DURBAN UNIVERSITY OF TECHNOLOGY

THE INCLUSION OF DESIGN THINKING AS A TOOL FOR ENTREPRENEURSHIP AT THE DURBAN UNIVERSITY OF TECHNOLOGY

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THE INCLUSION OF DESIGN THINKING AS A TOOL FOR ENTREPRENEURSHIP AT THE DURBAN UNIVERSITY OF TECHNOLOGY

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ABSTRACT

The volatile nature of the entrepreneurship environment requires specific characteristics from individuals entering the field. These traits can be developed through entrepreneurial learning, utilising a method- and design-based approach known as design thinking (DT). Design Thinking prioritises the entrepreneurial process, particularly the mindset and skills of student entrepreneurs. It also encourages student-centred learning by ensuring that the acquired skills are applicable to real-life situations. The study evaluated the inclusion of DT as an entrepreneurship and business development tool at the Durban University of Technology. Entrepreneurial learning through a design-based and method approach was conceptualised. A quantitative research approach was used, focussed on students who have either enrolled in entrepreneurship modules that follow the DT approach or in courses that do not follow the DT approach, for comparative purposes. The collection of data was done using a semi-structured questionnaire. Thereafter, SPSS version 24 was used to analyse the collected data. The study results showed a lack of awareness concerning DT, and that most participants have not enrolled in DT boot camps or workshops. This lack is evident in the limited number of ventures undertaken by participants. In conclusion an intervention is recommended which will allow the incorporation of DT into the Higher Education Institution curriculum to foster innovation and the execution of novel ideas.

DECLARATION

I, Owami Ntobeko Shane Thiba, hereby declare that this dissertation submitted for the Degree of Master's in Management Sciences specialising in Business Administration in the Faculty of Management Sciences at the Durban University of Technology is my own original work and has not previously been submitted at any institution of higher education. All the sources have been acknowledged, accurately cited and referred to in the bib

Signed Date 23/07/2024

Owami N

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DEDICATION

This thesis is dedicated to the four remarkable women who raised me and moulded me into the person I am today: Sizakele Thiba, Mbali Kweyama, Phyllis Ngcobo, and Patricia Thiba.

What was once a distant dream has become a reality because of these incredible women. Their unwavering support and love have empowered me to strive higher and never surrender. The world may see only the achievements that stand before them, but the true essence of those accomplishments lies in the wisdom and strength imparted by these extraordinary women, whose lessons will forever remain etched in my heart. Amazwe asazokwazi ngani zintokazi, Ngiyabonga.

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CHAPTER ONE

1. INTRODUCTION

1.1. INTRODUCTION AND BACKGROUND

Entrepreneurship is defined as the pursuit of business ventures where individuals take risks and manage trade to create new products or services (Hisrich, Peters and Shepherd 2018). According to Ndlovu *et al.* (2023), successful entrepreneurs possess skills such as resilience, creativity, as well as adaptability, and they constantly search for opportunities to address problems and innovate. Entrepreneurship is therefore important in driving economic growth, job creation, and social change. In addition, Aldrich (2019) states that entrepreneurship also promotes social mobility and inclusivity by availing opportunities for persons from diverse cultures and backgrounds to start businesses. However, while entrepreneurship offers potential rewards, it also comes with challenges such as funding constraints and market competition.

The origins of entrepreneurship can be traced back to ancient times; it has evolved with each era, from the agricultural revolution to the industrial age, and now to the digital age (Baron and Shane 2017). Today, entrepreneurs have access to various resources and tools to start and scale their ventures, including crowdfunding platforms, incubators, accelerators, and online marketplaces. Social media and e-commerce have also opened new avenues for entrepreneurs to reach customers (Chinomona and Maziriri 2015; Daniel 2016).

Traditionally, entrepreneurship has been taught using a business administration perspective, where the world is seen as linear with known inputs and outputs, and where future prediction is central. However, the world of entrepreneurs is quite different, characterised by an environment that is highly uncertain, demanding specific characteristics from individuals who venture into the field (Linton and Klinton 2019).

Pedagogical approaches, such as Design Thinking (DT), have been found to enhance entrepreneurship education. Design Thinking is a problem-solving, human-centered approach that emphasises empathy and creativity (Razzouk and Shute 2018). It can

be applied in various fields, including education, to provide practical and hands-on learning experiences. Other pedagogical approaches include project-based learning, flipped classrooms, and collaborative learning, which promote teamwork, communication, and critical thinking (Blenker *et al*. 2014; Fayolle 2008; Hagg and Kurczewska 2016; Heinonen 2007; Higgins *et al*. 2013; Robinson *et al*. 2016).

This study conceptualises learning entrepreneurship through a design-based and method approach. Design Thinking has gained attention in entrepreneurship education as it fosters innovation and problem-solving skills among aspiring entrepreneurs. Kimbell (2011) argues that DT is an approach that allows students to experience the world outside the classroom and to engage with real-world users and customers to obtain feedback. Dam and Siang (2021) posit that DT is a process of obtaining the challenging assumptions of the user as well as the problems and using that information to create an innovative solution which can be prototyped and assessed. This process should ensure that higher learning institution's entrepreneurship training involves solving problems through purposeful innovation. Therefore, by incorporating DT principles into entrepreneurship education, educators can provide students with practical, hands-on, learning experience that prepares them for the dynamic nature of the business world (Auernhammer and Roth 2021; Micheli *et al*. 2019; Tham 2021).

Entrepreneurship education has evolved over time, with a shift towards combining traditional and innovative teaching methods (Kuratko 2015). However, there are gaps and limitations in entrepreneurship education in Africa, such as a lack of focus on developing an entrepreneurial mindset, and challenges in accessing education and resources. Despite these challenges, there is growing recognition in Africa of the importance of entrepreneurship education, and initiatives have been implemented to improve entrepreneurship education as well as foster an entrepreneurial ecosystem (Gamede 2019; Ndlovu *et al*. 2023; Nkomo 2015).

It has been argued that universities should focus on research and transferring knowledge. Whilst this can be viewed as the main practice of universities, innovation is another phenomenon that researchers in universities consistently strive for (Jami and Gökdeniz 2020). Innovation and entrepreneurship have a close relationship even

though they are distinct concepts (Dieffenbacher 2023). Kahn (2018) posits that innovation is the process of generating new ideas, products, and business models whilst entrepreneurship goes beyond that; it takes the risks and responsibilities of taking those new ideas to the market and bringing the business model to life. Universities are thus the perfect agent in the ecosystem of entrepreneurship, enabling an environment in which entrepreneurs can contribute towards societies through commercializing their research output, and providing solutions for the betterment of our societies (Universities South Africa 2023).

Higher education institutions must develop more entrepreneurs and innovators in order to improve employment rates through creative enterprises and ideas (Jwara and Hoque 2018). There must also be novel approaches to innovation and entrepreneurship education given the high failure rates of SMMEs. For example, higher institution curricula must consider the failure rates of SMMEs so that students can be equipped to overcome obstacles and increase their chances of success (Jwara and Hoque 2018; Linton and Klinton 2019).

Design Thinking is essential for business ideation, however, its importance has not been sufficiently demonstrated. This research study aimed to compare the methods approach with Design Thinking for teaching entrepreneurship and business development.

1.2. RESEARCH PROBLEM

Higher education institutions (HEIs) have the difficult task of developing their curricula taking into account the demands of labour markets in a world that is dynamic, increasingly technologically oriented, and presenting ill-defined difficulties (Griffin, Muñiz, and Espinosa 2012). According to the World Economic Forum (2025), problem-solving and creativity are two of the top five skills that employers will be looking for. They are frequently referred to as twenty-first century skills; the new skills that students should have in addition to the former basic knowledge and skill expectations, particularly in light of the adoption of new technology (Binkley *et al*. 2012). Increasing unemployment rates in South Africa and the lack of new solid business prospects are problems that need to be urgently addressed because, if

left unattended for too long, South Africa will be left with only a few economic activities, which will have a negative impact on the stability of the nation. Therefore, there is a need for interventions in entrepreneurial education, to introduce and execute DT, for entrepreneurs to have the additional skills set necessary to succeed in a variety of environments. Since Universities of Technology (UoT), like the DUT, already offer a variety of programmes that encourage entrepreneurship, the UoT will be a key force behind the integration of DT into the curriculum with concrete measurements. To incorporate DT into the entrepreneurial curricula easily, Sarooghi *et al*. (2019) created an opportunity design framework in which the idea of DT is linked to an alignment-based paradigm. It is imperative to integrate entrepreneurial processes into the existing curricula in a way that enables students to develop new skills and competencies in a secure, user-friendly, learning environment that minimizes the risk of failure.

1.3. AIM AND OBJECTIVES OF THE STUDY

1.3.1 Aim

The aim of the study was to evaluate the inclusion of Design Thinking as an entrepreneurship facilitation method at DUT.

1.3.2 Objectives

The following objectives were sought to be achieved by this study, to assist in achieving the overall aim:

- To evaluate the influence of Design Thinking on students' entrepreneurial ambition and/or intention.
- To assess how Design Thinking enhances students' entrepreneurial mindset.
- To determine the feasibility of including Design Thinking as an entrepreneurship facilitation tool.

1.4. RESEARCH QUESTIONS

- In what ways does Design Thinking influence students' entrepreneurial ambition and/or intention?

- What is the influence of Design Thinking on students' entrepreneurial mindset?
- What is the feasibility of including Design Thinking as an entrepreneurial facilitation tool at DUT?

1.5. SIGNIFICANCE OF THE STUDY

Incorporating DT as a tool for entrepreneurship education at the DUT is important in addressing the evolving landscape of business education. Recognising the challenges faced by aspiring entrepreneurs, this study aimed to bridge the gaps in traditional entrepreneurship education. The incorporation of DT in teaching not only equips students with essential skills such as creativity, problem-solving, and empathy, but also cultivates their mindset of innovation which is critical in today's competitive business world. This study is poised to not only improve entrepreneurship within DUT students but to contribute towards producing graduates who are job creators instead of job takers, reducing the unemployment rate among DUT graduates.

1.6. OUTLINE OF THE STUDY

Chapter 1: Introduction

This chapter presents a detailed introduction and background of the study, the problem statement, research aims and objectives, and significance of the study.

Chapter 2: Literature review

Recent literature and the theoretical framework of the study are discussed in this Chapter.

Chapter 3: Research methodology

Chapter 3 describes the research methodologies used in the study, including tools to conduct and test the research hypothesis.

Chapter 4: Results and discussion

This chapter details the research findings, analyses of the data collected, and interpretation of the results.

Chapter 5: Conclusion, limitations of the study and recommendation

Chapter 5 presents an overview of the key study findings and conclusions, as well as recommendations to improve entrepreneurship education at the DUT.

1.7. CHAPTER SUMMARY

This chapter presented an introduction to the study and discussed the research problem. The aim, objectives, and rationale that motivated this study are also provided. Furthermore, the framework of the study chapters were described. The next chapter will present a review of the relevant literature and theories that illuminate how DT can be included as an entrepreneurship facilitation method at DUT.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. INTRODUCTION AND ENTREPRENEURSHIP DEFINED

The preceding chapter outlined the background, research problem, aim and objectives of the study. This chapter provides a review of the literature pertaining to entrepreneurship and DT. The chapter begins by outlining the significance of entrepreneurship, followed by an articulation of the history of DT and entrepreneurship education, from a global, African, and South African perspective. Lastly, the chapter ends by describing the paradigm shift in higher education including the incorporation of DT.

Entrepreneurs can be defined as people who engage in business, where they manage and take risks related to trade and the creation of new products or services (Diandra and Azmy 2020). They are driven by a deep passion for innovation and are willing to invest their time, resources, and energy into pursuing their ideas. Successful entrepreneurs possess a unique set of skills including creativity, resilience, and the ability to conform to evolving market conditions. Entrepreneurs constantly seek opportunities, identify problems, and develop innovative solutions to address them. Through entrepreneurship, individuals can transform their ideas into thriving businesses, creating value for themselves and society (Ndlovu *et al*. 2023).

Entrepreneurs play a critical part in growing the economy and the creation of jobs. They are often seen as the engines of innovation, bringing new ideas and technologies to market (Daniel 2016). In addition to driving economic growth, entrepreneurship also promotes social change by addressing societal challenges and creating opportunities for underrepresented groups. However, entrepreneurship is not without its challenges. Entrepreneurs come across a great number of obstacles such as funding constraints, market competition, and barriers with regulatory boards. Despite these challenges, the rewards of entrepreneurship can be immense, both personally and professionally (Chinomona and Maziriri 2015). By taking calculated risks, entrepreneurs have the

potential to achieve financial independence, make a meaningful impact, and leave a legacy.

The documented origins of entrepreneurship date back to ancient times, around 1700 BCE, when the trade in obsidian was prevalent (Vladasel, Lindquist, Sol and Van Praag 2021). The agricultural revolution brought a shift from roaming for resources to farming and specialisation, giving rise to early entrepreneurs. Then the industrial age, fuelled by energy availability and a large labour pool, saw the emergence of influential entrepreneurs such as Henry Ford. The digital age has further accelerated entrepreneurship, with the rise of technology enabling the creation of innovative start-ups and online businesses (Katz 2003). Today, entrepreneurs have access to a diverse and vast number of tools and resources to help them start and scale their ventures. These include crowdfunding platforms, incubators and accelerators, as well as online marketplaces. Additionally, the rise of social media and e-commerce has paved new avenues for entrepreneurs to reach and connect with customers (Lekhanya 2013; Sehar *et al*. n.d.; Wang *et al*. 2019). As the business landscape continues to evolve, entrepreneurship will remain a key driver of economic growth, innovation, and social change.

2.2. SIGNIFICANCE OF ENTREPRENEURSHIP

Entrepreneurship is a vital force for driving economic and social progress in society. It is of paramount importance for economic growth, job creation, wealth generation, technological and social advancement, as well as overall societal progress. Baker and Welter (2020) states that entrepreneurship serves as a catalyst for innovation, drives economic development, and fosters resilience and adaptability in the face of changing environments. It encourages competition, fosters creativity and problem-solving, and promotes the efficient allocation of resources. Furthermore, entrepreneurship also promotes social mobility and inclusivity by availing opportunities for individuals from varied backgrounds to establish businesses and achieve economic independence. Additionally, entrepreneurs play a crucial part in driving economic sustainability and addressing pressing world-wide challenges, such as climate change and inequality (Akhmetshin *et al*. 2019).

Entrepreneurs have been instrumental in developing new products, services, and technologies that contribute to overall economic development. This is done through identifying opportunities and taking risks, thus fostering economic progress and prosperity. Businesses are established and expanded by entrepreneurs, they generate employment opportunities, which contribute to reducing unemployment rates and stimulating economic activity (Audretsch and Moog 2022). Entrepreneurship acts as a catalyst for job growth and provides opportunities for individuals to work and earn a living. Wealth is created for both entrepreneurs and the wider society. Hence, successful entrepreneurial ventures can generate significant profits and financial success for business owners. This, in turn, can lead to increased wealth and economic prosperity for individuals and communities. Furthermore, successful entrepreneurs often reinvest their profits into new ventures or philanthropic initiatives, contributing to wealth distribution and social welfare (Pellegrini 2022).

The ability of entrepreneurs to identify societal needs and develop innovative solutions drives progress in various fields. From technological advancements to social impact initiatives, entrepreneurship has the power to address challenges, improve living standards, and create positive change in society (Ndlovu *et al*. 2023). Most importantly, entrepreneurs possess the ability to adapt to changing circumstances and overcome challenges. They have the drive and resilience to navigate uncertain environments and seize opportunities, even amid adversity. This adaptability contributes to the overall resilience and dynamism of the economy and ensures its ability to withstand and recover from shocks and disruptions.

In addition to economic and social benefits, entrepreneurship also fosters a culture of creativity, problem-solving, and innovation. Entrepreneurs are often driven by a desire to create something new or improve existing solutions. They constantly seek out opportunities for growth and development, pushing the boundaries of what is possible. This mindset of continuous improvement and innovation permeates throughout society, influencing not only businesses but also other sectors such as education, healthcare, and government.

The entrepreneurial spirit encourages individuals to think critically, challenge the status quo, and find creative solutions to complex problems (van Reine 2017). This may be

the reason why criticism of the education system for prioritising the creation of workers rather than entrepreneurs has been increasing. The main criticism has been around schools focusing on respecting authority, punctuality, measurement, basic literacy, and arithmetic, which stifles creativity and independence. Some argue that the education system should place more emphasis on cultivating entrepreneurial skills such as critical thinking, problem-solving, and adaptability (Ratten and Usmanij 2021). Nurturing these skills better equips individuals to navigate the challenges of entrepreneurship and seize opportunities for innovation (Forcher-Mayr and Mahlknecht 2020). Additionally, there is growing recognition of the need for inclusive entrepreneurship, where underrepresented groups are given equal access to resources and support to start and grow businesses. This can help address systemic barriers and create a more diverse and inclusive entrepreneurial ecosystem. Ultimately, entrepreneurship offers individuals the freedom to pursue their passions, make a positive impact, and shape their own destinies. However, the need for financial security still leads to the preference for employment over entrepreneurial pursuits, resulting in limited financial freedom and skills passed down to future generations.

