamis and Monnot, 2019, p. 227). Examples of relational effectiveness include "positive attitude, trustworthiness, effective communication, leadership ability, cooperativeness, responsibility, initiative, ability to manage emotions, team and self-awareness" (Parlamis and Monnot, 2019, p. 227). This study is unrelated to interior design and focuses on Management Studies, but the approach holds value for a holistic 4IR education strategy due to its category approach, supported by examples of specific skills linked to the graduate profile description of being a successful participant in the work environment. Simplifying the soft skills topic from individual skills to skill categories is necessary to allow flexibility and complexity within a conceptual framework.

Proposed conceptual model for 4IR soft skills development in South Africa: The SPOT model

The proposed conceptual model blends a learner-centred approach with the principle of interconnected relationships inherent in the "internet of things" (IoT) (Schwab, 2016, p. 22). The model places the learner at the core and describes the four relationships, or skills categories, integral to 4IR soft skill development.

The CORE model's (Parlamis and Monnot, 2019, p. 227) emphasis on relationships supports the importance of the human aspect in a 4IR future (Schwab, 2016, p. 95). These CORE relationships between the individual and the organisation, and the individual and other people (within or related to the organisation) form the proposed model's foundation. To address the South African 4IR strategy's (PC4IR, 2020, p. 69) pedagogic aims of creating lifelong learners, an essential addition to the above CORE model categories include the relationship between the individual and the self. The relationship between the self and technology enables the conceptual model to address the South African 4IR strategy (PC4IR, 2020).

The model aims to provide a contextually appropriate framework for soft skills development using the four integral relationship categories of individual-to-Self, individual-to-Organisation, individual-to-Person, and individual-to-Technology – summarised with the acronym, SPOT.

Where to next?

The incremental steps proposed by Oke and Fernandes (2020, p. 19) provide a practical strategy to approach the development. Suggestions for researchers and educators include:

1. Use a methodology similar to Gale, et al. (2017) and Huber (2018) to conduct a study in your area to determine the industry expectations of:
    a. the local vernacular and commonly used terminology for soft and hard skills specific to interior design or interior architecture (or other fields),
        i. descriptions of successful skill demonstration (Touloumakos, 2020);
    b. perceived strengths and weaknesses in graduates that have recently engaged with the organisation,
        i. the willingness and preferences of the organisation to hire graduates in relation to the identified soft and hard skills, and strengths and weaknesses
    c. categorise the local terminology variants of soft skills into the four relationship categories of the SPOT model: individual-to-Self, individual-to-Organisation, individual-to-Person, and individual-to-Technology, to identify regional industry strengths and weaknesses in terms of 4IR-readiness
2. Conduct an institution-specific study using the categorised terminology and definitions:
    a. determine the strengths and weaknesses of soft skills and hard skills in current or recent graduates of the specific institution
        i. cross-reference the current skill strengths and weaknesses against the SPOT model's relationship categories to identify institutional and curriculum strengths and weaknesses in terms of 4IR-readiness
3. Research the appropriate teaching framework, approaches and tools to develop these skills parallel to the existing curriculum.

Study limitations and strengths

Study limitations include the narrow search parameters of focusing solely on the interior design and interior architecture disciplines. Many sources are available on the topic, and due to the intended transferability of soft skills between disciplines, the parameters were likely too exclusive.

The study strengths are within the proposed conceptual model and incremental approach to identifying contextually relevant soft skills.

Conclusion

As educators, we have the opportunity to prepare South African interior design graduates and graduates of other disciplines for the shift to a 4IR workplace by developing their soft skills. 4IR literacy in educators and a thorough understanding of the effects of 4IR on the future South African workplace will help prepare educators for this opportunity.

The literature showcased two approaches to soft skills: a single skill approach that provides specific goals and a category approach that provides a development framework. Based on these findings, the study proposes a conceptual soft skill development model of four relationships, or categories, integral to 4IR. The four relationships include individual-to-Self, individual-to-Organisation, individual-to-Person, and individual-to-Technology relationships that form the proposed SPOT model. The study further proposes a practical strategy for educators on how to approach soft skills identification and development within a specific industry, institution, and context using the SPOT model.

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Problem placement in fashion design practice: Reflections and recommendations for fashion design education in an era of complexity

Terese Potgieter, *Stadio*
Carol Lavelle, *University of Johannesburg*

Abstract

This paper identifies the desired design outcomes and problem domains of experienced Johannesburg fashion designers, to provide recommendations for fashion design practice and education. Traditional fashion design education often emphasises aesthetics and technical construction before strategically deciding on where the design effort needs to be focused within complex integrated systems. However, within the context of the fourth industrial revolution (4IR), complex integrated systemic thinking is becoming increasingly important. As such, this paper provides an overview of the design outcomes of practising fashion designers and explores the correlation between the problems they manage and Buchanan's (1998) seminal proposition of problem framing and placement domains. Based on a master's study whereby a multiple-case study was conducted to observe, compare, and describe the communal design activities that experienced Johannesburg fashion designers manage using activity theory to analyse the complex nature of design, found that the biggest challenge faced by experienced fashion designers is their inability to define the complexity of the design problem. Against this backdrop and as the fashion industry moves into the fourth industrial revolution this paper identifies the design outcomes and problem domains that have to be considered as part of designers' practices that may be used to inform fashion education.

Keywords: Activity theory, fashion design education, fashion designers practice, problem placement

Introduction

The act of designing is fundamentally about problem solving. As design evolved from craft into professional practices and academic disciplines, it became increasingly focused on finding ways to add value to people's lives through solving complex problems (Dorst, 2019, p. 118, Friedman, 2016, p. xxii). Different design disciplines developed to offer solutions through products, services, and systems that can be sold to a market (Press & Cooper, 2003, p. 70, Dorst, 2011, p. 522). Regardless of the discipline, open-complex problems in design lie in the need "to conceive and plan what does not yet exist ..., before the final result is known" (Buchanan, 1992, p. 18).