Theoretically, entrepreneurship offers the potential for financial stability and prosperity, especially in low- and middle-income countries (LAMIC). This may be due to limited access to capital, lack of supportive infrastructure, and regulatory barriers which often make it difficult for aspiring entrepreneurs to start and grow their businesses (Cant 2016; Gamede 2019). Additionally, cultural and societal norms may discourage risk-taking and innovation, further hindering entrepreneurial activity. Despite these challenges, entrepreneurship continues to be a powerful force for change and progress. Governments, organisations, and individuals are recognising the importance of supporting and promoting entrepreneurship as a means to drive economic growth, create jobs, and address societal issues (Fourcade and Khurana 2013). Various initiatives, such as incubators, accelerators, and funding programmes, are being implemented to provide aspiring entrepreneurs with the resources and support they need to succeed. However, the remaining gap is the incorporation of entrepreneurship into higher education curricula.

2.3. PEDAGOGICAL APPROACHES

Pedagogy refers to techniques and strategies employed by educators, encompassing various theories and approaches that shape their teaching style (Hägg and Gabrielsson 2019). These approaches involve using innovative pedagogical practices, such as the DT approach, that promotes the development of critical thinking skills, creative confidence, and the capacity to think in unconventional ways, encouraging individuals to explore diverse perspectives and ideas (Hägg and Gabrielsson 2019). There are various pedagogical approaches that can be employed in education to enhance learning experiences for students. Prevalent pedagogical approaches include constructivism, social constructivism, behaviourism, cognitivism, liberationism, collaborative learning, differentiated instruction, project-based learning, flipped classroom, reflective, integrative, and inquiry-based approaches (Blenker *et al*. 2014; Fayolle 2008; Hägg and Kurczewska 2016; Heinonen 2007; Higgins *et al*. 2013; Robinson *et al*. 2016).

Pedagogical approaches typically centre on the mental processes involved in learning, such as perception, memory, and problem-solving (Higgins *et al*. 2013), neglecting equally important processes that emphasise active, hands-on learning that encourages students to construct their own knowledge through experiences, reflection, active participation, and problem-solving. The promotion of group work to solve problems and complete tasks, promoting teamwork, collaboration, encouraging communication, and cooperation is a common approach (Heinonen 2007; Robinson *et al*. 2016). Equally common is the promotion of students engaging in real-world projects, encouraging them to apply their knowledge and skills to solve authentic problems.

It is noteworthy that different subjects may require different approaches; and often a combination of approaches may be used depending on the setting and subject matter. These methods empower students to recognise their own abilities, leading to enhanced self-confidence and self-esteem, allowing students to achieve their maximum potential, and fostering a strong basis for learning. However, the integration of different subjects and disciplines to create a more holistic learning experience is still lacking. Conventional classrooms and the real world are often disconnected, operating

independently without meaningful integration or exchange of ideas. Similarly, there are disciplinary boundaries in the work fields that often restrict the flow of knowledge and expertise, preventing subject matter experts from venturing into unfamiliar territories (Higgins *et al*. 2013; Middleton and Donnellon 2014). This continued disconnect between institutions of learning and workplaces, calls for change.

Previous studies have highlighted the benefits of incorporating real-world problems into the classroom (Achmetli *et al*. 2019; Baysal and Sevinc 2022). For example, a study in Singapore found that using real-world problems in mathematics lessons generated rich classroom discussions and improved problem-solving skills (Achmetli *et al*. 2019; Baysal and Sevinc 2022). The value of real-world practical projects in education, especially higher education, is vital because it teaches students that research and innovation spaces should not be detached from the real world. This encourages students to connect their own experiences and perspectives to the topics and issues being discussed, so that the ideas and solutions being provided are contextualised. Successful real-life innovations with long-lasting impacts have been shown to have had a multidisciplinary team, therefore, students at HEIs should be encouraged to work with individuals from other disciplines so as to develop their skills in solving and tackling real-world problems (Kauppi *et al*. 2020; Mård and Hilli 2022; Onodipe *et al*. 2020; Rajabzadeh *et al*. 2022; Sikström *et al*. 2022).

2.4. HISTORY OF DESIGN THINKING

Design Thinking has been evolving since the 1960s and has incorporated ideas, methods, and perspectives from various fields. It has also been influenced by multiple approaches and influential figures from various disciplines. Its evolution can be traced from its nascent stages in the 1960s, characterised by the emergence of distinct approaches in America and Scandinavia (Elsbach and Stigliani 2018).

In America, there was the design science movement led by Buckminster Fuller, which aimed to apply scientific principles to design and solve systemic failures through interdisciplinary collaboration (Auernhammer and Roth 2021). In Scandinavia, there was a cooperative design approach that emphasized participatory design involving different stakeholders in the design process (Grönman and Lindfors 2021). Key figures

who significantly contributed to the development of DT, include Fuller, Herbert Simon, Victor Papanek, Horst Rittel, and Melvin M. Webber. These individuals introduced novel perspectives, methodologies, and ideas that shaped the trajectory of DT (Eriksson 2022).

Design Thinking has emerged as a significant concept within the broader field of design theory. Design theory encompasses various perspectives, methodologies, and frameworks that aim to understand the principles and processes underlying the design practice. Design Thinking can be seen as a specific approach within the larger framework of design theory since it incorporates elements from various design theories and disciplines, including but not limited to industrial design, architecture, and human-computer interaction. It draws upon theories of problem-solving, creativity, and user-centred design to provide a structured approach to tackling complex problems and driving innovation (Tham 2022). Most importantly, it has contributed to the evolution and diversification of design theory by offering a distinct problem-solving methodology emphasising the importance of empathy, collaboration, and iterative processes in design practice (Auernhammer and Roth 2021; Micheli *et al*. 2019; Tham 2021). This is how it became a mainstream approach in various sectors and has been embraced for its potential to drive growth, innovation, and social change.

2.5. PEDAGOGICAL APPROACH TO DESIGN THINKING

A universal definition for DT does not yet exist; it is commonly defined as a human-centred approach to problem-solving (Micheli *et al*. 2019). Its foundations are based on the significance of understanding users and their needs, through cultivating empathy and emotional intelligence (Achmetli *et al*. 2019; Micheli *et al*. 2019; von Thienen *et al*. 2023). Users are actively involved in problem-solving as opposed to working on assumptions about user needs or basing it on user need surveys (Micheli *et al*. 2019).

Design Thinking is typically used in business for developing new products and services. It became widely adopted in corporations and organisations, where it is utilised to improve business through innovation (Auernhammer and Roth 2021; Edelman *et al*. 2021; Ku and Lupton 2022). However, DT can be applied in various

fields, such as product design, software development, and even education. In the field of education, DT can be used as a tool for teaching and learning in order to achieve empathy with learners, as well as ensure successful engagement and achievement of learning objectives (Heinonen 2007; Kavousi *et al*. 2020). In addition to emphasizing the importance of understanding the needs of students, it encourages creativity, collaboration, and experimentation.

Student learning experiences in DT can be adjusted and diversified by educators to be engaging according to the needs of the student. Adopting DT can have a systemic impact on organisations because students are empowered to become critical thinkers, problem solvers, and innovators (Higgins *et al*. 2013; Rajabzadeh *et al*. 2022). Incorporating DT into the HEI curriculum can therefore create an environment where the needs of the students are centred through attaining empathy.

Contemporary pedagogical approaches similar to DT include ADDIE (analyse, design, develop, implement, and evaluate), Agile, and SAM (Successive Approximation Model). The ADDIE model is a systematic approach to instructional design - the process of creating effective and engaging learning experiences (Sharif and Cho 2015; Spatioti *et al*. 2022). The ADDIE model provides a framework for educators to follow when designing and developing instructional materials (Spatioti *et al*. 2022). This approach analyses the end-user need, through information gathered from interviews, surveying, direct observation, reviewing existing data, existing documents, and existing training programmes (Shakeel *et al*. 2023). Conclusions are drawn based on the gathered information. Then the learning needs and goals of the learners are determined to create learning materials and these then implemented (Shakeel *et al*. 2023; Valverde-Berrocoso and Fernández-Sánchez 2020). Lastly, the effectiveness and impact of the learning materials are assessed (Shakeel *et al*. 2023).

The Agile approach utilises an iterative and collaborative approach. Instead of following a linear process like the ADDIE model, it involves breaking down the design and development tasks into smaller, manageable chunks called iterations (Akhmetshin *et al*. 2019; Fischer *et al*. 2022). During these iterations, the development team works on a set of prioritized tasks, delivering a working product increment at the end of each chunk. This approach allows for flexibility and the ability to respond to changing

requirements and feedback (Frydenberg *et al*. 2018; McAvoy and Sammon 2005). It also provides frameworks and practices to help teams effectively persevere under uncertain and turbulent environments (Fischer *et al*. 2022).

The SAM is an iterative instructional design model that emphasises collaboration and rapid prototyping (Allen and Sites 2012; Wolverton and Hollier 2022). Similar to Agile, SAM breaks down the design process into smaller, manageable chunks (Svihla 2017). Each iteration involves the design team working closely with stakeholders to develop and test prototypes (Allen and Sites 2012; Svihla 2017; Wolverton and Hollier 2022). Feedback gathered during each iteration is used to refine and improve subsequent iterations.

These instructional design tools assist both learners and educators to overcome cognitive rigidness caused by mastering theoretical knowledge without acquiring the requisite practical skills (Edelman *et al*. 2021). It is thus important to supplement theoretical learning with practical experience so that students are equipped with real-world applicability, broad problem-solving abilities, and multidisciplinary knowledge that fosters systemic solutions to problems (Auernhammer and Roth 2021; Mård and Hilli 2022; Rajabzadeh *et al*. 2022). When multiple sectors collaborate to find solutions, often the root issues are identified and addressed in the proposed solution, using the wider perspective (Mård and Hilli 2022; Rajabzadeh *et al*. 2022).

The values and principles of the approaches discussed above are rooted in authentic human interactions, collaborating with end-users and teammates, and delivering a working solution to the customer's problem. These approaches differ from DT in being slow, methodical, and having a primary focus on providing solutions for predefined problems (Shé *et al*. 2022; Svihla 2017). As DT focuses on finding the right problems to solve, it directly influences continuous innovation since there is no set goalpost but a search for solutions to a non-predefined search for problems (Svihla 2017).

Challenges that educators may face with the DT approach include establishing timeframes for the typically lengthy tasks that are assigned (McLaughlan and Lodge 2019). However, it has been established that in addition to DT encouraging the submission or presentation of unfinished products, limited timeframes in the institute

of learning will not pose a great challenge to the DT learning (Pellegrini 2022; Svihla 2017). The expectation to find a balance between being creative and flexible, as well as being authoritative has been identified as another challenge of this approach since DT operates in a way that can be perceived to undermine hierarchies or threaten existing power dynamics (Carlgren *et al*. 2016; van Reine 2017). In summary, DT has the potential to transform curricula and pedagogical methods.

2.6. DESIGN THINKING PEDAGOCIAL APPROACH IN ENTREPRENEURSHIP

Design Thinking has gained attention in the field of entrepreneurship and is considered a valuable tool for fostering innovation and problem-solving skills among aspiring entrepreneurs (Daniel 2016; Hägg and Gabrielsson 2019). It is increasingly recognised and utilised in the field of entrepreneurship education as it offers a different approach to instructional design, focusing on the skills and mindset relevant to entrepreneurs (van Reine 2017). Design Thinking emphasizes a practical and user-centred approach, encouraging student entrepreneurs to step outside the classroom and interact with real-world users and customers for feedback (Pellegrini 2022). With the incorporation of DT principles into entrepreneurship education, educators can provide students with a practical and hands-on learning experience that prepares them for the dynamic and complex nature of the business world (von Thienen *et al*. 2023). This approach encourages students to think critically, take risks, and refine their ideas based on user feedback. Overall, DT offers a valuable framework for fostering entrepreneurial mindsets and empowering the next generation of innovators.

The DT method has the potential to enhance entrepreneurship education by providing a more empathetic and iterative approach to course design, addressing the needs of students and supporting creative solutions (Shé *et al*. 2022). It also offers useful guidelines for the design of entrepreneurship education programmes. However, there is still a need for more research and understanding of how DT processes and tools can be effectively incorporated into entrepreneurship education (Daniel 2016; von Thienen *et al*. 2023). Overall, DT instructional design holds promise for promoting entrepreneurial skills and innovation in educational settings.

2.7. ENTREPRENEURSHIP EDUCATION HISTORY

Entrepreneurship education history can be traced back to the early 19th century, with significant strides being made in the late 20th century (Katz 2003; Wadhwani and Viebig 2021). In the 1960s and 1970s, entrepreneurship programmes started to emerge in universities and colleges, focusing on teaching students the skills and knowledge needed to start and manage their own businesses (Fourcade and Khurana 2013). Since then, entrepreneurship education has evolved and expanded, with a growing recognition of its importance in fostering innovation and economic growth. It has evolved from the traditional teaching practice to work-integrated learning, and presently the active construction of knowledge (Fourcade and Khurana 2013; Hägg and Gabrielsson 2019; Katz 2003; Wadhwani and Viebig 2021). This evolution was largely facilitated by the availability of institutions that provide entrepreneurial education and the type of educators. As the number of institutions grew, the curriculum available at different institutions changed to gain a competitive advantage (Katz 2003). Over time, graduates of entrepreneurship education grew in number and expertise allowing for change in the curriculum and teaching approaches (Hägg and Gabrielsson 2019).

Furthermore, entrepreneurship education has recognised the importance of fostering an entrepreneurial ecosystem (Wadhwani and Viebig 2021). This includes connecting students with industry professionals, entrepreneurs, and investors through networking events, pitch competitions, and incubator programmes. By creating a supportive and collaborative environment, entrepreneurship education encourages students to network, seek mentorship, and gain valuable connections within the entrepreneurial community. Today, entrepreneurship education is offered at various levels, from primary and secondary schools to higher education institutions (Kuratko 2015). It encompasses a wide range of topics, including business planning, marketing, finance, and leadership.

Traditional teaching methods in entrepreneurship have been subject to scrutiny in recent years. Studies have shown that these methods, such as lecturing, tutorials, and case studies, may not be adequate in achieving the objectives of entrepreneurship courses (Higgins *et al*. 2013). Students often perceive both traditional and non-

traditional teaching methods as important for the development of their entrepreneurship skills and knowledge. There is thus a need to combine traditional methods with innovative methods to enhance the learning experience (Blenker *et al*. 2014; Hägg and Kurczewska 2016; Middleton and Donnellon 2014; Robinson *et al*. 2016; Spatioti *et al*. 2022). Experiential teaching methods, which involve practical activities and active participation, have been found to be more effective in stimulating students' interest and drive for engaging in business start-up activities (Fischer *et al*. 2022). Overall, the historical change in entrepreneurial education towards the combination of teaching methods that link theory and practice is necessary to provide students with the skills and knowledge needed for entrepreneurship.

2.8. ENTREPRENEURSHIP EDUCATION HISTORY IN AFRICA

There is a strong entrepreneurial culture in many African countries, but formal entrepreneurial education is not as strong. Entrepreneurship education in Africa emerged as a response to the continent's unique challenges and opportunities (Bawuah *et al*. 2006; Bwisa 2012). The African continent has a young and dynamic population, with a high unemployment rate among the youth. Entrepreneurship education is seen as a way to empower young people to create their own opportunities and contribute to economic development.

In recent years, there has been a growing emphasis on entrepreneurship education in Africa. Many universities and educational institutions have launched entrepreneurship programmes and courses to equip students with the skills and mindset needed to start and grow successful businesses (Bawuah *et al.* 2006; Bwisa 2012). These programmes often focus on practical skills such as business planning, financial management, and marketing, however, their effectiveness in producing self-employed graduates has been questioned. A study conducted in Kenya suggests that effective entrepreneurship delivery and assessment methods, the development of effective entrepreneurship educators, the integration of entrepreneurs in curricula design and delivery, and the establishment of university business incubators are recommended for improving entrepreneurship education in Africa (Bwisa 2012). Governments throughout Africa have implemented various programmes to improve entrepreneurship education through skill-oriented learning and education for self-

reliance (Akinyemi and Adejumo 2018), however, poverty alleviation is yet to be achieved through job creation.

2.9. GAPS AND LIMITATIONS IN ENTREPRENEURSHIP EDUCATION IN AFRICA

Entrepreneurship education in Africa has several gaps and limitations. Firstly, there is a lack of focus on developing an entrepreneurial mindset, which is crucial for the journey of an entrepreneur (Ndlovu *et al.* 2023). Low-quality teaching and learning, limited access to education, weaknesses and challenges in policy, gaps in current entrepreneurship education, resource and time constraints, and contextual challenges are some of the issues faced in Africa's education system (Chinomona and Maziriri 2015; Nkomo 2015). These challenges can hinder the development of high-quality entrepreneurship education programmes, equal access to education, and developing tailored frameworks that address the unique challenges of the African context. Moreover, a majority of African countries have not fully developed strategies to tap into the potential of entrepreneurs, with haphazard policies designed for the informal sector. Therefore, African countries should structure their curricula to ensure that all or most students have access to entrepreneurship courses, which is essential for economic and social development.

2.10. STRENGTHS IN ENTREPRENEURSHIP EDUCATION IN AFRICA

Entrepreneurship education in Africa has a significant history and has been recognised as a potential solution for economic growth and development. Many African universities have introduced entrepreneurship education at various levels of education (Bawuah *et al.* 2006; Bwisa 2012). Funding for such studies in Africa remains with governments and organisations providing support for entrepreneurial initiatives (Gamede 2019).