The question that arises is what are the problem domains that experienced fashion designers manage? Relevant publications often used in fashion education by authors such as Elizabeth Bye (2010), Sue Jenkyn Jones (2011), Janice Greenberg Ellinwood (2011), Kathryn McKelvey and Janine Munslow (2012), Steven Faerm (2017), Sorger and Udale (2017) and Dieffenbacher (2020) suggest that fashion design is mainly concerned with garment aesthetics (the visual elements and principles of design and textile selection), and garment construction (pattern drafting, draping, and sewing). These publications place emphasis on the design processes and methods, creating the perception that fashion designers manage two-dimensional design problems that are situated within the parameters of communicating aesthetic appeal and construction methods of a product.

A focus on the process of design is not unique to fashion design texts, descriptive work about design, in general, have historically focused on analysing and describing the design process and methods (Tan, 2012, p.24, Dorst, 2008, p. 5, Lawson, 2005, p. 33). Although understanding the design process and methods are essential in education, other aspects of design such as solving problems at different levels in practice need further exploration (Black, 2010, p. 6, Dorst, 2008, p. 5, Cross, 2006, p. 100, Press & Cooper, 2003, p. 127). Fashion studies have predominantly focused on topics regarding the social, cultural, economic, and historical nature of fashion in neglect of fashion as an applied field of design (Morley 2013, pp. 12-13, Lavelle, 2013, p. 1). The lack of design-specific research in fashion has led to a vague understanding of experienced fashion designers' creative practice and the complexity of the design problems they manage. As the fashion industry moves into the fourth industrial revolution this paper reflects on what problems fashion designers are faced with, to better understand how fashion education needs to adapt.

This paper is based on the findings of a master's study that considered the holistic design activity of selected experienced fashion designers in Johannesburg through activity theory to describe their communal creative practice. One of the key findings of the study was that solving design problems is at the core of fashion design activity and practice. A recommendation of the study for further research, identified that more emphasis needs to be placed on exploring where design problems emerge and how experienced designers approach problems. As we move into the fourth industrial revolution it is necessary to reflect on the problems managed by expert designers, as business sustainability becomes increasingly reliant on the designer's ability to adapt through strategic thinking. Therefore, this paper relates fashion designers' design outcomes, to the problem domains situated within Buchanan's (1998) strategic modes of thinking.

Due to the complexity of design activity, activity theory provides a suitable framework to collect and analyse data as a basis for further reflection of design problems that emerge in practice. In this paper, we reflect on the findings of a master's study by firstly discussing design reasoning as proposed by Dorst (2019; 2011), secondly, reflect on the multidimensional design problems in fashion design through the dimensions of activity theory and thirdly, correlate design problems experienced by fashion designers with Buchanan's (1998) problem placement domains to identify the implications for fashion design education.

Design reasoning and problem framing

The necessity of understanding fashion design problem domains

"In its evolution from craft to sophisticated professional practice and academic discipline, design has had to find novel ways to deal with the ever-increasing complexity of the problems it needed to address” (Dorst, 2019, p. 118). In his article *Design beyond Design,* Dorst (2019) suggests that the best way to manage complex design problems is to start by considering the desired outcome. A basic human reasoning process considers the elements the world is made up of (the *what* of the design problem) and the connections between these elements (the *how* of the design problem) to realise the desired outcome (Dorst, 2019, p. 119).

Dorst (2011) explains that problem-solving reasoning patterns emerge according to what is known and unknown. The reasoning pattern of deduction can be applied when the *what* (products or services) and the *how* (working principles) aspects are known and can be tested in different contexts. Induction is inherently a creative process when the *what* and the *desired outcome* is known requiring the development of the working principles to achieve the desired outcome. Abduction-1 reasoning is required when the desired outcome is known as well as the *how* placing the design effort on *what* needs to be developed. Abduction-2 or design abduction requires the designer to start with the only known factor to solve the design problem (the desired outcome) requiring the designer to develop the working principles as well as the product or service.

If the best way to manage complex design problems is to understand the desired outcome, this begs the question, what is the desired outcome of fashion designs? When reviewing some of the most recent publications used in fashion education, very few insights into the outcomes of professional fashion designers are offered. Dieffenbacher (2020) explores the diverse strategies and thinking behind students’ design collections. This publication opens education up to more flexible, adaptive, and individual design processes, but the research is based on students not practising designers, and like the work of McKelvey and Munslow (2012) focuses on design process and methods. Faerm (2017) offers insight into the fundamentals of fashion design processes, design influences, and developing good aesthetics through fabric selection, including a focus on the user through customer profiles, but the depth lies in the process and methods of design, not the design outcome. We see the same focus in Sorger and Udale’s (2017) publication explaining the fashion design process. These texts have been vital in fashion design education to clarify known principles of how the fashion design process works but they do not explore the complex and multidimensional outcomes of practising fashion designers.

An overview of multidimensional design problems

There is some evidence in literature that there is a need to identify what constitutes multidimensional design problems. In fashion marketing Posner (2015) suggests that fashion design should have multidimensional outcomes to create a strategy for product profitability. Designers should create well-constructed collections that not only consider aesthetics, construction, and fit but also add value to the customer to differentiate strategically it from similar products offered by competitors. Posner (2015, pp. 42-43) based these suggested outcomes on Theodore Levitt’s total product concept model. Levitt (1983) proposed that consumers purchase more than just a core product. They are motivated by everything in the product that offers them value. The total product concept that was developed from Levitt’s work includes four outcomes:

1. **The generic or core product:** the basic product, such as a jacket or dress.
2. **The actual or expected product:** the expected design specifications, styling, and design details as well as price and quality.
3. **The total product:** everything the customer receives, the added value such as branding, emotional and intangible benefits.
4. **The potential product:** what the product could offer in the future.

If we consider the previous observations in this paper, that fashion design education is predominantly concerned with garment aesthetics and construction it appears that students only design at the first two levels of Levitt's total product concept model, the core and actual product. This is one approach from a marketing perspective on the different outcomes that need to be incorporated into a design problem, but it does not sufficiently deal with the complexity of the fashion design outcome. It does, however, highlight that design problems are multidimensional and that more research needs to be done to explore the problem domains within these dimensions.

Press and Cooper (2016, pp. 35-37) support this idea from a design perspective. They claim that organisations use design to increase their competitive advantage, placing focus on the need for design to be strategic to increase profitability. According to Press and Cooper (2016:, pp. 35-37, 64) design should dictate how products are manufactured, retailed, visualised, and communicated for sales. All of these factors contribute to the total product experience, and the value the product adds to give it a competitive advantage ***if*** approached strategically design contributes to the economic success of industries and companies (Press & Cooper, 2016, p. 40). These are typically problems of strategy that emerged in the latter half of the twentieth century and are important within the context of business. Buchanan (2019, p. 16), however, suggests that design has the potential to add value by integrating human experience forming the nexus where all disciplines of design can add value to the desired outcome. We suggest that to progress the idea of strategy (action) into human interaction (thought) that considers why designers do what they do, one first needs to identify what the activities of practising fashion designers are.

Activity theory as a suitable framework for studying the fashion design problem

Dorst (2008, p. 5) stated that to describe something as complex as design you need a framework that can describe the object of the activity (the design outcome), the actor, the context as well as the activities within the design process. In response to Dorst and Kuutti (2011, p. 5) identified activity theory as a suitable framework to describe design. Activity theory originated in psychology, where it was used as a cultural-historical theory to describe activity, but it has since developed into a multidisciplinary framework and has gained acceptance in Design Research (Engeström, 1999, p. 19; Kuutti, 2011, p. 5). The activity theory model identifies multiple perspectives on an activity related to its subject, tool, object, community, division of labour, and rules to provide a comprehensive description of real-world practices (Anthony, 2012, p. 338; Nardi, 1997, p. 8). It is important to note that the objective of the activity is at the centre of activity theory, and when relating this to this paper it means that the design outcome is at the heart of the design activity highlighting the need for designers to identify and solve interrelated problems in different domains using tools to achieve the desired outcome.

The components of the activity system can be applied to fashion design, to observe and describe the activity of practising fashion designers. Although the original study that the paper is based on described each of the activity system components, this paper will only focus on the findings related to the object, the design outcome, and problem domains. Figure 4 shows how the Activity system components were adapted to fashion design activity.

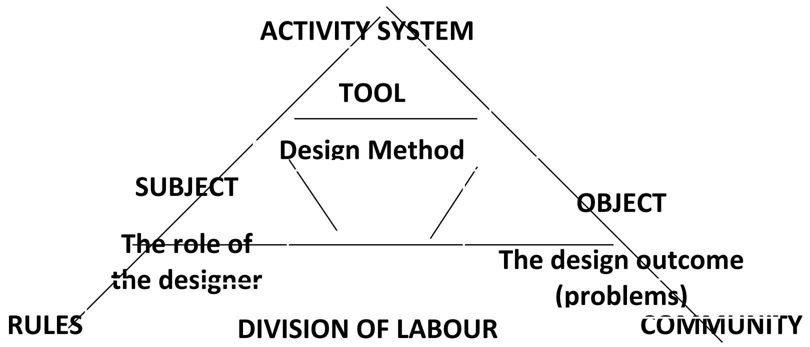

Figure 4: An adapted fashion activity system model, 2021 (Figure adapted by the author)

Research methodology

This paper reflects on the design outcomes and domains of design problems that experienced Johannesburg fashion designers are faced with daily to provide further recommendations for fashion design practice and education. To identify the design outcomes, the original study used a multiple-case study. Activity theory was used as a theoretical framework to collect and analyse the data. In this paper the findings of the multiple case study are reflected on and correlated with Buchanan's (1998, p. 13) design thinking matrix that identifies four orders of design used to interpret the problem domains that designers manage.

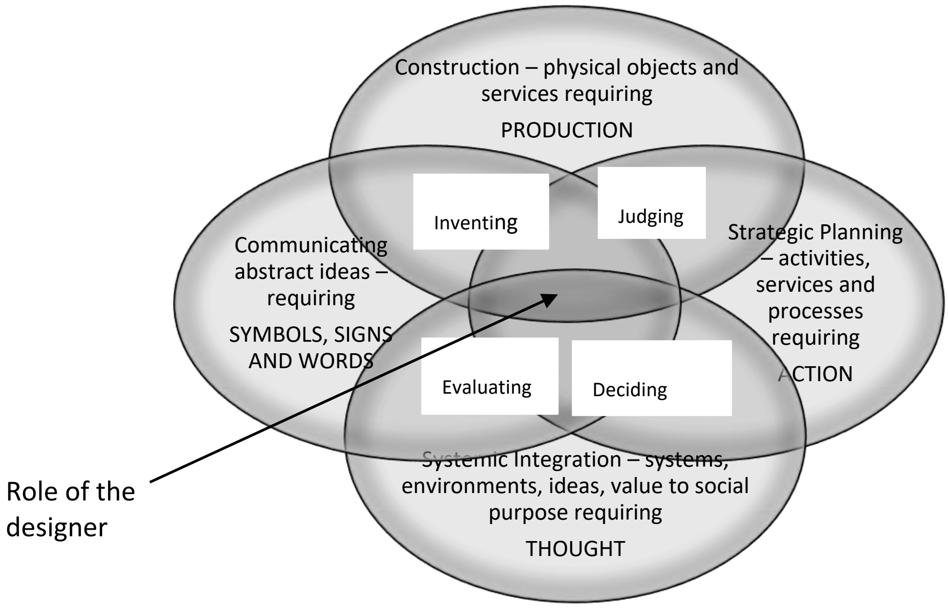

Figure 5: Problem placement areas (Adaption of Buchanan's (1998:13) four orders of design matrix)

Research approach and methodology

This paper adopts a qualitative approach to interpret and correlate the findings of a multiple-case study that was conducted to identify the design outcome and problem domains of selected fashion designers in Johannesburg through the lens of activity theory. A qualitative approach was taken to develop detailed descriptions of how the participants (subjects) involved interpreting their individual experiences of fashion design activity. Three cases were selected in the original study as the findings reached a point of saturation and redundancy and sufficient similarities emerged for conclusions to be made. The professional fashion designers were selected for the case based on their expertise as defined by the following criteria:

- The designer must currently be practising;
- The designer must have been practising for eight or more years;
- The designer must own their own business such as a fashion label or studio;
- The designer must have exhibited on multiple platforms such as fashion weeks; and
- The designer must have received recognition for their work through awards and/or media publicity.