Another important aspect of entrepreneurship education in Africa is the focus on practical skills and real-world experiences, the emphasis on innovation and problem-solving, and the establishment of strong networks and collaborations within the entrepreneurial community (Gamede 2019; Ndlovu *et al.* 2023). These strengths have

contributed to the growth and success of entrepreneurship education in Africa and have helped foster a culture of entrepreneurship and innovation on the continent. Despite the challenges and limitations, entrepreneurship education in Africa continues to evolve and make a positive impact on economic development and job creation. Many entrepreneurs in Africa are driven by a desire to address social and environmental challenges in their communities.

2.11. SOUTH AFRICAN ENTREPRENEURSHIP EDUCATION

In South Africa, initiatives have been taken in both the private and educational sectors to engage in entrepreneurship education. Entrepreneurship education in South Africa is in its developmental stage, with universities primarily using traditional teaching methods. However, there is a need for interactive methods, such as simulation, to be incorporated to enhance students' analytical and decision-making skills (Gamede 2019; Ndlovu *et al.* 2023; Nkomo 2015). Various initiatives have been taken by both the private sector and the educational sector to engage in entrepreneurship education, including the implementation of a pilot core syllabus for entrepreneurship and economic education in schools (Forcher-Mayr and Mahlknecht 2020). The importance of entrepreneurship in higher education institutions is recognised, and there is increasing commitment from these institutions to offer academic, research, and outreach programmes in entrepreneurship.

2.12. SOUTH AFRICAN BUSINESS STATISTICS

South Africa has undergone major transformations in its business environment since 1994, including economic restructuring and improvements in fiscal and monetary discipline, domestic and global competitiveness, and the general business climate. Despite this, small businesses in South Africa face numerous challenges, including environmental, marketing, financial, and managerial problems, which can impact their success (Chinomona and Maziriri 2015).

In 2020, the new business density in South Africa increased by 1.8 new companies per 1,000 individuals, a growth of 16.89% from 2019. South Africa's GDP growth is projected to slow to 0.3% in 2023 before picking up to 1% in 2024. Although the country

has recovered from macro-economic reforms, South Africa has not experienced significant private sector growth and job creation, with average GDP growth below the required level to address unemployment (Bwisa 2012). Small and medium-sized enterprises (SMEs) play an important role in South Africa's socio-economic development, contributing to employment and GDP, but their performance is affected by factors such as economic conditions, competition, socio-economic problems, and change.

2.13. PARADIGM SHIFT IN EDUCATION: EQ VS IQ AND THE RISE OF AI

There is a paradigm shift in education towards incorporating emotional intelligence (EI) (Sikström *et al.* 2022). Emotional intelligence is seen as a set of qualities and skills not measured by intelligence quotient (IQ) tests but important for success in life (Patil 2016). It is recognised that veterinarians, educators, and leaders in higher education can benefit from training in non-technical competencies, including communication skills and EI (Sharp *et al.* 2020). However, there are challenges in implementing EI due to the choice of different models and the lack of direct correlation between high EI and success in specific professions. Despite this, there is growing interest in scientifically based applications of EI in education, as it has been shown to improve people's lives and increase performance in various areas. Emotional intelligence can be developed later in life through proper tutoring and commitment. Overall, EI is seen as a relevant and valuable concept in education.

There is a growing appreciation for the importance of EI in the educational environment, as it contributes to the improvement of teaching practice and enhances the well-being of teachers and students. Emotional intelligence is seen as an attribute that supports adaptive coping with stress and can have a positive impact on outcomes, particularly achievements. However, there are concerns about the EI discourse in education, as it is often associated with other influential discourses and may not go beyond traditional concepts. The paradigm shift in education towards incorporating EI recognises the importance of not only academic knowledge but also the ability to understand and manage emotions. By integrating EI into education, students can develop crucial skills such as empathy, self-awareness, and effective communication. These skills are vital for success not only in the classroom but also in their personal

and professional lives. The paradigm shift towards integrating EI into education recognises the importance of nurturing skills such as empathy, self-awareness, and effective communication alongside academic knowledge. By combining both academic and emotional intelligence skills, students can become well-rounded individuals capable of thriving in various social and professional contexts.

Additionally, the rise of artificial intelligence (AI) in education is seen as both a challenge and an opportunity for teachers, as AI has the potential to bring about profound changes in teaching and learning. The world has recognised the importance of AI in education and the workplace, so efforts are being made to digitize education through initiatives that incorporate AI and machine learning. For example, AI-powered digital tools can play a significant role in enhancing students' performance in academic writing and other disciplines (Kurniati and Fithriani 2022). Incorporating AI into DT pedagogy can help students develop critical thinking skills and innovative problem-solving abilities: leadership skills, empathy, advanced critical thinking for complex cases, that AI struggles to grasp. There is also the potential for AI to play a role in business development. Here, AI can assist in enhancing decision-making processes, automating repetitive tasks, and providing valuable insights through data analysis.

2.14. CHAPTER SUMMARY

This chapter presented the literature relevant to DT and entrepreneurship and how they link to the education system. Design Thinking as a concept was clarified and its dimensions, antecedents and consequences were explored. The literature confirms that DT can have an impact on both students and tertiary institutions. Furthermore, the literature highlighted gaps and strengths in the education system in South Africa. The next chapter discusses the research methodology and design.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. INTRODUCTION

In the previous chapter, the literature was reviewed. In this chapter the study research design, population, data collection, data analysis, pre-testing, study limitations, validity and reliability, and ethical considerations will be discussed.

3.2. RESEARCH METHODOLOGY

Budert-Waltz (2021) defines research methodology as special techniques that a researcher uses to collect and analyse data to uncover new information. These methods provide a strategy by which the researcher can explore systematic processes to understand a phenomenon and answer research problems and/or questions. Research is not rigid; there is a variety of ways to do research. The path a researcher takes will guide how the information is gathered to answer research questions (Mackey and Gass 2022). This research design and methodology chapter will show how the outcomes were obtained in line with achieving the objectives of this study.

3.3. RESEARCH DESIGN

Research design is a reflection of the researcher's plan. This acts as a guide to bind the research together through a research plan which outlines all the major parts of the study that need to be explored to address the research problems or questions. Research designs determine the methods to be used to collect and analyse the data and how the information is going to answer the research questions (Asenahabi 2019: 77). The primary objective of a research design is to guide the collection of evidence to answer the research questions. Sileyew (2019: 28) adds that the significant decision in the research design process is the research approach to be adopted because it will reveal the relevant information needed for the study. In this study, data were collected from students who are studying entrepreneurship in the Department of Entrepreneurial Studies and Management, DUT. Questionnaires were distributed to students via their student emails.

According to Asenahabi (2019: 78), research design is divided into three groups namely, quantitative, qualitative, and mixed method research design, and the researcher needs to adopt the most appropriate design that will be effective for the study.

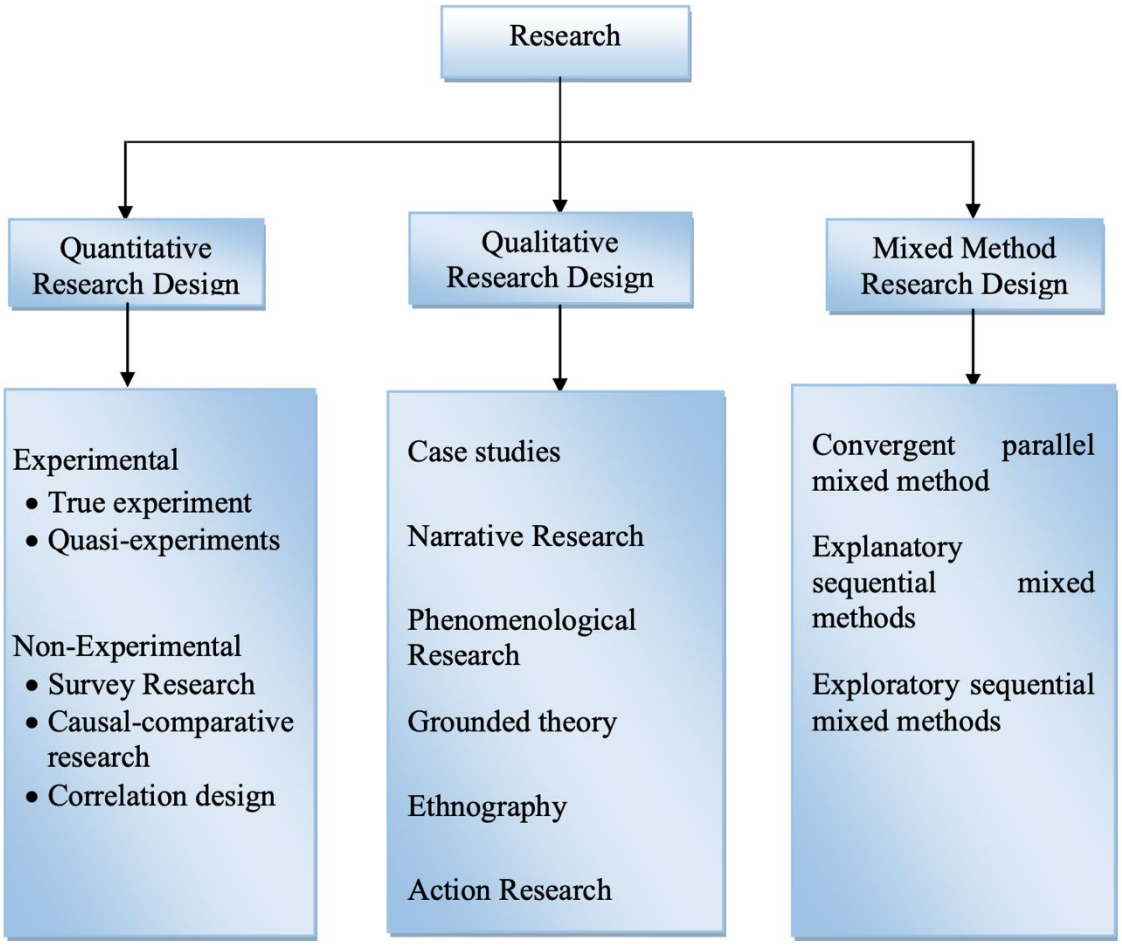

Figure 3.1. Summary of research design types (Source: Asenahabi 2019: 78).

3.3.1. Qualitative research design

Aspers and Corte (2019) define qualitative research as a repetitive process where the scientific community obtains new insights or understanding of the phenomenon examined. The qualitative research approach is commonly explored when there is less knowledge regarding a complex phenomenon, or if the phenomenon is explored in a

new perspective (Kyngäs 2019). A qualitative research study should serve three purposes: to explore, describe, and explain. The research study can utilise one or more of the stipulated purposes (Babbie 2010). Qualitative research, contrary to quantitative, is demanding, systematic, disciplined, and commonly offers a practical alternative approach. This approach includes studying all the difficulties of the phenomenon (Mehrad and Zangeneh 2019).

3.3.2. Quantitative research design

In a quantitative research design, the main purpose is to examine the connection between an independent and a dependent variable or consequence variable in a population. It includes descriptive research or experimental research. A descriptive study examines the relations between variables whereas an experimental study establishes interconnection (Mehrad and Zangeneh 2019). Quantitative means quantity (how much) and information gathered in the study and the results are in a numeric form. The quantitative research design deals with numbers, logic and an objective stance (Haradhan, 2020). This approach is viewed as an analytical method of research. The collection and analysis of data are conducted using mathematical and statistical methods (Asenahabi 2019: 79)

3.3.3. Mixed methods research design

The mixed method research design is the integration of both quantitative and qualitative approaches. Qualitative research provides open-ended data without providing predetermined responses while quantitative research brings close-ended questions (Asenahabi 2019: 84). This approach offers researchers the advantage of answering research questions with adequate depth and breadth and assisting in generalising the findings and implications of the issues being researched (Dawadi, Shrestha and Giri 2021).

In this study, a quantitative research design was used. This was viewed as the best method for this study as it facilitates comparison of the numerical data, allowing for statistical inferences about the differences and similarities between the two groups.

This study had a large student population, and the quantitative research approach is efficient in handling sizable samples.

3.4. TARGET POPULATION AND AUDIENCE

The target population refers to the group of individuals or items that the intervention seeks to conduct research and gather conclusions on (Barnsbee, Barnett, Halton and Ngheim 2018). According to Akman (2023), the target population, also referred to as the target audience, is a group that possesses similar characteristics that may differentiate them from the general population. Casteel and Bridier (2021) further explain that all boundary considerations should be explored to ensure that the target population is inclusive enough to provide sufficient data for the research study.

The target population for this study was all the students registered for entrepreneurial modules in the Entrepreneurial Studies Department through a bootcamp and the general lecture, which comprised 900 and 91 students, respectively.

3.5. SAMPLING

Sampling is a critical component in quantitative research since it involves selecting a representative subset of individuals from a bigger group (Alele and Malau-Aduli 2023). The main aim of sampling is to gather a small group that represents a smaller population to produce an accurate generalization of the larger group (Jain and Chetty 2020). There are two types of sampling namely, probability sampling and non-probability sampling. Non-probability sampling uses the subjective method of selecting units from a universe, which is useful when performing preliminary studies or focus groups. Probability sampling is based on simple random sampling, cluster, and stratified sampling (Mishra and Alok 2017).

This study sample includes 204 students out of a total of 278 who consented to participate, from across five faculties at the DUT, representing a 73.3% response rate. Only students who were attending Entrepreneurial Edge 101 and Introduction to Technopreneurship 101 modules in the Department of Entrepreneurial Studies were sent questionnaires. This population was selected on the basis that they are serviced

by the department that curated the curriculum and the content was the same; with the exception that one did not have DT included in their syllabus.

The researcher determined that the simple random sampling method was appropriate to answer the research questions because the populations were all studying the same module, although only one of the class included DT. Noor, Tajik and Golzar (2022) define simple random sampling as a randomly selected subset of the larger population with each member of the population receiving an equal chance of being selected. Students were contacted using the class lists of students for Entrepreneurial Edge and Introduction to Technopreneurship. Emails were sent directly to the student emails with the questionnaires that clearly stated the intentions of the study and asked for their consent. Murphy (2021) states that stratified sampling accurately ensures that the population receives proper representation through subgroups.

3.5.1. Hypotheses

McCombes (2022) defines a hypothesis as a statement that can be tested by scientific research. These are predictions that the researcher has before conducting the study and they are not guesses; they should be based on theories and knowledge. Jansen (2020) states that research hypotheses need to have three attributes namely, specificity, clarity and testability. The independent variable in this study was the entrepreneurial intentions of students.

H1: Students studying entrepreneurship modules which include DT have higher chances of starting a business.
H0: Students studying entrepreneurship modules which include DT have lower chances of starting a business.

H2: Students who do not study DT have fewer chances of generating business ideas.
H0: Students who do not study DT have more chances of generating business ideas.

3.5.2. Research procedure

The researcher received a gatekeeper's letter and approval from the ethics committee to conduct the study on students. The first page of the form required the participants to state if they fully understood the brief of the study, the purpose and what the study results will be used for. Consent was requested, and if consent was not granted, the form did not allow the participant to continue with the questionnaire.

3.5.3. Sample size

The sample was a total of 278 questionnaires that were emailed to students email addresses for students registered for the selected entrepreneurship modules. Of these, 204 questionnaires were returned, which yielded a 73.4% response rate. The response rate was calculated as: number of students that were the sample divided by the number of students who responded and gave consent and multiplied by 100.

$$\frac{204}{278} \quad X \quad 100$$

$$= 73.4\%$$

3.6. DATA COLLECTION

Data collection is the process of gathering information to gain knowledge and insight into the existing research problem (Bhandari 2020). Data collection is a methodological process, and the researcher must ensure that the data are complete during the collection phase and that it was collected legally and ethically (Corte 2021). Primary data collection is the gathering of data directly from the source (Taherdoost 2021) and the methods for collecting primary data include surveys, interviews, and observation. Secondary data collection is the process of collecting data from someone other than the primary source (Costa 2022). The primary data collection instrument used in this study was a semi-structured questionnaire.

3.7. DATA COLLECTION INSTRUMENT

Questionnaires can be used in a quantitative and qualitative study. According to Bhandari (2023), questionnaires are a set of questions or items used to obtain information regarding a certain phenomenon. McCleod (2023) describes a questionnaire as a research instrument that consists of a set of questions aimed at gathering information from respondents. This can be viewed as a written interview that can be conducted via face-to-face, telephone conversation, post or computer.

Data were collected in September 2023. The data were collected via Google Forms, and it took a few weeks for most respondents to submit their answers. The questionnaires were distributed via student emails using the class registers and lecturers were requested to make students aware of the questionnaire in their students' email, whilst the researcher was given a five minute slot to urge students to respond.

3.8. DESIGN AND LAYOUT OF QUESTIONNAIRE

The researcher can either have self-administered questionnaires or researcher-administered questionnaires. Self-administered questionnaires can be delivered online, in pen and paper format, or through mail while researcher-administered questionnaires are interviews done in person, via phone call or between researcher and respondents (Bhandari 2023).

The questionnaire was divided into four parts: Part One provided the respondent the information about the research and the respondent was asked if they consented to participate in the study. Part Two (Section 1) was Demographics, Part Three (Section Two) was Design Thinking and Entrepreneurship and Part Four (Section Three) was the Open-Ended questions.

Section 1 of the questionnaire was about the demographics of the students. This section requested age, gender, faculty, year of study, their exposure to entrepreneurship, and the format of their entrepreneurship class. This was to determine if there is a correlation between the demographics and the format for teaching entrepreneurship.

Section 2 of the questionnaire was about DT and entrepreneurship. This section examined the level of exposure the students had to DT and entrepreneurship and evaluated the level of their intention to become entrepreneurs in university and post-university.