A multiple-case study method was used to identify similarities through replication of three cases to validate the findings (Yin, 2014, p. 57). Each of the three designer's activity system models, as outlined in activity theory was viewed as an individual case. The findings of each individual case were first coded and analysed and then compared in a cross-case analysis to identify similarities within the designers' activity systems. The findings that emerged from this analysis were collated and clustered together to describe the designer's design outcomes. These findings are compared to Buchanan's (1998) problem domains to identify the problem domains of the fashion designers. Observations of the designers and their teams working in their studios were conducted through field notes and video recordings. Semi-structured interviews were also used as a data collection method to observe and describe each individual case. The triangulation of data from multiple collection methods allowed for in-depth and credible findings to emerge (Yin, 2014, p. 17; Merriam, 2009, p. 40).

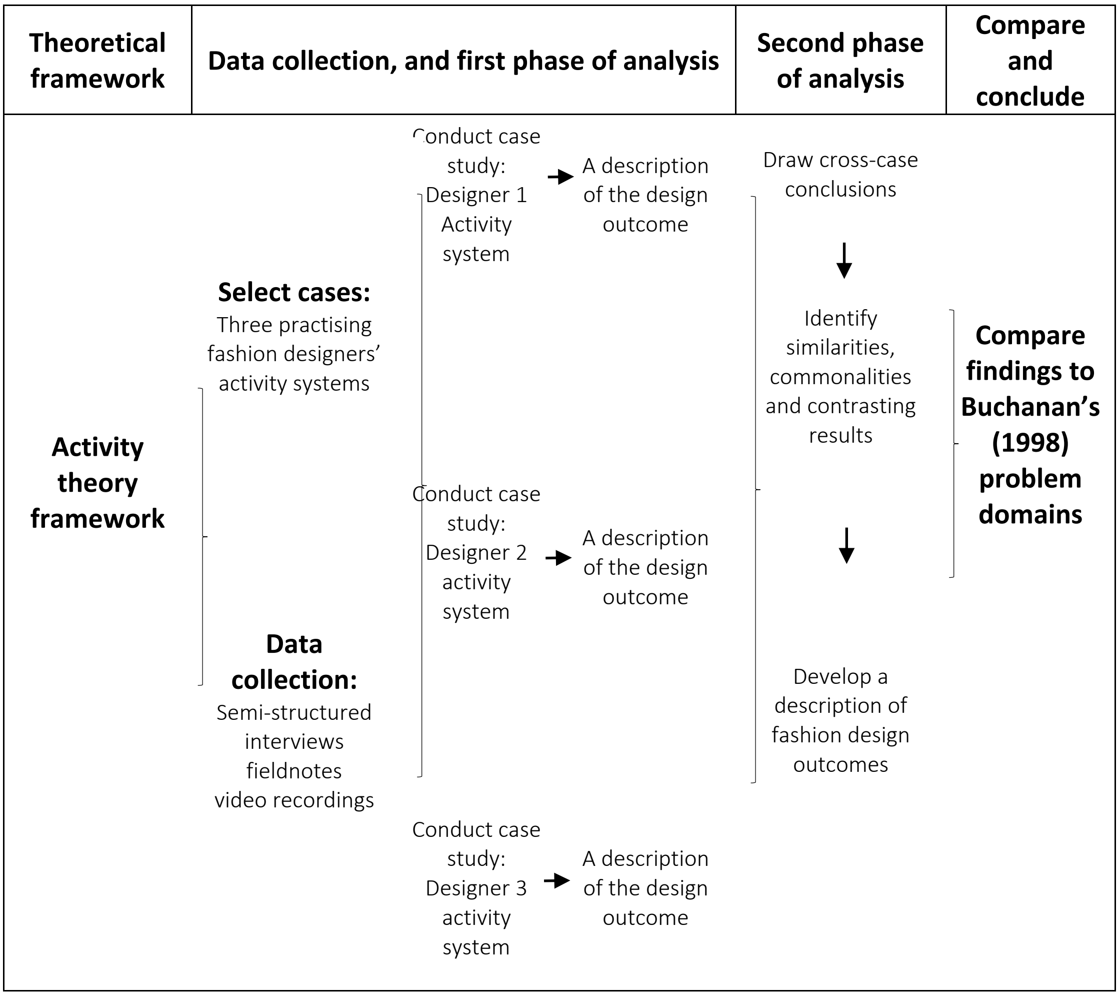

Figure 6: Multiple-case study method, 2021 (Figure adapted by the authors from Yin, 2014, p. 60)

Ethics

This paper is based on the finding of a master's study whereby permission to use the data was requested and granted by the departmental research committee within the Department of Fashion Design at the University of Johannesburg. Participation in the study was voluntary and consent was obtained from all participants through signed consent forms. An information letter was provided to all of the participants, to disclose the nature and the purpose of the research. The names of all participants are kept anonymous to keep their identities confidential. Furthermore, the interviews were transcribed verbatim to ensure that the data was accurately and truthfully disclosed.

Discussion of results

Fashion design outcomes

Fashion designers manage open-complex problems throughout the design process whereby each attempt to solve a problem changes the understanding of what the problem may actually be (the object and desired outcome). It is, therefore, necessary to review the interrelatedness of the outcomes that make up the complex design problem. This study reflects on the interrelated design outcomes of three fashion designers working on different types of design projects, namely commercial collections for an online shop and boutique, a runway collection for the South African Fashion Week, costumes for a theatre production, and bespoke designs for individual clients. This means that the data that emerged is relevant to a variety of design contexts. The participants in the study were concerned with five outcomes during all these projects, namely:

Aesthetic design. Aesthetic design refers to the distinct style and look that a designer is known for. Aesthetics are best described through the elements of design, colour, texture (fabric types), form (garment silhouette), and the shape of garment details.

Conceptual design. The design concept refers to the creative or strategic idea that informs the design of either an individual garment or a collection of garments. In this study, the design concepts were mainly emotionally and creatively motivated.

Functional design. Functional design considers how a garment services the wearer in relation to comfort, fit, and quality. The functionality of a garment refers to both how the garment is experienced by the wearer in terms of comfort, fit, and the practicality of garment details such as the pockets and openings, as well as the quality of the construction.