Section 3 of the questionnaire was open-ended questions. This was to evaluate the respondents view of the curriculum of entrepreneurship, their application of DT within their lifestyle, and developments they want in the entrepreneurship curriculum.

3.9. PILOT STUDY

A pilot study was conducted after the questionnaire was approved by the Institutional Research Committee (DUT IREC). According to Simkus (2023), a pilot study is a fundamental stage in research. It evaluates the feasibility of the study, resources and practicality, and identifies design issues before the main research study is conducted. A pilot study was conducted on five students to evaluate the relevance and effectiveness of the selected research design, methodology, and measuring instrument.

3.9.1. Findings of the pilot study

Pilot testing was done on 9 March 2023. The responses indicated that the respondents understood the questions and that the questions were clear. This pilot study also indicated through the data collected, that the questionnaire covered all the issues as intended. The data collected were found to be sufficient and the measuring tool used efficiently gathered the needed information. The pilot study confirmed the validity and reliability of the questionnaire. The researcher thus determined that the questionnaire was successful in collecting the desired information and was the correct instrument to collect the data for the main study.

3.10. ADMINISTRATION OF QUESTIONNAIRES

As the researcher was working at the selected site, students were physically visited in the class and boot camps. To coordinate and encourage students to participate in the

study, lecturers were requested to remind students in class and time was given for students to participate. The number of responses was monitored, and a reminder was sent via MS Teams classes. The respondents were requested not to discuss the semi-structured questionnaire and their answers with anyone to limit biases that may arise due to such activity. A month was allocated for the data collection. The study aimed to obtain 278 responses, however, 204 students gave their consent and participated. This may be because the university was approaching the September recess and students were leaving the campus.

The three-section semi-structured questionnaire was self-administered and contained a consent letter and an information letter. This included an assurance of confidentiality and anonymity. The letter of information stipulated the research study title and a brief description of the study. The researcher and supervisor's contact details were provided if the participants required an explanation regarding the study and their involvement in it. The semi-structured questionnaire was written in English as it is one of two languages of communication adopted at DUT, and all respondents were more proficient in it than Isizulu.

3.11. ACCESS AND ETHICAL CONSIDERATIONS

3.11.1. Ethics approval gatekeeper permission

The research proposal was approved by the Department Research Committee (DRC) and the Faculty Research Office (FRC) and was submitted together with the data collection instrument, letter of information and consent forms, to the Institutional Research Ethics Committee (IREC) for ethical clearance. The ethical clearance provisional permission was obtained. The request was sent to the gatekeeper department for a letter of approval. Upon receiving the gatekeeper letter, full permission was granted to conduct the study on students from the IREC office.

3.11.2. Informed consent

The respondents of the study were informed of all the consequences of the study before the questionnaires were sent to their emails. The form stated that participation was voluntary, and that participants had a right to withdraw at any time from the study.

This study did not at any point expose the participants to risks or any situation that could endanger them either mentally or physically.

3.11.3. Autonomy and confidentiality

The letter of information and consent assured participants that their identity will remain anonymous, and that the confidentiality of the data and the protection of their rights and welfare will not be compromised. This was assured by not collecting the names, surnames and student numbers of the participants and not turning on the feature of collecting the emails of respondents. All study data were stored securely and due to the identity information not being collected, the data remained anonymous. The material obtained (The Google Form) were stored electronically and could only be accessed by the researcher and supervisor. This information will be disposed of after five years in a manner that will ensure the confidentiality of the participants.

3.12. RELIABILITY AND VALIDITY

Reliability and validity are methods used to evaluate the standard of the research. Reliability measures the consistency of the method used while validity refers to the accuracy of the method in obtaining data (Middleton 2023). In statistics, reliability refers to the ability of the data collection techniques to reproduce the same result repeatedly as required. If the reliability is low, this means it is difficult to reproduce similar results in the study, which then decreases the validity of the study (Kalla 2023). This study's semi-structured questionnaire was pilot tested, which is where the questionnaire was deemed fit for the intended population of this study. The reliability of this study was concluded based on the responses of the students.

3.13. DATA ANALYSIS

Data analysis is a process by which researchers summarise the data collected into a story for interpretation and provide insight (Bhat 2023). In this study, the quantitative data were analysed using SPSS version 24.

3.14. ETHICAL CONSIDERATIONS

Ethical considerations are sets of principles that guide the research and practices (Bhandari 2023). The following ethical issues were considered:

- Participation in this study was voluntary and at no point were participants forced to respond to the semi-structured questionnaire.
- The letter of information and consent was sent to the respondents for their knowledge.
- The participants were informed that their information would be kept confidential and only used for research purposes. The participant's emails and contacts were not requested or obtained to ensure that anonymity was maintained.
- No harm or unconsented inconveniences were caused to the respondents in this study.

3.15. CHAPTER SUMMARY

This chapter explained the methods and research designs that were selected for this study**.** The sampling of this study comprised DUT students registered for entrepreneurship modules, namely, Entrepreneurial Edge and Introduction to Technopreneurship. The quantitative research method and instrument was used to collect data for this study and ethical considerations were discussed. The next chapter will present the findings of this study.

CHAPTER FOUR

4. RESULTS

4.1. INTRODUCTION

In the dynamic landscape of higher education, the fusion of entrepreneurship education and innovative methodologies has gained significant attention. One such approach is the integration of DT into entrepreneurship curricula. Design Thinking, a human-centred problem-solving framework, offers a unique perspective on fostering creativity, innovation, and entrepreneurial thinking among university students.

This research study explored the impact of DT on entrepreneurship education within a university context. Its aim was to understand the relationships between DT attendance, confidence levels in generating and executing ideas, participation in entrepreneurship courses, and the initiation of entrepreneurship ventures among students. The study aimed to investigate whether DT should be adopted as a teaching and learning strategy in university entrepreneurship programmes. Data were collected using both closed and open-ended survey questionnaires. The data was distributed to 209 respondents, and 204 gave their consent to participate in the survey; a response rate of 97.6% (Table x).

Table: xx

		Frequency	Percent
Do you give consent to participate in the study?	No	5	2.4
	Yes	204	97.6
	Total	209	100

4.2. DEMOGRAPHIC CHARACTERISTICS

4.2.1. Age group

Figure 4.1 depicts the age distribution of the respondents. The data shows that the majority falls into the 20-22 age group (55.4%), followed by 17-19 (28.9%), 23-25 (10.3%), and 26+ (5.4%).

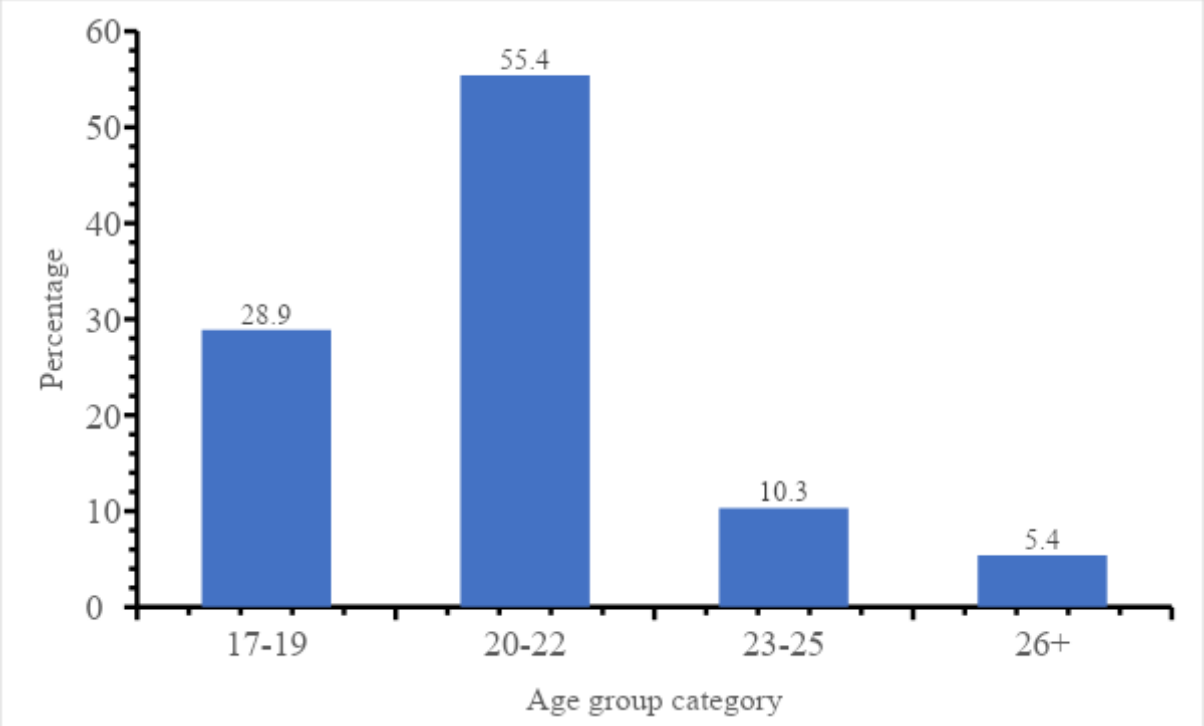

Figure 4.1: Age distribution of the respondents

4.2.2. Gender

Figure 4.2 shows the gender distribution of the respondents, with 38.1% identifying as male and 61.9% identifying as female among the valid responses.

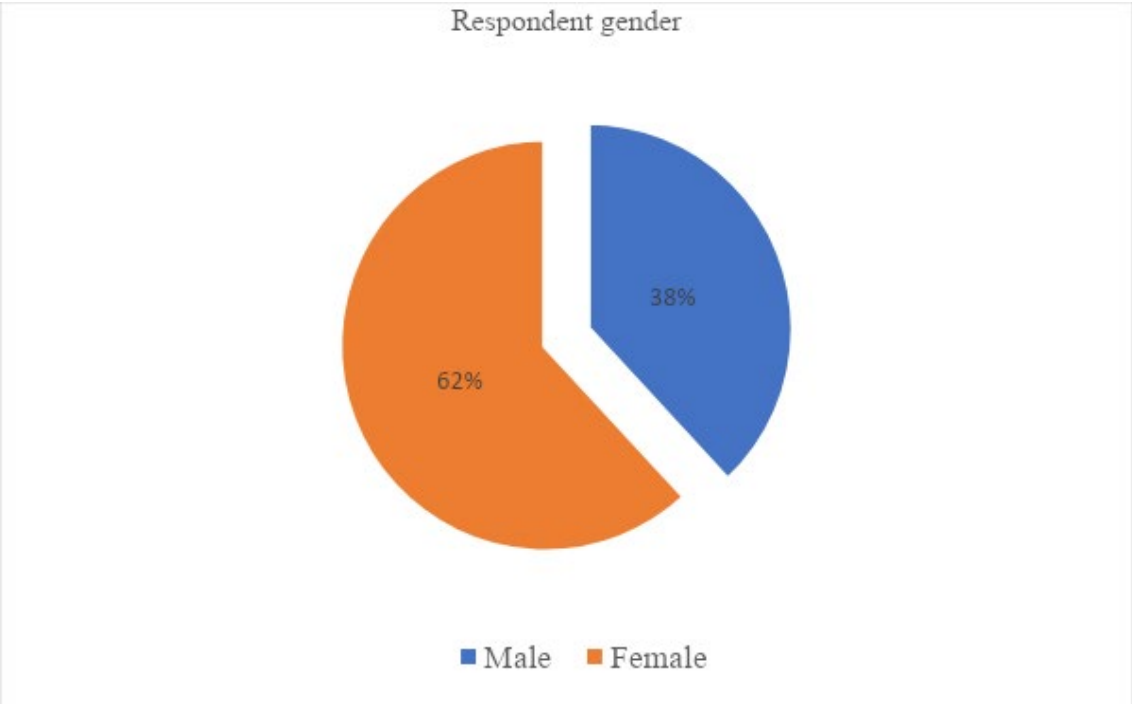

Figure 4.2: Gender of respondents

4.2.3. Faculty

Figure 4.3 depicts the distribution of respondents across different faculties or fields of study, with the majority (85.3%) from the Applied Sciences faculty, followed by Arts and Design (8.3%), Accounting and Informatics (3.4%), Health Sciences (2.0%), and Management Sciences (1.0%).

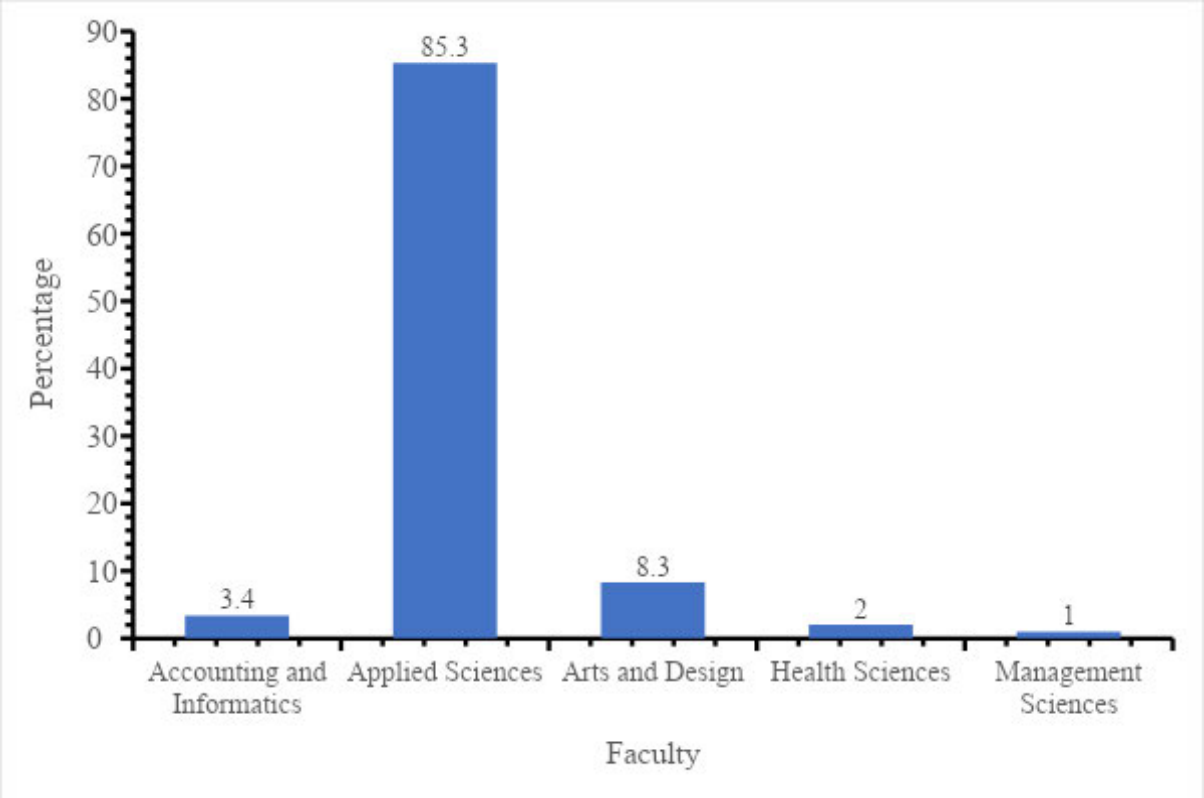

Figure 4.3: Faculty of respondents

4.2.4. Level of study

Figure 4.4 provides information about the distribution of respondents across different years of study. The majority (48.5%) were in their 1st year, followed by the 2nd year (43.1%), with smaller numbers in the 3rd year (4.4%), 4th year (2.9%), and 5th year (0.5%). There were also respondents who were DUT alumni (0.5%).

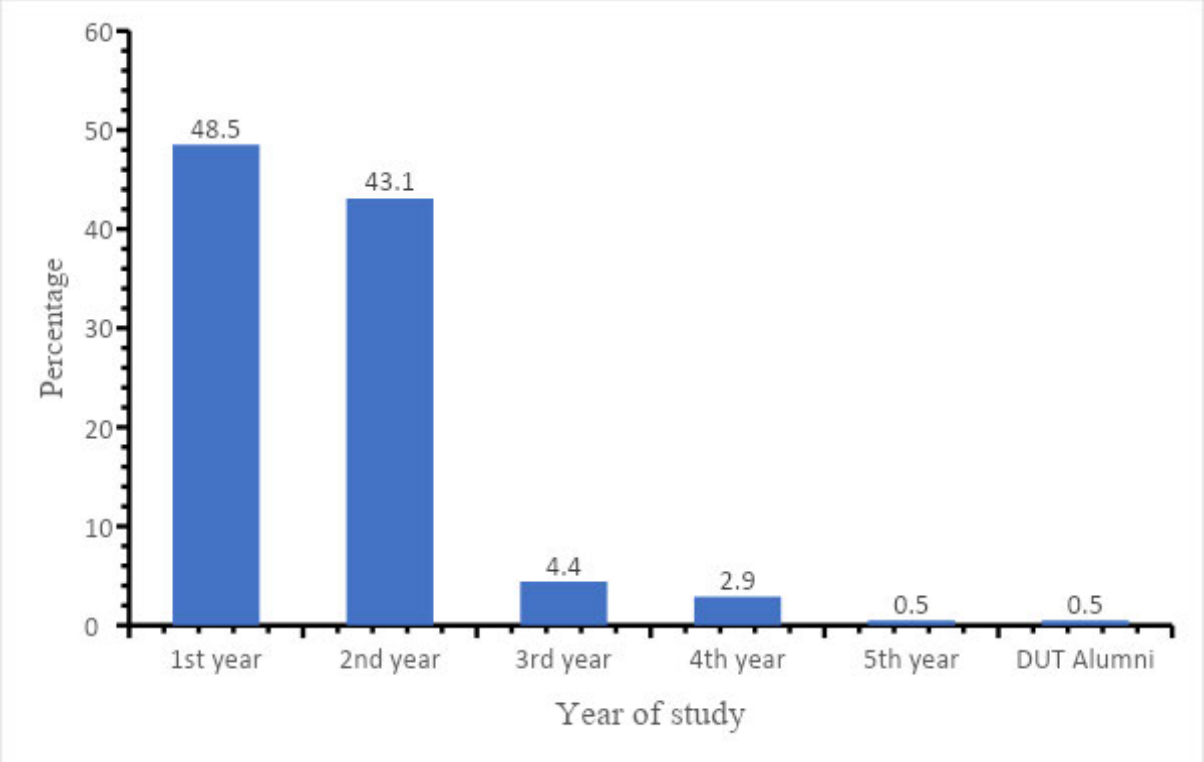

Figure 4.4: Respondents level of study

4.2.5. Course on entrepreneurship

Table 4.1 reflects the responses of the respondents based on whether they have previously taken courses on entrepreneurship. The data shows that the majority of respondents (75.0%) have not previously taken courses on entrepreneurship, while a minority (25.0%) have taken such courses.