Profitable design. Profitable design is concerned with understanding consumers 'needs within a specific market category as well as their perceived value of a garment at a specific price point (the added benefits the consumer is receiving). Understanding the consumers' needs and expectations within the market category that the product is being designed for, is a strategic approach to increase profitability. This design outcome is also concerned with increasing sales by addressing as many consumers within the market category as possible by offering a variety of garments and garment styles. Lastly, this outcome is also concerned with promoting the products through various external communication strategies.

Responsible design. Responsible design is firstly concerned with sustainable design practices such as the reduction of waste during the manufacturing process and the sourcing of fabrics that have a low environmental impact both when it is produced and discarded. Secondly, this outcome is concerned with social responsibility and addressing social dilemmas.

It is important to note that these outcomes are interrelated and form part of a holistic and complex design problem. Profitability encompasses the design problem as the main objective of the designer, while also providing the strategic direction that informs the other design outcomes. The design concept can be informed by any of the other outcomes, runway collections often have a creative concept based on an idea, theme, or trend but the concept can also refer to the strategy behind a collection (this is not necessarily a runway collection). Aesthetics is the starting point or basis of a garment or collection and also strategically informs the design as each of the designer's brands has a distinct aesthetic that they are known for. The functionality of the garment can be related to aesthetics, as the fit of the garment directly correlates to the visual proportions of the body. The quality, fit, serviceability, and practicality of a garment directly motivate the consumer's purchasing decision that again relates to the strategy for increasing profitability. It is thus apparent that the design outcomes are interrelated and need to be considered holistically. Design problems are often described as being complex, this is evident if you consider multidimensional and interrelated outcomes that all form part of one design problem.

Fashion design problem domains

As the fashion industry moves into the fourth industrial revolution, we need to recognise the problems that designers are faced with, to understand how fashion design education can adapt to prepare students for the substantive challenges in an evolving professional practice. In particular, we need to understand the different design outcomes and how they correlate to the different design problem domains. Buchanan (1998, p. 13) argues that there are four main domains or four orders of design where problem definition and solution need to be considered simultaneously as solutions actioned in one domain may impact all other domains. These domains presented by Buchanan (1998:13) have been linked to fashion design outcomes as follows:

Symbolic and visual communication. The inventing of signs, symbols, and images are used as a representation for communicating information, ideas, and arguments. In particular, communicating the design idea forms part of the design process and promoting the design outcome of brand development. Some examples of these activities include sketching, draping, and computer-aided design (CAD) modelling as part of the design process and runway shows, social media, look books, and magazine adverts as part of promoting their brand identity to name a few. Within this domain of design, designers are required to interact with communication designers, journalists, and organisers of fashion events.

Construction of material objects. By judging physical products, the correct materials, and skills required to construct garment ranges that meet the physical, social, psychological, and cultural needs of their current and potential customers. Within this domain of design, designers interact with customer feedback, wholesalers, and valued teams consisting of pattern makers, technical designers, and manufacturers.

Strategic planning of activities and organisational services. Deciding on the most efficient action to reach specific objectives including meeting the needs of consumers within a specific market category, improving garment quality, manufacturing, and the consideration of how to improve their business and services to contribute to making the human experience more meaningful and satisfying.

Systemic integration of complex systems for living, working, learning, and playing. Evaluating the parts that make up complex systems and environments, such as the lived experiences of human beings that consider, reaching new understanding and social purpose regarding appropriate activity such as sustainable design and design aimed at solving social dilemmas as well as products requiring collaboration and interaction with other disciplines.

Buchanan (1998) highlights that it is important to note that these four domains of thought, action, products, and signs are interrelated and cannot be separated as problem framing in one domain will impact all other domains that have developed within contemporary society. The practices of fashion designers can be considered through these problem domains as they are necessary to run a business and to maintain a brand. These problem domains reflect the typical supply chain of a fashion system including symbolic and visual communication, design and construction, and strategy that is informed by action to meet customer needs. Within the context of the twenty-first century and 4IR, the domain of systemic integration presents the designer with the increasing challenges that need to navigate between the concerns of human-centred design, the inclusion of diverse participants, user experience design, and the negotiation of different values held by diverse participants to establish a middle ground to achieve what is possible requiring thought (Buchanan 2019:19).

Conclusion

As the fashion industry moves into the fourth industrial revolution, it is important to understand the complex problems that designers are faced with and to reflect on these problems within fashion education to ensure that students are adequately prepared to meet the challenges this new era presents. As more practical and technical skills become mechanised, the role of the designer as a strategist and thinker becomes increasingly important. As highlighted in the findings, the ability to design strategically for commercial success is informed by the different design outcomes and problem domains that make up the complex design problem. As such, this paper recommends that more emphasis should be placed on the different design outcomes and problem domains that designers manage.

The design outcomes and problem domains within education

A recommendation that has emerged from this study, is that the identified design outcomes and problem domains can be used to inform design theory, practice, and education. Traditional fashion design education often emphasises aesthetics and technical construction before strategically deciding on where the design effort needs to be focused within complex integrated systems. In the review of popular texts used in fashion education, it was evident that these texts, although vital to understand the fashion design process and method, do not explore the complex and multidimensional outcomes of practising fashion designers beyond aesthetics and functions. This has led to design problems within education that lack a strategic focus within a complex and integrated system. Furthermore, there is a need for theory that can underpin and inform the problems given in design modules and briefs, to ensure that they have the necessary strategic and systemic focus.

The nodes of problem placement in this paper can be used by educators to help identify suitable design theories that can be used to inform design briefs, such as human-centred design and experience design. For example, design thinking can be applied as an approach to involve -consumers' perspectives and understand their lived experience, product expectations, and how they interact with garments both as part of functional design and to integrate their social purpose and values. Sustainable design practices (such as upcycling, recycling, zero-waste design, and products with a circular lifecycle) and design for the common good (designs that improve the social, economic, and environmental condition of a consumer), can be applied to address consumers social purpose and values as part of responsible design and systemic integration. This is to name just a few examples, demonstrating how educators can use the problem outcomes and domains to identify suitable theoretical and methodological approaches that can underpin design briefs.