Table 4.1:Number of respondents who have previously taken course on entrepreneurship

		Frequency	Percent
Have you previously taken any courses on entrepreneurship?	No	153	75,0
	Yes	51	25,0
	Total	204	100,0

4.3. DESIGN THINKING AND ENTREPRENEURSHIP

4.3.1. Bootcamp or Timetabled attendance

Table 4.2 reflects the number of respondents who did attend the bootcamp (3-5 days) or timetabled class (every week). The data shows that the majority of respondents (88.7%) attended timetabled classes on a regular basis, while a smaller portion (11.3%) attended a bootcamp that lasted 3-5 days.

Table 4.2: Number of respondents who attended bootcamp or timetabled class

		Frequency	Percent
Did you attend the bootcamp (3-5 days) or Timetabled class (every week)	Bootcamp	23	11.3
	Timetabled	181	88.7
	Total	204	100.0

4.3.2. Design Thinking

Table 4.3 reflects the responses to the questions about DT. When asked if the respondents have heard of DT, the data revealed that the majority of respondents (75.5%) have heard of DT, while a smaller percentage (24.5%) have not. When asked if the respondents have participated in any DT workshops, the results suggests that a significant majority of respondents (73%) have not participated in DT workshops or courses, while a smaller percentage (27%) have engaged in such activities.

Table 4.3. Respondents' knowledge and participation in Design Thinking course or workshops

	No n (%)	Yes n (%)
Have you heard of Design Thinking?	50 (24.5%)	154 (75.5%)
Have you participated in any Design Thinking workshops or courses?	149 (73%)	55 (27%)

4.3.3. Level of confidence on the ability to generate and execute new ideas

Table 4.4 provides responses to questions about the level of confidence in generating and executing new ideas. The response categories are on a scale from 1 to 5, with 1 being the lowest level of confidence and 5 being the highest. One-sample t-test was performed to determine if there are significant differences in each of the response. In terms of the level of confidence about their ability to generate new ideas, 5.9% of respondents feel very unconfident (rated 1), 12.3% are somewhat unconfident (rated 2), 36.3% are neutral or moderately confident (rated 3), 27.5% are somewhat confident (rated 4), and 18.1% are very confident (rated 5). The average response score is 3.40, which indicates that, on average, respondents have a moderate level of confidence in their ability to generate new ideas. The p-value suggests that there is a significant difference in respondents' confidence levels regarding generating new ideas ($t(203)= 44{,}180$; $p<0.001$).

In terms of the respondents confidence about their ability to execute on new ideas, 5.9% of respondents feel very unconfident (rated 1), 21.1% are somewhat unconfident (rated 2), 32.8% are neutral or moderately confident (rated 3), 24% are somewhat confident (rated 4), and 16.1% are very confident (rated 5). The average response score is 3.24, which indicates that, on average, respondents have a moderate level of confidence in their ability to execute on new ideas. The p-value is measured suggests that there is a significant difference in respondents' confidence levels regarding executing new ideas ($t(203)= 40{,}776$; $p<0.001$).

In summary, the above results suggest that the surveyed individuals generally have moderate confidence in their ability to generate and execute new ideas. Overall, the respondents' confidence in executing on new ideas appears to be slightly lower on average (mean of 3.24) compared to their confidence in generating new ideas (mean of 3.40).

Table 4.4. Respondents level of confidence in ability to generate and execute new ideas

Response	Level of confidence on ability to generate and execute new ideas (n=204)								
	1	2	3	4	5	Mean(Std)	t	Df	P
How confident do you feel about your ability to generate new ideas?	5.9%	12.3%	36.3%	27.5%	18.1%	3.40(1.098)	44,180	203	<,001
How confident do you feel about your ability to execute on new ideas?	5.9%	21.1%	32.8%	24%	16.2%	3.24(1.133)	40,776	203	<,001

4.4. ENTREPRENEURIAL VENTURES

4.4.1. Entrepreneurial ventures in university

Table 4.5 reflects the response to the question seeking to know if the respondents have started any entrepreneurial ventures while at university. The table shows that the majority of respondents (80.9%) have not started any entrepreneurial ventures while in university, while a smaller percentage (19.1%) have engaged in entrepreneurial activities during their time in university.

Table 4.5. Respondents' response to starting entrepreneurial ventures while in university

		Frequency	Percent
Have you started any entrepreneurial ventures while in university?	No	165	80,9
	Yes	39	19,1
	Total	204	100,0

Among those who started entrepreneurial ventures while in university, the majority (84.6%) indicated that DT did help spark the idea for their ventures, while a smaller percentage (15.4%) stated that it did not play a role (Table 4.6).

Table 4.6. Influence of Design Thinking on sparking idea for entrepreneurial ventures

		Frequency	Percent
If yes, did Design Thinking help spark the idea for your entrepreneurial venture?	No	6	15,4
	Yes	33	84,6
	Total	39	100,0

4.4.2. Design Thinking and entrepreneurial ventures

The data in Table 4.7 show responses related to the perceived value and likelihood of using DT in the process of starting entrepreneurial ventures. The response categories were on a scale from 1 to 5, with 1 being the lowest perceived value and 5 being the highest. A one-sample t-test was performed to determine if there were significant differences in each of the responses. In terms of how valuable respondents believe DT is in the process of starting an entrepreneurial venture, 6.9% of respondents see DT as not valuable (rated 1), 5.9% as somewhat valuable (rated 2), 25.0% as moderately valuable (rated 3), 27.9% as valuable (rated 4), and 34.3% as highly valuable (rated 5). The mean score measured was 3.77, indicating that, on average, respondents perceive DT as having a moderately high value in the process of starting entrepreneurial ventures. The p-value is <0.001, suggesting that there is a significant difference in respondents' perceived value of DT in the context of starting entrepreneurial ventures.

In terms of how likely the respondents are to use DT in the future when starting an entrepreneurial venture, 6.9% of respondents see DT as not likely (rated 1), 9.3% as somewhat likely (rated 2), 23.5% as moderately likely (rated 3), 27.0% as likely (rated 4), and 33.3% as highly likely (rated 5). Respondents expressed a high likelihood (mean of 3.71) of using DT in the future when starting entrepreneurial ventures. The

p-value of <0.001, suggests that there is a significant difference in respondents' perceived likelihood of using DT in the future when starting entrepreneurial ventures.

Overall, these results suggest that the surveyed individuals generally perceived DT as valuable in the process of starting entrepreneurial ventures, and they expressed a high likelihood of using it in the future. The low p-values indicate that these perceptions are statistically significant.

Table 4.7. Respondents' perception of Design Thinking as valuable in the process of starting entrepreneurial ventures and the high likelihood of using it in the future

Response	Values and likelihood of using Design Thinking in entrepreneurial venture (n=204)								
	1	2	3	4	5	Mean (Std)	T	Df	P
How valuable do you believe DT is in the process of starting an entrepreneurial venture?	6.9%	5.9%	25.0%	27.9%	34.3%	3.77(1.183)	45,506	203	<0,001
How likely are you to use DT in the future when starting an entrepreneurial venture?	6.9%	9.3%	23.5%	27.0%	33.3%	3.71(1.216)	43,515	203	<0,001

4.5. INNOVATIVE PROBLEM SOLVING THROUGH DESIGN THINKING IN ENTREPRENEURSHIP.

Respondents were asked if they can describe a time when they used DT to generate a new idea for an entrepreneurship venture. The responses grouped in Table 4.7 into various categories are detailed below:

No experience with Design Thinking (36.3%): Many respondents expressed their lack of experience with DT. They mentioned that they had never used it before or were

unsure about it. Some acknowledged the importance of creativity in entrepreneurship but had not yet applied DT in their ventures.

Design Thinking used in educational assignments (23.5%): A significant portion of respondents shared that they had used DT in educational assignments, particularly in group projects. They cited instances where they applied DT to generate new business ideas, solve problems, or create innovative solutions as part of their coursework.

Entrepreneurial ventures (6.4%): A smaller group of respondents discussed using DT in the context of their entrepreneurial ventures. They mentioned using DT to identify market niches, define problems, and create unique business concepts. These individuals applied DT principles in real-world business scenarios.

Limited or unclear use of Design Thinking (3.9%): Some respondents had limited or unclear experiences with DT. They expressed curiosity about its potential impact but had not yet applied it in practical situations. Their responses suggested a desire to explore DT further.

Personal aspirations and reflection (4.9%): Several respondents shared personal aspirations and reflections related to entrepreneurship and DT. They expressed ambitions to start businesses, address societal problems profitably, and recounted moments when they considered innovative business ideas, often driven by a desire to make a positive impact on society.

Miscellaneous responses (1.0%): A few responses fell into the miscellaneous category, such as a suggestion for a feature in a music app. These responses were unrelated to entrepreneurship but still showcased the potential application of DT.

Overall, the responses highlighted a range of experiences and perspectives regarding the use of DT in entrepreneurial ventures, from those with no prior exposure to it to those who had applied it both in educational settings and in real-world business situations. Additionally, some respondents reflected on their personal aspirations and ideas, emphasizing the role of DT in fostering creativity and innovation.

Table 4.8. Summary of time Design Thinking can be used to generate a new idea for entrepreneurship venture

Category	Direct statements	Frequency	Percentage
No experience with Design Thinking	-"I have never used design thinking." -"I've never used design thinking before." -"I've never used design thinking. -"I don't know anything about Design Thinking as yet." -"I haven't used it, but I know entrepreneurship needs creativity." -"I can use design thinking to generate new ideas for an entrepreneurial venture during the initial stages of planning." -"I am not sure."	74	36.3%
Design Thinking used in educational assignments	-"I used design thinking in designing my new windbreaker jacket." -"I used design thinking to generate a new business idea which we were asked to, but it was a group assignment for Introduction to Technopreneurship module." -"I used design thinking when I was doing business management last semester." -"During a group assignment." -"During group assignment."	48	23.5%
Entrepreneurial ventures	-"Based on the insights gained from empathy, I defined a specific problem or opportunity within the sustainable fashion space." -"I had to find a niche in the market and find ways to execute differently than the already existing businesses in my community." -"I used design thinking the time I was doing a business Management module last semester. -"By developing a new sweet shop which offers a unique customer experience." -"I decided to sell prepared food for working people and delivered them to their doorsteps."	13	6.4%
Limited or unclear use of Design Thinking	-"Actually, I would say no because it is the first time and it seems like it has no impact so far but I am curious."	8	3.9%

	-"Any time you are free." -"I didn't use it."		
Personal aspirations and reflection	-"Honestly, ever since I was 17 years old, I always think of starting major businesses, a huge company." -"I would have used design thinking to address solutions for the problem which occurs in the society but in a profitable way." -"I think I was still in high school and I was thinking if I go to varsity, I will have to start my own business." -"It was when I thought about this device that acted like teeth when placed in a woman's body, to help against rape." -"When I saw a show about entrepreneur on TV" -"When i have to think about a business I'm going to make, so that other people can like it." -"When I was starting my business." -"When I started my small business." -"When I used design thinking the business was a success."	10	4.9%
Miscellaneous responses	-"For YouTube music to continue playing a certain song even if you have exited the app."	2	1.0%
Total		204	100.0%

4.6. ENHANCING ENTREPRENEURSHIP EDUCATION THROUGH DESIGN THINKING INTEGRATION

Table 4.9 highlights the responses gathered from the question which aimed to understand how university programmes could better incorporate DT into their entrepreneurship curriculum. The suggestions provided by the respondents were categorised into different themes which are detailed below.

Curriculum integration (18.8%): Many of the respondents emphasized the need to incorporate DT into the university curriculum. The respondents suggested adding it as a module, making it compulsory, or integrating it into the existing entrepreneurship

courses. They proposed the creation of dedicated DT courses and practical techniques rather than theory.

Awareness and promotion (10.4%): Respondents highlighted the importance of raising awareness about DT. They suggested hosting events, inviting industry experts for workshops and talks, and creating opportunities for discussions and gatherings. They emphasized the value of promoting DT as a module for every course to help students understand its significance.

Practical application (10.9%): Respondents revealed how students can apply DT in real-world scenarios. They proposed practical modules that encourage students to start businesses, collaborate, engage in thinking challenges, and sell products. Design Thinking also emphasizes a systematic approach to teaching problem-solving.

Student engagement and participation (11.9%): Respondents suggested that students should actively participate in programmes and collaborate across disciplines to bring diverse perspectives to DT. This encourages cross-functional teams to apply DT to entrepreneurial challenges.

Resources and support (5.9%): Here, respondents emphasized the importance of providing access to DT tools, software, and resources. They also stressed the need for funding and support for students to start businesses.

Miscellaneous (6.4%): Some respondents provided suggestions such as providing opportunities to apply DT to real-world problems, coming up with strategies and solutions, and making the process engaging.

No suggestion (7.4%): Some respondents expressed uncertainty or a lack of knowledge about how DT can be better incorporated into the curriculum, leading to the "no suggestion" theme.

The above narratives represent the different perspectives and ideas respondents have regarding the incorporation of DT into university entrepreneurship programmes.

Table 4.9. Summary of respondents' suggestions regarding incorporation of Design Thinking into University entrepreneurship programmes

Theme	Direct quote	Frequency	Percentage
Curriculum Integration	Adding them more to some entrepreneurial modules. By adding it as a module or rather together with entrepreneurship module. By adding such modules and make them compulsory to students. By allowing all first year student to do module like itch and having programmes where they will tell us more about design thinking. By introducing a module to students whereby they will be taught about design thinking. By making entrepreneurship are course. Courses should offer entrepreneur based modules in order for students to be aware of Design Thinking. Create a Design thinking course. Introduction of practical techniques rather than theory. They should Design Thinking as a module. To better incorporate Design Thinking into entrepreneurship curriculum, universities could integrate real-world case studies, guest lectures from industry experts, and hands-on projects that emphasize user-centered problem-solving. Additionally, fostering interdisciplinary collaboration and providing access to design tools and resources would enhance students' ability to apply Design Thinking in entrepreneurial contexts. University can introduce dedicated design thinking courses within the entrepreneurship curriculum. These courses should cover key principles, methodologies, and tools of design thinking, such as empathy mapping, prototyping, and user testing. Students can learn to apply these techniques to real-world entrepreneurial challenges. University should make Design Thinking be part of every student module so that it should be understood better.	38	18.8%
Awareness and promotion	By designing programmes that makes us aware of the importance of design thinking. By hosting events that educate us more about it. Invite industry experts and practitioners who have successfully used Design Thinking in entrepreneurship to	21	10.4%

	conduct workshops or give talks. They could have workshops in every week. Or have a course that requires them to think and act like entrepreneurs. They could host weekly optional gatherings for discussions, and such. Almost like an online forum, except it's not as anonymous and is in person. It would be pretty good for people to bounce their thoughts, worries and solutions off of each other. They could include Design Thinking as a module for every course in the University for students to learn how they can be independent.		
Practical application	By adding a practical module. This module will promote and encourage students to creatively start a business, act on it, give a report for marks, while making extra cash or losses on the side. By allowing students to practice what they learn by providing them with the necessary resources. Make activities such as thinking challenges and competitions that incorporate design thinking. Encourage students to work as groups and reflect on their design thinking process. Make that section more involved and engaging. Making it fun. Students could use design thinking process based on their courses since we know that the rate of unemployment is very high in South Africa. They must allow students to sell their products while studying. They must create a market day holiday annually. Use a creative, systematic approach to teach problem-solving. Use unique techniques.	22	10.9%
Student engagement and participation	By encouraging Students to participate in programmes. Encourage students to collaborate across disciplines. Design Thinking benefits from diverse perspectives, so programmes could promote partnerships between business students and those in fields like engineering, design, or the social sciences. Encourage students to collaborate across disciplines. Partner with other departments like design, engineering, or psychology to create cross-functional teams that can apply Design Thinking to	24	11.9%

	real-world entrepreneurial challenges. Encourage students to participate.		
Resources and support	Provide access to Design Thinking tools, software, and resources to support student projects and ideation processes. Provide funding so that it will be easy for students to start their own business. Providing support and funding.	12	5.9%
Miscellaneous	"Provide opportunities to apply Design Thinking principles to real-world problems." By coming up with more strategies, planning, and solutions on their entrepreneurship." "Making it a fun engaging process." "Making it a focal point	13	6.4%
No suggestion	"N/A", "No", "None", "I am not sure", "I don't know", "Not sure", "I don't know because I have not understood design thinking in deep detail", "I don't really know"	15	7.4%

4.7. CROSS-DISCIPLINARY PROBLEM SOLVING AND INNOVATION

Table 4.10 highlights the response to the statement How do you think DT in other fields of study beyond entrepreneurship? From the responses provided, the following were uncovered:

Innovation and problem solving (2.9%): Design Thinking is seen as a way to innovatively solve problems. It's described as a means of innovating and identifying solutions for crises in various studies. It can be applied to foster innovation and problem-solving in multiple contexts beyond entrepreneurship.

Education (2.0%): DT can be used in education to develop innovative teaching methods, create engaging learning experiences, and design educational tools and resources that meet the diverse needs of students. It can also help students think critically and potentially start their own businesses.

General application (0.5%): DT's adaptable nature was highlighted, making it a valuable tool in various fields where creativity, empathy, and problem-solving are important. It encourages a human-centered approach that can lead to meaningful outcomes in different disciplines.

Entrepreneurship focus (6.4%): DT is associated with creating more entrepreneurs, encouraging students to take charge, generate entrepreneurial ideas, and create value using their skills. It's also linked to helping businesses stay ahead through innovation, empowering graduates to start their own businesses, and financial success.

Uncertainty/Not sure (8.3%): Some responses express uncertainty about how DT can be applied in other fields, indicating a lack of clarity or confidence in its potential applications.

Applying Design Thinking in different fields (12.4%): DT is discussed in various fields, such as healthcare, fashion design, engineering, science, and more. It is seen to encourage innovative problem-solving, thinking outside the box, and addressing complex challenges in diverse domains.

Teaching and curriculum integration (2.9%): Some respondents suggest that DT should be included in every faculty and integrated into the curriculum to empower students with entrepreneurial skills and problem-solving abilities.

Political studies (1.0%): DT is mentioned by some of the respondents as applicable in political studies, where it can help address difficulties related to cooperation with other superpower countries.

High school and primary school (1.0%): DT is suggested as a valuable approach for primary and high schools, potentially helping students develop problem-solving and creative thinking skills from an early age.

Other fields (7.4%): Various responses propose the application of DT in specific fields or contexts, demonstrating its versatility in addressing unique challenges across a wide range of domains.

In summary, DT is perceived as a versatile approach that can be applied to foster innovation, problem-solving, and entrepreneurship in various fields, although there is some uncertainty about its applicability in some cases. It is also seen as a valuable tool for enhancing education, teaching methods, and curriculum development.

Table 4.10. Summary of cross-disciplinary problem solving and innovation Design Thinking can be applied beyond the entrepreneurial venture

Theme	Direct quotes	Frequency	Percentage
Innovation and problem solving	"A way to innovatively solve problems" "As a means of innovating" "By identifying the problem and solution for any crisis in that particular study. Makes innovation of other things." "Design thinking can be applied to various fields beyond entrepreneurship to foster innovation and problem solving"	6	2.9%
Education	"By educating people" "Design Thinking can be used to develop innovative teaching methods, create engaging and interactive learning experiences, and design educational tools and resources that meet the needs of diverse learners." "Can be used to assist students to think critically through practicals" "Can help students to start their own business when finishing their studies"	4	2.0%
General application	"Design Thinking's adaptable nature allows it to be a valuable tool in almost any field where creativity, empathy, and problem-solving are important. It encourages a human-centered approach that can lead to more meaningful and impactful outcomes across a wide range of disciplines."	1	0.5%
Entrepreneurship focus	"It could be use by creating more entrepreneurs" "By creating more entrepreneurs" "By taking charge and be owners"	13	6.4%

	"Create ideas of entrepreneurship to students" "Creating value with their own skills" "It helps brands stay ahead of the curve by driving innovation in a business environment" "It can empower graduate by opening their own businesses." "Lower because some students had never been doing business studies at high school" "You can make money and be successful" "You could use design thinking and your field of study to create a business venture"		
Uncertainty/Not sure	Various responses expressing uncertainty about how Design Thinking can be used in other fields.	17	8.3%
Applying design Thinking in different fields	"In healthcare, Design Thinking can be used to improve patient experiences, enhance healthcare delivery processes, and develop patient-centered solutions." "Incorporate it with the knowledge in your field" "It could be used by giving us an open mind by wanting to start a business related to the course we are doing" "It could be used in fashion designs, engineering, and many more." "It could be used in science when coming up with new ideas to solve problems" "It enables one to think outside the box and could help students find solutions and understand things better." "It will depend on the field" "It will help students have background information regarding entrepreneurship" "Students can determine the problem based on their field of study and try to come up with a solution that could be lucrative for them." "Design Thinking can be applied in various fields beyond entrepreneurship, such as healthcare, education, and product development, by encouraging empathy-driven problem identification and innovative solution ideation. Its user-	25	12.4%

	centric approach can help address complex challenges across diverse domains."		
Teaching and curriculum integration	"It should be included in every faculty" "It should be used in all faculties because most of us like to be bosses of our own." "Teach it to later year students instead of 1st years because they have acquired more skills from their field of study" "There should be a module for design thinking" "Through Cornerstone and Communication modules. In fact, since DUT is highly ranked in SA as an institution that is doing well in Entrepreneurship. Design Thinking should be considered and added as a compulsory module for every field in DUT like Cornerstone"	6	2.9%
Political studies	"I think even in Political studies because politics faces a wide range of difficulties in the country where they have to co-operate with other superpower countries." "Politics is a suitable spot to use design thinking because we know that they have to deal with other superpower countries in order to co-operate."	2	1.0%
High school and primary school	"Should start at primary school" "I think they should be used in high schools also."	2	1.0%
Other fields	Various responses suggesting the application of Design Thinking in specific fields or contexts.	15	7.4%

4.8. HYPOTHESIS TESTING

Part of the research enquiry is to do a comparative study on students who have done an Entrepreneurship module following the DT format versus a more generic entrepreneurship programme which does not use DT in order to determine whether DT should be adopted as a teaching and learning strategy or not. This section aims to address this.

4.8.1. Relationship between Design Thinking attendance and confidence to generate and execute ideas

Table 4.11 shows the mean, standard deviation, and independent t-test of the respondents' ability to generate and execute new ideas based on their attending DT (Bootcamp) versus those who did not (timetabled). The data revealed that there was no statistically significant difference in confidence levels between those who attended the bootcamp and those who were part of the timetabled class for both generating and executing new ideas. Both groups express a moderate level of confidence in these abilities, with bootcamp attendees having slightly higher mean confidence scores, but the differences are not statistically significant (P>0.05).

Table 4.11. Confidence level of executing and generating news based on attending bootcamp and timetabled

	Did you attend the bootcamp (3-5 days) or Timetabled class (every week)	N	Mean	Std. Deviation	Std. Error Mean	t	df	P value
How confident do you feel about your ability to generate new ideas?	Bootcamp	23	3,61	0,988	0,206	0.981	202	0.328
	Timetabled	181	3,37	1,111	0,083			
How confident do you feel about your ability to execute on new ideas?	Bootcamp	23	3,57	1,080	0,225	1.487	202	0.139
	Timetabled	181	3,19	1,136	0,084			

4.8.2. Association between attending entrepreneurship course and starting business ventures

A logistic regression analysis was performed to examine the association between two predictor variables (attending a bootcamp or timetabled class, and previously taking an entrepreneurship course) and starting entrepreneurship venture at university. The

unadjusted (univariate) and adjusted (multivariable) odds ratios (OR), along with their 95% confidence intervals (95%CI) and p-values are reported in Table 4.12. The results reveal that for those who attended the bootcamp, the odds of the outcome (starting entrepreneurship ventures at university) are 1.20 times higher. However, this result is not statistically significant, as the p-value is 0.735. This suggests that there is no significant association between attending the bootcamp and the outcome. For those in the timetabled class, the odds of the outcome are 0.83 times lower. Again, this result is not statistically significant (p-value = 0.735), indicating no significant association. In the adjusted model, attending the bootcamp or timetabled class does not show a significant association with starting entrepreneurship venture at university (P=0.874).

For those who have previously taken an entrepreneurship course, the odds of starting entrepreneurship ventures at university are 3.95 times higher compared to those who have not taken such a course. This difference is statistically significant with a p-value of 0.000, indicating a strong association between taking an entrepreneurship course and starting entrepreneurship ventures at university. In the adjusted model, the odds ratio for having previously taken an entrepreneurship course is 3.3, with a 95% confidence interval ranging from 1.47 to 7.51. The p-value remains statistically significant (0.004), suggesting that even when accounting for other variables (age, sex, faculty, and level of study), the results indicate that there is a significant association between having previously taken an entrepreneurship course and starting entrepreneurship ventures at university.

Table 4.12: Factors influencing the likely chance of starting entrepreneurship ventures at university

Variable	**Unadjusted (Univariate)**		**Adjusted (Multivariable)**	
	OR (95%CI)	**P-value**	**OR (95%CI)**	**P-value**
Attending bootcamp or timetabled				
Bootcamp	1.20 (0.42-3.46)	**0.735**	R	R
Timetabled	0.83 (0.29-2.40)	**0.735**	0.84 (0.10-6.87)	**0.874**
Previously taken entrepreneurship course				
Yes	3.95 (1.89-8.25)	**0.000**	3.3(1.47-7.51)	**0.004**
No	R	**R**	R	**R**

Adjusted with gender, sex, faculty, level of study

4.9. CHAPTER SUMMARY

This chapter presented the results and data analysis, in two sections. Firstly, the empirical data, consisting of demographic information, analysed questions such as age group, gender, faculty and level of study was described. Following this, the perspectives of respondents were illustrated using frequency tables, bar graphs and pie charts. Thereafter, the results of the different tests conducted were used to show that the inclusion of DT as an entrepreneurship facilitation method at DUT will be of benefit to the institution's students. The following chapter is a discussion of these results in relation to both the literature and study objectives.

CHAPTER FIVE

5. DISCUSSION

5.1. INTRODUCTION

The previous chapter presented the results from the data collection and analysis. This section aims to contextualise the findings derived from the data collected and analysed from the survey participants. The study findings are related to the literature reviewed by the researcher.

5.2. DEMOGRAPHIC INFORMATION

The background information analysis revealed that a significant proportion of the participants were female. The UNESCO (2020) suggests that shifting societal norms surrounding gender have facilitated an increase in the number of women pursuing higher education, leading to greater acceptance and support for women in academic and professional pursuits. This trend is evidenced by the 61.9% female participants in the research study. Additionally, the findings showed that the majority of respondents were under the age of 26, indicating a recognition among young individuals of the value of tertiary education. The OECD (2022) notes that younger students generally have fewer financial obligations, such as supporting a family, which makes pursuing full-time education a more viable option for them. On the other hand, older students may encounter financial challenges that could hinder their return to formal education. Typically, students transition to tertiary education immediately or shortly after completing their secondary schooling, which in many countries concludes around the age of 18. As a result, the average age of tertiary education entrants tends to fall within the 18-19 age range. This conventional educational pathway explains why the majority of students are under the age of 25 upon completion of their undergraduate studies (Altbach, Reisberg, and Rumbley 2019).

The analysis revealed that the faculty of Applied Sciences has a higher enrollment of students compared to those studying entrepreneurship or management. As reported by the Durban University of Technology (2022), the faculty of Applied Sciences serves as a center for research, accounting for approximately 80% of the university's research

endeavors. This faculty has a number of National Research Foundation (NRF) rated researchers, specialising in key areas such as industrial biotechnology, water and wastewater technology, and environmental biotechnology. The faculty's emphasis on research excellence draws students with an interest in cutting-edge science and technology, explaining the predominance of participants coming from this faculty. Notably, the majority of participants in the study were first-year students. According to the National Centre for Education Statistics (NCES) (2019), initial enrollment in institutes of higher education tends to peak in the freshman year, typically due to the influx of recent secondary school graduates. Subsequent years generally witness a decline in retention rates, resulting in fewer students progressing after the first year. A previous study suggests that the initial year of college is pivotal for student persistence, with many individuals discontinuing their studies due to academic, social, or financial obstacles (Tinto 2019).

Regarding their prior exposure to entrepreneurship education, the study revealed a significant number of participants who had not completed any form of coursework in entrepreneurship. This finding aligns with a previous study by Oosterbeek, van Praag and Ijsselstein (2020), which suggests that some individuals may not see entrepreneurship as relevant to their chosen career paths, particularly in disciplines where entrepreneurial skills are not deemed essential. The study findings are also consistent with Shinnar, Giacomin and Janssen (2018) who argued that certain cultures place more value on traditional career paths such as medicine, engineering, or law over entrepreneurship, resulting in students conforming to societal norms rather than pursuing their interest in entrepreneurship. Many students view entrepreneurship as a risky career choice with uncertain outcomes compared to more conventional career options, which may deter them from enrolling in entrepreneurship-related courses.

5.3. DESIGN THINKING AND ENTREPRENEURSHIP

It is recognised that DT and entrepreneurship are closely intertwined concepts that work harmoniously to facilitate innovation and foster the establishment of prosperous ventures. Design Thinking, a methodology rooted in the prioritisation of human needs, technological possibilities, and business requirements, serves as a catalyst for

innovative solutions (Tham 2022). Conversely, entrepreneurship encompasses the comprehensive process of conceptualising, launching, and managing a novel business endeavor, typically commencing on a small scale or as a startup (Ndlovu et al. 2023). Through the incorporation of DT principles into the entrepreneurial journey, emerging startups and nascent ventures can cultivate products and services that not only showcase innovation but also resonate with consumer preferences and market trends.

The study results showed that a large number of participants are familiar with the concept of DT. This high level of awareness is consistent with the findings of Hägg and Gabrielsson (2019), who suggested that DT has become increasingly popular in the realm of entrepreneurship due to its effectiveness in promoting innovation and problem-solving skills among future entrepreneurs. Despite the widespread recognition of DT among participants, the majority had not engaged in any workshops or training sessions on this methodology. This poor participation can be attributed to a general lack of understanding of what DT entails and how it can be advantageous. Many students may not fully grasp the relevance of DT to their academic studies or future career prospects. Research has indicated that a key obstacle to adopting innovative learning approaches is a lack of awareness or comprehension of their benefits, which may explain why courses on DT have limited enrollment. As indicated by Brown and Katz (2021), there is a clear need for enhanced communication strategies to emphasise the value and practical applications of DT across various fields.

The survey participants were polled on their confidence levels regarding the generation and implementation of new ideas. The results indicated that participants exhibited a moderate level of confidence in their capacity to come up with and enact fresh ideas. This aligns with Kolb (2018), who noted that many higher education curriculums place a heavy emphasis on theoretical knowledge, leaving little room for students to participate in practical, hands-on, projects that could bolster their confidence in executing new concepts. Moreover, students often lack access to mentors and role models who can provide guidance and motivation during the idea generation and execution process. This perspective is further supported by Robinson and Aronica (2015), who identified a tendency within educational institutions to

prioritise standardised testing and memorisation techniques over fostering creative thinking and problem-solving skills. Such an approach can hinder students' belief in their creative abilities. Robinson (2019) contends that conventional education systems tend to discourage creativity and risk-taking, both of which are essential for fostering innovation. As a result, the survey results suggested that participants exhibit a moderate level of confidence in their ability to generate and implement new ideas.

5.4. ENTREPRENUERIAL VENTURES

The results of the study regarding participants initiating entrepreneurial endeavors during their time at university indicated that the majority had not pursued such ventures. This trend could be attributed to a perceived lack of knowledge and skill necessary to launch a business among students. Traditional university curricula often do not incorporate practical entrepreneurship education, further contributing to this hesitation. Additionally, Gibb (2020) identifies fear of financial loss, failure, and uncertainty surrounding business start-ups as significant deterrents for students. The presence and efficacy of institutional support systems, such as incubators, mentorship programmes, and access to funding, play a crucial role in influencing students' decision to pursue entrepreneurial ventures. Kaufman and Sternberg (2018) posit that universities with robust support mechanisms witness higher levels of student involvement in entrepreneurial activities.

The results also showed that a significant number of individuals who initiated entrepreneurial projects while attending university credited DT for inspiring their ideas. Design Thinking is a methodology that stresses the importance of understanding the needs and challenges of users. This empathetic approach enables students to identify genuine issues that can serve as the basis for entrepreneurial endeavors, which explains why it ignited inspiration in the majority of participants. Design Thinking advocates taking action and exploring different options. Rather than waiting for the perfect solution, students are urged to create prototypes of their ideas quickly and seek feedback from potential users. This rapid testing process helps to alleviate the fear of failure and promotes a proactive approach to entrepreneurship (Kolb 2018).

In conclusion, the findings indicate that the individuals surveyed generally viewed DT as beneficial in the initiation of entrepreneurial endeavours, expressing a strong intention to utilise it in the future. The statistical significance shown by the low p-values reinforces the credibility of the findings. Notably, Brown (2018), emphasises DT's focus on understanding and empathising with the needs and challenges of users. This approach aids entrepreneurs in developing products and services that effectively address issues, ultimately increasing the chances of market acceptance and success. The process of DT proves valuable in entrepreneurial ventures by prioritising the comprehension of user needs and early validation of ideas through prototypes, thereby reducing risks commonly associated with such ventures. In contrast to traditional business planning methods, DT places a strong emphasis on human-centered problem-solving. This approach not only enhances students' understanding of their target audience but also fosters empathy and connection with end-users, leading to sustained customer loyalty and engagement (Dorst 2021). It is crucial for students to recognize DT as an important tool in launching entrepreneurial projects. Nonetheless, some individuals in the study expressed a lack of appreciation of DT. These reservations may stem from the perception of DT processes as time-consuming, impractical, or not directly relevant to the challenges involved in venture launches (Brown and Wyatt 2017).