This study found that the biggest challenge faced by experienced fashion designers is their inability to define the complexity of the design problem. The contribution of this paper is to identify the design outcomes and problem domains that forms part of experienced fashion designers strategic thinking. As the fashion industry moves into the fourth industrial revolution the role of the designer as a strategist and thinker becomes increasingly important. As such this paper recommends that more emphasis should be placed in practice and education on the different design outcomes and problem domains that fashion designers manage to foster the strategic thinking that will allow fashion designers to adapt to any context of complexity.

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Visual hermeneutics and the fusion of horizons: Reflections on a globally networked learning project with graphic design students from three countries

Rolf J Gaede, *Durban University of Technology*

Abstract

The paper discusses a globally networked learning project with graphic design students from Mexico, the United States of America, and South Africa. Globally networked learning (GNL) aims for cost-effective internationalization strategies where digital platforms replace physical student exchanges. The project was designed according to Collaborative Online International Learning (COIL) principles, which included ice-breaker activities at the beginning of the project and reflection activities at the end. The participating students, who were all of a similar age and nearing the end of their undergraduate curriculum, were asked to identify one well-known designer from the geographic region in which their home university is located, as well as an already completed visual communication design produced by this designer. The participants were also required to discuss how the visual features of the chosen design link with the visual culture of the geographic region.

Methodologically, the paper is an ex-post reflection that focuses on selected features of the COIL project guided by theoretical concepts from visual hermeneutics, or the processes of interpretation and validation as applied to visual statements. The emphasis is on the notion of fusing horizons, which stems from Gadamer's version of the hermeneutic circle, where a first interpretation merges with a second interpretation after the interpretant was faced with a new situation. In the case of the COIL project discussed in this paper, the student's first interpretation of how the visual features of the chosen design link with the visual culture of the geographic region at the beginning of the project fuse with a second interpretation at the end of the project after having encountered the new situation of interacting digitally with graphic design students from another country. In this way, the main learning outcome of acquiring a deeper understanding of diversity in the context of design practice through a process of international collaboration was achieved.

Keywords: collaborative online international learning (COIL), fusion of horizons, graphic design education, visual hermeneutics

Introduction

Against the background of lockdowns and restrictions related to the global COVID-19 pandemic, this paper is located at a place where local culture, learning through technology, as well as the influences of the fourth industrial revolution (4IR) on higher education converge. The paper discusses a globally networked learning project with graphic design students from Mexico, the United States of America, and South Africa. Globally networked learning (GNL) aims for cost-effective internationalisation strategies where digital platforms replace physical student exchanges (Critelli, et al., 2017). As discussed in more detail below, the project was conducted according to Collaborative Online International Learning (COIL) principles (Guimarães & Finardi, 2021; Naicker, et al., 2021), which included ice breaker activities at the beginning of the project and reflection activities at the end of the project.

Methodologically, the paper may be described as a theory-driven *ex-post* personal reflection. In other words, the COIL project was designed and conducted as an integral part of a History and Theory of Graphic Design module taught on a third-year level, and not as a research project in its own right. This implies that no research hypotheses were formulated *ex ante* and then tested and evaluated in the course of the project, nor that the COIL assignment formed part of one or more plan-act-reflect cycles as typically employed in action research. Because research ethics clearance is never issued retrospectively, and the project was not screened by an ethics review committee prior to its implementation, this paper does not include any direct quotations or images that the participants contributed while interacting with each other, or while participating in the project in other ways.

As the students and lecturers who took part in the COIL assignment did not explicitly give their prior consent that any of the raw data[56] which accumulated in the course of the project may be published as part of scholarly research output, this paper stays at the level of a factual description of the main features of the project in general terms, and a personal reflective discussion of some of the issues which emerged. In addition, it is also important to point out that the theoretical concepts and principles which guided the collaboration that culminated in the project as it was eventually implemented are not the same as those which guide the ex-post discussion contained in this paper. Specifically, the negotiations with the international partners in Mexico and the United States of America, which occurred while we were busy exploring what type of joint project would be feasible, were based primarily on literature in the area of globally networked learning, and the scope and content of the assignment was informed by scholarly literature on COIL, as well as the input and advice of colleagues from other academic departments who shared their experiences with COIL in person. In contrast, the theoretical concepts from visual hermeneutics, as discussed in greater detail below, only entered the picture when the COIL project was already winding down, and the lecturers and students who had participated in it began with their own personal reflections.

The remainder of the paper covers a short description of the COIL assignment, which includes information about the level of study and courses at each participating institution, the main tasks that the students were asked to perform, as well as the learning outcomes which guided the activities. This is followed by a section that introduces visual hermeneutics and the notion of fusing horizons. The paper ends with a discussion about how the concept of fusing horizons applies to the phase of the COIL project during which the participating students met online with students from other countries to discuss the essay they had written about the work of a designer of their choice from the geographic region where their home university is located.

The collaborative online international learning (COIL) project

To elaborate on what was briefly mentioned above, one of the main advantages of the COIL approach is that it offers opportunities for "an alternative Thirdspace for promoting

[56] Even though it would have been heuristically valuable to include a few screen grabs from some of the videos which were produced in the course of the COIL project in this paper, as well as a small selection of images taken from the student essays, this was not done because the participants did not explicitly give their consent for this to occur.

intercultural encounters in the internationalisation of higher education" (Guimarães & Finardi, 2021, p. 1) in contrast to the traditional forms of internationalisation, which include physical student and staff exchanges as well as other activities which fall into the broad category of Global Citizenship Education (Guimarães & Finardi, 2021). A key hurdle which needs to be overcome by a lecturer who would like to include a COIL assignment in a module offered at the lecturer's home university is to identify one or more suitable international partners and to negotiate a joint project with them successfully. In our case, we relied on the Virtual Partnering Fair organised by the COIL Center attached to the State University of New York (SUNY), where lecturers can post their contact details together with ideas for a joint project. After getting in touch with each other via email, online meetings and shared online folders, we eventually agreed to a project with graphic design students from the University of Monterrey (UDEM) in Mexico, the Rockland Community College (RCC), which is part of the SUNY university system in the United States of America, and the Durban University of Technology (DUT) in South Africa.

Even though the majority of students in the three groups were of a similar age (roughly 20 years of age, or in their early 20s), and all three groups were studying towards a career in the graphic arts, there were significant differences with regard to student numbers. At the University of Monterrey 18 students were enrolled for the subject Packaging Design, while there were only six students at the Rockland Community College pursuing the course Graphic Design. At the Durban University of Technology 32 students were enrolled for the subject History and Theory of Graphic Design 3. In the light thereof, we agreed to a COIL project that was five weeks in duration and during which we allocated the participating students to groups in such a manner that six of the groups consisted of three to four DUT students, two UDEM students and one RCC student, and three of the groups had three to four DUT students and two UDEM students. Another important difference was that the language of instruction is Spanish at UDEM (American) English at RCC and (South African) English at DUT. However, the level of English language proficiency of the UDEM students was adequate for the project to proceed.

We took the COIL course design principles as contained in Rubin (2015) and other training materials of the SUNY COIL Global Network into account when we formulated the following learning outcomes for the joint assignment: After completing the project, the participants will (a) have acquired a deeper understanding of diversity in the context of design practice, (b) be able to compare and evaluate examples of visual communication designs from different geographic regions, (c) be able to collaborate internationally, and (d) be able to reflect on individual experiences, discuss the personal and academic relevance of these experiences, and evaluate the success of the COIL project.

We ensured that the assignment topic was sufficiently general in nature so that each of the participating lecturers could integrate it into their own modules without difficulty. It is also important to point out that the assessments of the student's assignments were done by the lecturers at the student's home university, and due to this we did not include any assessment criteria, or an assessment rubric, in the jointly negotiated assignment brief. At the end of the project, a certificate was issued to all students who had completed all the activities of the COIL assignment, regardless of how their lecturers had assessed their work. The jointly agreed on assignment brief read as follows: For this project, you are required to identify one well-known designer (contemporary or from history) from your geographic region and an already completed visual communication design (including graphic art, animation, short film, print media design, packaging design, online advertisement, instructional illustration, among others) produced by this designer. Your assignment must discuss how the visual features of the design link with the visual culture of your geographic region.

We also suggested to the students that (a) they choose a design which will be of interest to someone from another country, (b) the key features of the chosen design should not be too simple, and also not too complex. Ideally, the visual communication design should be of such a nature that it is possible to comfortably talk about it for five to eight minutes, (c) a design which contains both visual images and text will in all likelihood be more suitable, but that any text which is not in the English language must be accompanied by an English translation, and (d) the chosen design can be historical in nature or current/recent, but it must be possible to access background information about the context in which it was produced without any difficulty. In addition, the students received written guidelines about online etiquette, ways of bridging language differences, information about working across different time zones, as well as practical guidelines for recording online meetings.

In line with the above-described envisaged learning outcomes, the COIL assignment comprised three activities, which closely link with the COIL course design principles discussed in Rubin (2015). The first activity involved getting to know the other students in the group. Each individual student was asked to upload a one-minute video of themselves into a shared folder, in which they introduce themselves to the others in their group (and all other participants as well), and each group was required to arrange an online meeting of the group, to video record this meeting, and to put a copy of the recording into a shared folder. During the first activity, the participating students were also asked to complete an ice-breaker exercise in which the students in each group were asked to share and compare the meanings of their first names and why these names were given. In addition, the lecturers uploaded short videos into a shared folder in which they introduced themselves to everyone else.

In the second activity, the students were required to upload an essay six to ten pages in length into a shared folder in which they discussed the chosen designer from their geographic region, and a design produced by this designer, as well as how the visual features of the design link with the visual culture of the applicable geographic region. After reading each other's submissions, the students met online with the others in their group (as a group), and further discussed and compared each other's work. Each individual student also had to answer a few questions on an activity sheet and upload this into the shared folder. The second online meeting of each group was intended to be similar to the question-and-answer session directly after a presentation at a scholarly conference. As was the case with Activity 1, the students were required to video record the online meeting of the group, and to place a copy of the recording into a shared folder.

In the third activity of the COIL assignment, each student was asked to upload a one-minute video of themselves in which the student reflects on the COIL experience. Each student was also asked to complete a short questionnaire about the COIL project on an individual basis, i. e. about what stood out, and how the process can be improved in future. Lastly, as was the case with the introduction videos, each lecturer uploaded a short video into the shared folder in which they reflected on their experiences.

Visual hermeneutics and the fusion of horizons

One of the main features of the COIL project was that the assignment required the participating students to interpret the visual meaning of their chosen design with reference to core aspects of the local visual culture. The brief referred to "the visual culture of your geographic region", which could be interpreted narrowly to the city of New York, Monterrey and Durban, or – more broadly – to visual signs and their social meaning associated with a particular province or linguistic region of the student's home country. More importantly, the assignment brief was formulated in such a way that the students were asked to share and compare these visual meanings among each other, which in turn led to cultural exchange and the acquisition of a deeper understanding of diversity in the context of design practice through a process of international collaboration.

Due to the importance of visual interpretation in the COIL assignment, theoretical concepts, models and frameworks related to visual hermeneutics seemed an appropriate point of departure for a more systematic reflection on some its features. Visual hermeneutics may be defined in general terms as the processes of interpretation and validation as applied to visual statements (George, 2020). Closely associated terms are, firstly, figurative hermeneutics (Müller, 2012), which emphasises comparative seeing (the original term in the German language is *vergleichendes Sehen*), and, secondly, objective hermeneutics, where the attempt to reconstruct the logic according to which a text was originally compiled stands in the foreground (Kleemann, et al., 2009).

A seminal publication in the development of hermeneutic theory over the years was Gadamer's Truth and Method, which was first published in 1960 (Dockhorn & Brown, 1980). As discussed by Malpas (2018), Gadamer emphasises the role of prejudice and pre-judgment in the hermeneutic processes, and in his version of the hermeneutic circle "the circularity of interpretation is not simply a methodological principle but an essential feature of all knowledge and understanding" (Schwandt, 2007, p. 135). The main point here is that interpretations are not formed in isolation, but that knowledge and understanding come into being through a chain of events. Schwandt (2007, p. 135) essentially argues that in Gadamer's hermeneutic circle "all efforts to interpret (to understand) always take place within some background (for example, historical tradition, web of belief, and practice) that cannot be transcended" and that this inability to fully transcend the context-specific nature of the interpretation is an inherent, defining feature of all interpretive processes.