5.5. INNOVATIVE PROBLEM SOLVING THROUGH DESIGN THINKING IN ENTREPRENEURSHIP

Participants were queried regarding their utilisation of DT in the context of generating novel ideas for entrepreneurial endeavours. A significant number of participants admitted to a lack of familiarity with DT, citing either a complete absence of prior usage or uncertainty surrounding the concept. Kelley and Kelley (2018) suggests that students' dearth of experience with DT may stem from the prevalent focus on theoretical knowledge in conventional tertiary education programmes, which often overlook practical skills such as DT in favor of traditional teaching methods like lectures, exams, and essays. Similarly, Cross (2021) posits that misconceptions about the nature of DT may contribute to students' confusion, with some mistakenly associating it with graphic design or mistakenly assuming its relevance is limited to

certain industries such as technology or product design. As a result, participants expressed their lack of familiarity with DT.

The study's results indicated that participants have utilised DT in academic tasks, showcasing examples of its application in generating fresh business concepts, addressing challenges, and developing innovative solutions as part of their coursework. According to Brown (2018), DT fosters a creative and systematic approach for students when tackling problems, thereby improving their capacity to recognise issues, brainstorm solutions, and iterate through prototypes – valuable proficiencies applicable in a multitude of fields. Tschimmel (2022) also supports the notion that DT proves beneficial in group projects, as it typically involves teamwork and collaborative efforts. Students benefit from collaborating, drawing upon a variety of perspectives, and collectively crafting solutions, mirroring professional settings and bolstering their teamwork skills.

Based on the research findings, a separate group of survey participants stated that they utilised DT in their entrepreneurial endeavors due to its ability to provide valuable guidance in practical business scenarios. This sentiment is supported by Dym (2015), who recognises a key advantage of DT in education as its relevance to real-world situations, aligning with the outcomes of the present study. Students value its practicality in addressing genuine issues and formulating solutions with tangible benefits extending beyond academic confines. Some respondents cited a lack of familiarity or understanding of DT, potentially stemming from limited exposure, as noted by Brown (2018), which could lead individuals to believe they lack experience with the concept.

Collectively, the feedback gathered reflects a variety of experiences and viewpoints concerning the application of DT in entrepreneurial pursuits, ranging from individuals with no prior exposure to those who have successfully implemented it in educational and business environments. Moreover, certain respondents reflected on their personal goals and concepts, underscoring the significance of DT in nurturing creativity and fostering innovation.

5.6. ENHANCING ENTREPRENEURSHIP EDUCATION THROUGH DESIGN THINKING INTEGRATION

The study's primary findings indicate that a significant number of respondents emphasised the necessity of incorporating DT into the university curriculum. Building upon this finding, Kelley and Kelley (2018) underscore the significance of integrating DT into the curriculum, as it encourages students to think innovatively and devise creative solutions. Design Thinking fosters a mindset that values experimentation, taking risks, and learning from failures, all of which are essential for promoting innovation across various industries. Given the current trend of prioritising employees who can innovate and solve complex problems, incorporating DT into the curriculum ensures that graduates possess skills that are highly sought after in the job market. Additionally, the study findings also highlight the importance of raising awareness about DT. Supporting this notion, Liedtka (2015) states that DT nurtures creative problem-solving skills, which are increasingly crucial in today's intricate and ever-evolving world. It is imperative for tertiary students to acquire these skills to effectively address real-world challenges.

Survey participants disclosed that students have the ability to employ DT in practical situations and recommended the initiation of new enterprises and the commercialisation of products. In an ever-evolving employment landscape, DT provides students with versatile skills that can be used in a variety of sectors and settings (Kolko 2015). Numerous employers now consider DT an essential capability for recent graduates, resulting in enhanced career opportunities and avenues for professional growth; highlighting the importance of incorporating DT into real-world business scenarios (Martin 2019). Norman and Verganti (2017) supports these findings, indicating that hands-on experience with DT methodologies leads to more profound educational outcomes compared to traditional lecture-based approaches. The application of theory into practice enables students to cultivate analytical thinking, inventive problem-solving skills, and effective teamwork in a practical setting.

The results indicated that participants recommended that students should proactively engage in programmes and cooperate across different disciplines to incorporate diverse viewpoints into DT. According to Edelson (2018), supporting these

recommendations by involving students in the development of their educational experiences can enhance their motivation and involvement. The inclusion of students in the DT process encourages creativity and innovation, which are crucial for solving intricate and unclear issues. Including university students in DT cultivates preparation for upcoming challenges, enriches their educational experiences, and contributes to the cultivation of essential skills required for success in a wide array of professional arenas.

The significance of offering resources and support for DT was also emphasised by the survey participants. Similarly, according to Dorst (2021), it is crucial to provide resources and support for university students, particularly those who are new to DT, as they may encounter difficulties comprehending the intricacies of these tools without proper guidance and resources. University institutions typically have diverse student populations with varying levels of exposure to DT. The provision of resources and support can promote equal opportunities for all students to learn and utilise these tools effectively (Kelley and Kelley 2018). These narratives illustrate the various perspectives and ideas that participants have concerning the integration of DT in university entrepreneurship programmes and how previous studies aligns with these perspectives.

5.7. CROSS-DISCIPLINARY PROBLEM SOLVING AND INNOVATION

Based on the data analysed in the previous section, it was found that participants believe DT can be applied in various fields beyond just entrepreneurship. Some of the areas highlighted included innovation, problem solving, education, entrepreneurial focus, political studies, primary and high schools, and others. This shows that DT has a wide applicability across different aspects of life. In agreement with the use of DT in political studies, Manzini (2021) asserts that DT prompts individuals to consider the ethical and societal impacts of their solutions, which is especially important in areas such as public policy where decisions can greatly affect communities. It has been suggested that DT can be beneficial in non-entrepreneurial fields because it places a strong emphasis on understanding the needs and experiences of those impacted by a problem or solution, and this can lead to more effective and sustainable solutions in areas such as healthcare, education, and social services (Brown 2018). Design

Thinking fosters a mindset that values creativity, experimentation, and risk-taking, which are essential for driving innovation in fields like technology, policy-making, and environmental sustainability (Greenberg 2019). The use of DT outside of entrepreneurship is supported by its human-centered approach, interdisciplinary nature, iterative methodologies, emphasis on creativity and innovation, ability to navigate uncertainty, and consideration of ethical implications. These aspects are critical for addressing complex challenges across diverse fields and facilitating meaningful change (Tschimmel 2022).

5.8. CHAPTER SUMMARY

In the current chapter, the findings derived from the interview responses concerning the integration of DT as a methodology for entrepreneurship at DUT were placed in context with the scholarly literature. The subsequent chapter will furnish the conclusions and suggestions arising from the examination of the study findings.

CHAPTER SIX

6. CONCLUSION, LIMITATIONS OF THE STUDY AND RECOMMENDATION

6.1. INTRODUCTION

Whilst the previous chapter discussed the findings of this study, this chapter will provide the conclusions of the study. Furthermore, recommendations on how DT can be included as an entrepreneurship facilitation method at DUT will be outlined. This chapter also highlights limitations of the study and areas for further research.

6.2. CONCLUSION

The study was conducted to explore the effects of integrating DT into entrepreneurship education within a university setting. Data were collected via surveys and analysed to examine the correlation between attendance in DT sessions, confidence levels, participation in entrepreneurship courses, and the initiation of entrepreneurial ventures among students. The results revealed that a portion of respondents were aware of DT, although the majority had not taken part in any DT workshops or courses.

Moreover, the study found that respondents displayed moderate confidence in generating and executing new ideas, with slightly higher confidence levels in idea generation compared to execution. While most students had not yet embarked on entrepreneurial ventures during their time at university, a smaller percentage had been involved in entrepreneurial activities. Among those who had started entrepreneurial ventures, a significant majority credited DT for inspiring their ideas.

Additionally, respondents provided recommendations for incorporating DT into university programmes, highlighting the importance of integrating it into the curriculum, raising awareness, promoting practical application, increasing student engagement, and providing support. They also discussed the versatility of DT across various fields beyond entrepreneurship, such as innovation, education, and general problem-solving.

The study highlighted the similarities between the discussions surrounding DT and the ongoing debate on the approach to entrepreneurship education. Design Thinking was recognised as a valuable and accessible tool for facilitating multidisciplinary projects, providing educators with essential concepts, tools, and methods that can be seamlessly integrated into existing courses. It was seen as an engaging method for students to learn about customer development, problem-solving, creativity, iteration, failure, resilience, and teamwork; helping them boost their creative confidence and reshape their perspectives on entrepreneurship.

In conclusion, the data offered valuable insights into the perceptions, experiences, and connections between DT and entrepreneurship education among university students. While awareness of DT was high, its practical application, particularly through workshops and courses, was less common. The study did not find a significant relationship between attending DT sessions or classes and the likelihood of initiating entrepreneurial ventures. However, it did identify a statistically significant link between prior enrolment in entrepreneurship courses and the commencement of entrepreneurial activities at the university, highlighting the positive impact of formal entrepreneurship education on student engagement in entrepreneurial pursuits.

6.3. RECOMMENDATIONS

Implementing design thinking into entrepreneurship education at tertiary institutions can enhance students' innovation and problem-solving abilities. Some suggestions for its inclusion include:

6.3.1. Integrating Design Thinking into the curriculum

The DUT is able to develop courses or modules focused on DT within entrepreneurship programmes. A thorough evaluation of the current entrepreneurship curriculum should be conducted to explore potential ways to incorporate DT principles, methods, and mindset. An assessment of which courses, modules, or topics are best suited for integrating DT practices must be done (Withell and Haigh 2018)

6.3.2. Hands-on projects

In order to include design thinking at DUT, management and lecturers should assign projects requiring students to apply DT methodologies to real-world entrepreneurial challenges. Guaman-Quintanilla, Chiluiza, Everaert and Valcke (2018:2954) state that facilitation of interactive workshops and training sessions led by experienced mentors to educate students on specific DT tools and techniques can be done so that students are more hands on.

6.3.3. Guest lectures and workshops

Another recommendation is to invite DT experts to lead workshops or lectures to demonstrate practical applications and case studies. Tertiary institutions such as DUT should provide a comprehensive introductory workshop or course focused on the core concepts of DT. This programme will aim to educate participants on essential principles, techniques, and perspectives associated with DT, such as empathy, ideation, prototyping, and iteration (Elliott and Lodge 2017:59).

6.3.4. Collaborative projects

Gilbert, Crow and Anderson (2018:38) encourage interdisciplinary collaboration to foster diverse perspectives and innovative solutions. Engaging in collaborative research projects with industry partners focusing on the integration of DT and entrepreneurship will be able to assist students to be able to use DT. Such projects have the potential to create valuable knowledge, insights, and methodologies that can be mutually beneficial for academia and industry. Revano and Garcia (2020) state that through partnerships, tertiary institutions can enhance their entrepreneurship facilitation approach with practical real-world perspectives, experiences, and opportunities. This can further enrich students' comprehension and utilization of DT principles within entrepreneurial settings.

6.3.5. Access to resources

Sari and Zulaikha (2021:42) note that it is important to provide students with the necessary tools, software, and facilities for prototyping and implementing DT ideas. This can be done by creating specialised design labs and studios furnished with the

necessary tools, equipment, and software for the purpose of prototyping, modelling, and visualisation. These DT resources will serve as collaborative spaces where students can explore various DT methodologies and devise inventive solutions for entrepreneurial obstacles. Additionally, maintaining a selection of literature, publications, and online materials in the university library pertaining to DT, entrepreneurship, innovation, and relevant subjects will also facilitate the access to resources for DT (Wrigley and Mosely 2022). Students should be granted the opportunity to utilise these resources to enhance their comprehension of DT principles and its relevance to entrepreneurship.

6.3.6. Mentorship and guidance

Luka (2017:65) states that assigning mentors experienced in DT and entrepreneurship to guide students can assist in the inclusion of DT as an entrepreneurial method. Management must be able to seek out seasoned professionals with entrepreneurial, design, and innovation experience to act as mentors for student entrepreneurs. These mentors should be well-versed in DT methodologies and have a history of successfully launching and scaling businesses. Pairing of mentors with student entrepreneurs can be based on their interests, objectives, and specialised knowledge (Daniel, 2019:216). The option of creating mentorship groups made up of individuals with different skills and backgrounds to offer a variety of perspectives and assistance can be explored.

6.3.7. Evaluation and feedback

Davey, Hannon and Penaluna (2020:173) recommend that tertiary institutions should incorporate evaluation criteria to assess students' application of DT principles and provide feedback for improvement. Comprehensive evaluation criteria in line with the principles of DT and entrepreneurial achievement can be established. These criteria should encompass factors such as creativity, viability, user-centricity, iterative enhancements, and the capacity to effectively tackle identified challenges or possibilities. Lecturers and tutors must utilise formative assessment techniques consistently throughout the entrepreneurial journey to offer continuous feedback and assistance to students (Revano and Garcia 2020). Emphasis on the importance of students documenting their advancements, reflecting on their encounters, and

soliciting input from colleagues, mentors, and educators at critical junctures of their ventures are also important.

By incorporating these strategies, Higher Education Institutions, and in this case DUT, can effectively integrate DT into their entrepreneurship programmes, preparing students for success in the complex entrepreneurial environment.

6.4. DIRECTIONS FOR FUTURE RESEARCH

The primary objective of this study was to evaluate the inclusion of DT as a method for fostering entrepreneurship at DUT. Research on the integration of DT as a facilitation method for entrepreneurship can open up avenues for enhancing its efficacy and influence. Some potential areas for future research could involve examining the effectiveness of various teaching approaches. This would entail exploring different educational methods for teaching DT in entrepreneurship such as project-based learning, flipped classrooms, and experiential learning; to determine which methods yield the best results in terms of student learning and entrepreneurial skills development.

Additionally, future studies could delve into the long-term effects on entrepreneurial endeavours. This can be done through conducting longitudinal studies to evaluate the lasting impact of incorporating DT into entrepreneurship education on the success and sustainability of students' ventures, including factors like innovation, market feasibility, and growth potential. Moreover, forthcoming research studies could focus on the role of mentorship and support networks to analyse how mentorship and support systems facilitate the integration of design thinking into entrepreneurship education. This would involve examining the attributes of effective mentors, the dynamics of mentor-mentee relationships, and the impact of mentorship on students' entrepreneurial mind-set and behaviour. Furthermore, future research studies could focus on developing comprehensive evaluation frameworks and metrics to gauge the effectiveness of DT in entrepreneurship education, encompassing both quantitative measures like student performance and venture outcomes, and qualitative measures such as student perspectives and learning experiences. This would help in informing evidence-based practices and continuous improvement initiatives. By addressing these research

avenues, researchers and professionals can enhance our understanding of how DT can be successfully incorporated into entrepreneurship education to nurture the next cohort of innovative and entrepreneurial leaders.

REFERENCES

Achmetli, K., Schukajlow, S. and Rakoczy, K. 2019. Multiple solutions for real-world problems, experience of competence and students' procedural and conceptual knowledge. *International Journal of Science and Mathematics Education,* 17(8): 1605-1625. Available: https://doi.org/10.1007/s10763-018-9936-5 (Accessed 20 June 2024).

Akhmetshin, E. M., Romanov, P. Y., Zakieva, R. R., Zhminko, A. E., Aleshko, R. A. and Makarov, A. L. 2019. Modern approaches to innovative project management in entrepreneurship education: A review of methods and applications in education. *Journal of Entrepreneurship Education,* 22(1): 1-15.

Akinyemi, F. O. and Adejumo, O. O. 2018. Government policies and entrepreneurship phases in emerging economies: Nigeria and South Africa. *Journal of Global Entrepreneurship Research,* 8(1): 35. Available: https://doi.org/10.1186/s40497-018-0131-5 (Accessed 20 June 2024).

Akman, S. 2023. What is target population: Definition and examples. Available: https://forms.app/en/blog/target-population (Accessed: 18 October 2023).

Aldrich, H. 2019. Entrepreneurship. *Research in the Sociology of Work,* 15: 3-31.

Alele, F. and Malau-Aduli, B. 2023. Sampling techniques in quantitative research. In: Alele, F. and Malau-Aduli, B. *An introduction to research methods for undergraduate health profession students*. Australia: James Cook University. Available: https://jcu.pressbooks.pub/intro-res-methods-health/chapter/3-4-sampling-techniques-in-quantitative-research/#:~:text=Sampling%20in%20quantitative%20research%20is,techniques%20based%20on%20probability%20theory (Accessed 18 October 2023).

Allen, M. W. and Sites, R. 2012. *Leaving ADDIE for SAM: An agile model for developing the best learning experiences*. United States: American Society for Training and Development.

Asenahabi, B. M. 2019. Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches,* 6(5): 77.

Aspers, P. and Corte, U. 2019. What is qualitative in qualitative research. *Qualitative Sociology*, 42: 139-160. Available: https://link.springer.com/article/10.1007/s11133-019-9413-7 (Accessed 17 October 2023).