Gadamer's approach to hermeneutics includes the notion of a fusion of horizons, which refers to those aspects of interpretation and validation where "the horizons of understanding expand when people not only identify the way in which things from the past or from other people are different but also when they ask how they can be combined with or otherwise affect their current understanding. Their horizons partially fuse with those of the other"(Coghlan & Brydon-Miller, 2014, p. 405). In other words, the process of a fusion of horizons implies that even if a listener (or viewer) disagrees with what is encountered, the "perception of the world changes, as does their understanding of themselves" (Coghlan & Brydon-Miller, 2014, p. 405). As pointed out by Mchunu (2021), the notion of fusing horizons closely relates to the term "included middle" as found in the literature on transdisciplinarity. The included middle has been discussed by several authors, but the most explicit definition of the term is by Ross & Mitchell (2018), who refer to it as "a process of integration allowing us to cross two different levels of reality or of perception and to integrate them effectively in both our thinking and being" (Mchunu, 2021, p. 31). Stated differently, a fusion of horizons occurs when a first interpretation merges with a second interpretation after the interpretant is faced with a new situation.

Discussion

When the above-outlined notion of fusion of horizons is integrated into reflections surrounding the latter part of the second activity of the COIL project, where the participating students were required to meet online with the other students in their group and to discuss each other's essays, then several issues emerge. First, it soon became clear that the students were enjoying the COIL project and that there was a very positive communicative atmosphere in all nine groups. However, in some of the groups, the students began the meeting with the time-consuming process of presenting their essays to each other using the share screen function of the video meeting software (Zoom, Google Meet or MS Teams), even though this was not envisaged when we formulated the assignment requirements and activity sheets. It left little time at the end of the meeting for critical discussion. However, this does not necessarily mean that, while passively listening, shifts and adjustments to the interpretations of the visual meanings of the images they were discussing did not take place. As pointed out by Schwandt (2007, p. 135), "every interpretation relies on other interpretations" and the process of sharing and comparing how the visual designs link with selected aspects of the visual culture in Mexico, the United States of America or South Africa inevitably led to some sort of revised interpretation at the level of each individual student.

Second, the video recordings of the group discussions show that in all nine groups the students were initially pre-occupied with collecting the information they needed to complete the activity sheet for Activity 2, which asked the students to answer the following questions: (a) compile a list of which members of your group discussed which designers and which designs or artworks, (b) what are the unique visual features of the design in each case? (c) which aspects of the design link it to a particular geographic region (for example, culture-specific references, local icons, among others)? and (d) is there anything which stood out for you? Questions (b) and (c) involved articulating the main visual meaning of the designs by isolating a small selection of key visual elements and then discussing the social meaning of these elements in the context of a clearly defined geographic region. These questions did not, however, specifically require the students to indicate whether their visual interpretations before, during and after the group meeting changed in any way, especially regarding the work of the designer they themselves presented to the group.

Third, in all nine COIL groups the discussions eventually drifted towards how similarities in visual meanings can exist across cultures. For example, in one of the groups the students ended up comparing two political cartoons at length. One of the students in the group had presented a cartoon from South Africa, which was followed by a student from UDEM who presented and analysed a political cartoon from Mexico, albeit from a different time period. In both cases, the graphic artists commented on the social issues of crime and corruption in a visually engaging, witty manner. In the course of the discussion, the South African students benefitted from the local knowledge of the UDEM students about Mexican history, and their familiarity with the political debates the cartoon by the engraver and cartoonist Manuel Manilla was referring to. In the same way, the Mexican students relied on the South African students to briefly orientate them about the underlying issues in South Africa's political landscape the cartoon by Jonathan Shapiro, also known as Zapiro, was based on. This was a good example of how "the horizons of understanding expand when people not only identify the way in which things from the past or from other people are different but also when they ask how they can be combined with or otherwise affect their current understanding" (Coghlan & Brydon-Miller, 2014, p. 405).

Fourth, it initially appeared that the notion of fusing horizons was directly relevant to the COIL project primarily because each student's first interpretation of how the visual features of their chosen design link with the visual culture of the geographic region at the beginning of the project fused with a second interpretation at the end of the project after having encountered the new situation of interacting digitally with graphic design students from another country. However, the actual state of affairs was more complex than that. This was because there was also a significant degree of diversity within the participating students from New York, Monterrey and Durban. For example, the group of students from New York included an exchange student from Brazil, who spoke about the visual culture of the eastern coast of North America from the perspective of an outsider. The group of students from Monterrey included a participant who was born in Syria and had only recently moved from Syria to Mexico with her parents. There was also a high level of diversity with regard to home language, ethnic background, religious affiliation, among others, within the group of students from Durban. This meant that the student's horizons of understanding did not necessarily expand in the course of the COIL project because they interacted with another graphic design student from another country, but also because the COIL assignment indirectly facilitated a more subtle type of cultural exchange among the students at the same university.

Conclusion

The above discussion suggests that theoretical concepts from the scholarly literature on hermeneutics, such as the concept of fusing horizons of knowledge, are sufficiently flexible in nature to apply to a visual communication design setting and to guide reflections about the type of COIL project discussed in this paper. Seen as a whole, the main learning outcome of the COIL project, i. e. that the participants would acquire a deeper understanding of diversity in the context of design practice through a process of international collaboration, were successfully met. The project also illustrated how collaborative online spaces can be transformative for all involved, especially in the context of the global COVID-19 pandemic, where online international collaboration proved to be an effective way of reducing the sense of isolation which inevitably accompanies curfews and other restrictions related to COVID-19 pandemic related lockdowns.

In a broader sense, the type of online international collaboration between design students discussed in this paper also links with research that deals with how the core elements of the 4IR impact on higher education. Stated differently, the present paper touches on issues relating to collaboration, fusion of horizons, digital platforms replacing physical student exchanges and transdiciplinarity which, taken together, closely relate to the way in which the advancing 4IR is changing higher education. Specifically, the impact of the 4IR on higher education has been described by Blaschke & Hase (2015) as a move from a higher education pedagogy to a higher education heutagogy. Heutagogy emphasises learner agency, self-efficacy, metacognition and reflection, as well as non-linear learning (Blaschke & Hase, 2015). This paper therefore contributes to 4IR education as it discusses the metacognition and reflection dimension of the heutagogic approach in a design education setting.

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