Audretsch, D. B. and Moog, P. 2022. Democracy and entrepreneurship. *Entrepreneurship Theory and Practice,* 46(2): 368-392. Available: https://doi.org/10.1177/1042258720943307 (Accessed 20 June 2024).

Auernhammer, J. and Roth, B. 2021. The origin and evolution of Stanford University's design thinking: From product design to design thinking in innovation

management. *Journal of Product Innovation Management,* 38(6): 623-644. Available: https:// doi.org/10.1111/jpim.12594 (Accessed 20 June 2024).

Badat, S. 2010. *The Challenges of transformation in higher education and training institutions in South Africa*. Development Bank of South Africa. Available: The Challenges of Transformation in Higher Education and Training Institutions - 2010.pdf (dbsa.org) (Accessed 20 June 2024).

Baker, T. and Welter, F. 2020. *Contextualizing entrepreneurship theory*. New York: Routledge.

Barnsbee, L., Barnette, A. G., Halton, K. and Nghiem, S. 2018. Cost-effectiveness. In: Gregory, S. D., Stevens, M. C. and Fraser J.F. eds. *Mechanical circulatory and respiratory support*. London: Academic Press. Available: https://www.sciencedirect.com/topics/engineering/target-population (Accessed 18 October 2023).

Baron, R. A. and Shane, S. 2017. *Entrepreneurship: A process perspective. The psychology of entrepreneurship,* 19-39.

Bawuah, K., Buame, S. and Hinson, R. 2006. Reflections on entrepreneurship education in African tertiary institutions. *Acta Commercii,* 6(1): 1-9. Available: https://doi.org/10.4102/ac.v6i1.78. (Accessed 20 June 2024).

Baysal, E. and Sevinc, S. 2021. The role of the Singapore bar model in reducing students' errors on algebra word problems. *International Journal of Mathematical Education in Science and Technology,* 53(2): 289-310. Available: https://doi.org/10.1080/0020739X.2021.1944683 (Accessed 20 June 2024).

Bhandari, P. 2020. *Data collection | Definition, methods and examples*. Available: https://www.scribbr.com/methodology/data-collection/ (Accessed 19 October 2023).

Bhandari, P. 2023. *Ethical considerations in research | Types and examples.* Available: https://www.scribbr.com/methodology/research-ethics/ (Accessed 12 December 2023).

Bhandari, P. 2023. *Questionnaire design | Methods, question types and examples.* Available: https://www.scribbr.com/methodology/questionnaire/#:~:text=A%20questionnaire%20is%20a%20list,quantitative%20and%2For%20qualitative%20information (Accessed 23 October 2023).

Bhat, A. 2023. *Data analysis in research: Types and methods.* Available: https://www.questionpro.com/blog/data-analysis-in-research/ (Accessed 12 December 2023).

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M. and Rumble, M. 2012. Defining twenty-first century skills. In: Griffin, P., McGaw B. and Care E. eds. *Assessment and teaching of 21st century skills*. New York: Springer, 17-66.

Blenker, P., Elmholdt, S. T., Frederiksen, S. H., Korsgaard, S. and Wagner, K. 2014. Methods in entrepreneurship education research: A review and integrative framework. *Education + Training*, 56(8/9): 697-715. Available: https://doi.org/10.1108/ET-06-2014-0066 (Accessed 20 June 2024).

Budert-Waltz, T. and Moffitt, K. 2021. *What is research methodology?* Available: https://study.com/academy/lesson/research-methodology-approaches-techniques-quiz.html (Accessed 16 October 2023).

Bwisa, H. M. 2010. Towards the improvement of entrepreneurship education in Africa. *Scientific Conference Proceedings,* 0(0), Article 0. Available: http://41.204.187.99/index.php/jscp/article/view/724 (Accessed 20 June 2024).

Cant, M. C. 2016. Business competition: Does it contribute to the SMME development? *Corporate Ownership and Control*, 13(4): 431-440. Available: https://doi.org/10.22495/cocv13i4c3p2

Carlgren, L., Elmquist, M. and Rauth, I. 2016. The challenges of using design thinking in industry - experiences from five large firms. *Creativity and Innovation Management,* 25(3): 344-362. Available: https://doi.org/10.1111/caim.12176 (Accessed 20 June 2024).

Casteel, A. and Bridier, N. 2021. Describing populations and samples in doctoral student research. *International Journal of Doctoral Studies*, 16: 339-362. Available: https://doi.org/10.28945/4766 (Accessed 20 June 2024).

Chinomona, E. and Maziriri, E. T. 2015. Women in action: challenges facing women entrepreneurs in the Gauteng province of South Africa. *International Business and Economics Research Journal (IBER),* 14(6): 835-850. Available: https://doi.org/10.19030/iber.v14i6.9487 (Accessed 20 June 2024).

Conte, J. M. 2005. A review and critique of emotional intelligence measures. *Journal of Organizational Behavior,* 26(4): 433-440. Available: https://doi.org/10.1002/job.319 (Accessed 20 June 2024).

Cote, C. 2021. *7 Data collection methods in business analytics*. Available: https://online.hbs.edu/blog/post/data-collection-methods (Accessed 19 October 2023).

Costa, M. 2022. *What is primary data and how do you collect it?* Available: https://www.surveycto.com/best-practices/primary-data-collection/#:~:text=Primary%20data%20collection%20is%20the,%2C%20observation%2C%20and%20focus%20groups (Accessed 19 October 2023).

Dam, R. F. and Siang, T. Y. 2021. *What is design thinking and why is it so popular?* Available: https://www.interaction-design.org/literature/article/what-is-design-thinking-and-why-is-it-so-popular (Accessed 12 September 2023).

Daniel, A. D. 2016. Fostering an entrepreneurial mindset by using a design thinking approach in entrepreneurship education. *Industry and Higher Education,* 30(3): 215-

223. Available: https://doi.org/10.1177/0950422216653195 (Accessed 20 June 2024).

Daniel, A. D. 2019. A design thinking approach in entrepreneurship education. *Industry and Higher Education*, 30(3): 215-223.

Davey, T., Hannon, P. and Penaluna, A. 2020. Entrepreneurship education and the role of universities in entrepreneurship: Introduction to the special issue. *Industry and Higher Education,* 30(3): 171-182.

Dawadi, S., Shrestha, S. and Giri, R. A. 2021. Mixed-methods research: A discussion on its types, challenges, and criticisms. *Journal of Practical Studies in Education,* 2(2): 25-36. Available: https://doi.org/10.46809/jpse.v2i2.20 (Accessed 20 June 2024).

Diandra, D. and Azmy, A. 2020. Understanding definition of entrepreneurship. *International Journal of Management, Accounting and Economics,* 7(5): 235-241.

Dieffenbacher, S. F. 2023. *What is the innovation and entrepreneurship relationship?* Available: https://digitalleadership.com/blog/the-innovation-entrepreneurship-relationship/ (Accessed 10 January 2024).

Edelman, J. A., Owoyele, B., Santuber, J. and Talbot, A. V. 2021. Designing as performance: Bridging the gap between research and practice in design thinking education. In: Meinel, C. and Leifer, L. eds. *Design Thinking Research. Understanding Innovation.* Cham: Springer. 75-101. Available: https://doi.org/10.1007/978-3-030-62037-0_3 (Accessed 20 June 2024).

Elliott, K. and Lodge, J. M. 2017. Engaging university teachers in design thinking. In: James, R., French, S. and Kelly, P. eds. *Visions for Australian tertiary education,* Melbourne: Melbourne Centre for the Study of Higher Education, 55-66.

Elsbach, K. D. and Stigliani, I. 2018. Design thinking and organizational culture: A review and framework for future research. *Journal of Management,* 44(6): 2274-2306. Available: https://doi.org/10.1177/0149206317744252 (Accessed 20 June 2024).

Eriksson, Y. ed. 2022. *Different perspectives in design thinking*. Boca Raton: CRC Press.

Fayolle, A. 2008. Entrepreneurship education at a crossroads: Towards a more mature teaching field. *Journal of Enterprising Culture,* 16(04): 325-337. Available: https://doi.org/10.1142/S0218495808000211 (Accessed 20 June 2024).

Fischer, S., Rosilius, M., Schmitt, J. and Bräutigam, V. 2022. A brief review of our agile teaching formats in entrepreneurship education. *Sustainability,* 14(1): Article 1. Available: https://doi.org/10.3390/su14010251 (Accessed 20 June 2024).

Forcher-Mayr, M. and Mahlknecht, S. 2020. A capability approach to entrepreneurship education: The sprouting entrepreneurs programme in rural South

African schools. *Discourse and Communication for Sustainable Education*, 11(1): 119-133. Available: https://doi.org/10.2478/dcse-2020-0011 (Accessed 20 June 2024).

Fourcade, M. and Khurana, R. 2013. From social control to financial economics: The linked ecologies of economics and business in twentieth century America. *Theory and Society,* 42(2): 121-159. Available: https://doi.org/10.1007/s11186-012-9187-3 (Accessed 20 June 2024).

Frydenberg, M., Yates, D. J. and Kukesh, J. 2018. Sprint, then fly: Teaching agile methodologies with paper airplanes. *Information Systems Education Journal,* 16(5): 22.

Gamede, B. and Uleanya, C. 2019. Factors impacting entrepreneurship education in TVET Colleges: A case of South Africa. *Journal of Entrepreneurship Education,* 22(3).

Gilbert, C. G., Crow, M. M. and Anderson, D. 2018. Design thinking for higher education. *Stanford Social Innovation Review,* 16(1): 36-41.

Griffin, K. A., Muñiz, M. M. and Espinosa, L. 2012. The influence of campus racial climate on diversity in graduate education. *Review of Higher Education: Journal of the Association for the Study of Higher Education*, 35(4): 535-566. Available: https://doi.org/10.1353/rhe.2012.0031 (Accessed 20 June 2024).

Grönman, S. and Lindfors, E. 2021. The process models of design thinking: a literature review and consideration from the perspective of craft, design and technology education. *Techne Series - Research in Sloyd Education and Craft Science A*, 28(2): 110-118.

Guaman-Quintanilla, S., Chiluiza, K., Everaert, P. and Valcke, M. 2018. Design thinking in higher education: a scoping review. In: Chova, L. G., Martinez, A. L. and Torres I. C. eds. *11th Annual International Conference of Education, Research and Innovation (ICERI2018).* Venue of conference, Seville, Spain, 12-14 November 2018. Place of publication: iated DIGITAL LIBRARY. 2954-2963. Available: https://doi.org/10.21125/iceri.2018.1663 (Accessed 20 June 2024).

Hägg, G. and Gabrielsson, J. 2019. A systematic literature review of the evolution of pedagogy in entrepreneurial education research. *International Journal of Entrepreneurial Behavior and Research,* 26(5): 829-861. Available: https://doi.org/10.1108/IJEBR-04-2018-0272 (Accessed 20 June 2024).

Hägg, G. and Kurczewska, A. 2016. Connecting the dots: A discussion on key concepts in contemporary entrepreneurship education. *Education + Training,* 58(7/8): 700-714. Available: https://doi.org/10.1108/ET-12-2015-0115 (Accessed 20 June 2024).

Haradhan, K. M. 2021. Quantitative research: A successful investigation in natural and social sciences. *Journal of Economic Development, Environment and People,* 9(4): 2.

Heinonen, J. 2007. An entrepreneurial-directed approach to teaching corporate entrepreneurship at university level. *Education + Training*, 49(4): 310-324. Available: https://doi.org/10.1108/00400910710754453 (Accessed 20 June 2024).

Higgins, D., Smith, K. and Mirza, M. 2013. Entrepreneurial education: reflexive approaches to entrepreneurial learning in practice. *The Journal of Entrepreneurship,* 22(2): 135-160. Available: https://doi.org/10.1177/0971355713490619 (Accessed 20 June 2024).

Hisrich, R. D., Peters, M. P. and Shepherd, D.A. 2017. *Entrepreneurship.* Place of publication: McGraw-Hill Education.

Jain, R. and Chetty, P. 2020. *What are quantitative research sampling methods?* Available: https://www.projectguru.in/what-are-quantitative-research-sampling-methods/ (Accessed: 18 October 2023).

Jami, M.Y. and Gökdeniz, I. 2020.The role of universities in the development of entrepreneurship. In: *The International Scientific Conference on Entrepreneurship & Social Economy-Innovations-Environment*. Venue of conference, Kraków, Poland, Day May 2019. Place of publication: Instytut Geografii Uniwersytetu Pedagogicznego im. Komisji Edukacji Narodowej w Krakowie.

Jansen, D. 2020. *What Is A Research (Scientific) Hypothesis?* Available: https://gradcoach.com/what-is-a-research-hypothesis-or-scientific-hypothesis/ (Accessed 19 October 2023).

Azo Jwara, N. and Hoque, M. Z. 2018. Entrepreneurial intentions among university students: A case study of Durban University of Technology. *Academy of Entrepreneurship Journal*, *24*(3): 1-19.

Kahn, K. B. 2018. Understanding innovation. *Business Horizons*, 61(3): 453-460. Available: https://doi.org/10.1016/j.bushor.2018.01.011 (Accessed 20 June 2024).

Kalla, S. 2009. *Statistical reliability.* Available: https://explorable.com/statistical-reliability (Accessed 25 October 2023).

Katz, J. A. 2003. The chronology and intellectual trajectory of American entrepreneurship education: 1876-1999. *Journal of Business Venturing,* 18(2): 283-300. Available: https://doi.org/10.1016/S0883-9026(02)00098-8 (Accessed 20 June 2024).

Kauppi, S., Muukkonen, H., Suorsa, T. and Takala, M. 2020. I still miss human contact, but this is more flexible—Paradoxes in virtual learning interaction and multidisciplinary collaboration. *British Journal of Educational Technology,* 51(4): 1101-1116. Available: https://doi.org/10.1111/bjet.12929 (Accessed 20 June 2024).

Kavousi, S., Miller, P. A. and Alexander, P. A. 2020. Modeling metacognition in design thinking and design making. *International Journal of Technology and Design*

Education, 30(4): 709-735. Available: https://doi.org/10.1007/s10798-019-09521-9 (Accessed 20 June 2024).

Kimbell, L. 2011. Rethinking design thinking: Part I. *Design and culture,* 3(3): 285-306.

Ku, B. and Lupton, E. 2022. *Health design thinking*: *Creating products and services for better health*. 2nd ed. Cambridge, MA: MIT Press.

Kuratko, D. F. 2005. The emergence of entrepreneurship education: Development, trends, and challenges. *Entrepreneurship Theory and Practice,* 29(5): 577-597. Available: https://doi.org/10.1111/j.1540-6520.2005.00099.x (Accessed 20 June 2024).

Kurniati, E. Y. and Fithriani, R. 2022. Post-graduate students' perceptions of quillbot utilization in english academic writing class. *Journal of English Language Teaching and Linguistics,* 7(3): 437. Available: https://doi.org/10.21462/jeltl.v7i3.852 (Accessed 20 June 2024).

Kyngäs, H. 2019. Qualitative research and content analysis. In: Kyngäs, H., Mikkonen, K. and Kääriäinen, M. eds. *The Application of Content Analysis in Nursing Science Research*. Cham: Springer, 3-11. Available: https://link.springer.com/chapter/10.1007/978-3-030-30199-6_1 (Accessed 17 October 2023).

Lekhanya, L. M. 2013. The use of social media and social networks as the promotional tool for rural small, medium and micro enterprises in KwaZulu-Natal. *International Journal of Scientific and Research Publications,* 3(7): 7.

Linton, G. and Klinton, M. 2019. University entrepreneurship education: A design thinking approach to learning. *Journal of Innovation and Entrepreneurship,* 8: Article 3. Available: https://innovation-entrepreneurship.springeropen.com/articles/10.1186/s13731-018-0098-z (Accessed 10 January 2024).

Luka, I. 2014. Design thinking in pedagogy. *The Journal of Education, Culture, and Society,* 5(2): 63-74. Available: https://doi.org/10.15503/jecs20142.63.74

Mackey, A. and Gass, S. M. 2022. *Second language research: Methodology and design*. New York: Routledge. Available: https://books.google.co.za/books?hl=enandlr=andid=CgpBEAAAQBAJandoi=fndandpg=PT13anddq=What+is+research+methodologyandots=1mBDEk2nFfandsig=FJsCZtWuWVAmAZMBm6V6tAU0-H0andredir_esc=y#v=onepageandq=What%20is%20research%20methodologyandf=false (Accessed 16 October 2023).

Mård, N. and Hilli, C. 2020. Towards a didactic model for multidisciplinary teaching-A didactic analysis of multidisciplinary cases in Finnish primary schools. *Journal of Curriculum Studies,* 54(2): 243-258. Available: https://doi.org/10.1080/00220272.2020.1827044 (Accessed 20 June 2024).

McAvoy, J. and Sammon, D. 2005. Agile methodology adoption decisions: an innovative approach to teaching and learning. *Journal of Information Systems Education,* 16(4): 409-420.

McCloed, S. 2023. *Questionnaire method in research*. Available: https://www.simplypsychology.org/questionnaires.html (Accessed 23 October 2023).

McCombes, S. 2022. *How to write a strong hypothesis | Steps and examples.* Available: https://www.scribbr.com/methodology/hypothesis/ (Accessed 19 October 2023).

McLaughlan, R. and Lodge, J. M. 2018. Facilitating epistemic fluency through design thinking: A strategy for the broader application of studio pedagogy within higher education. *Teaching in Higher Education,* 24(1): 81-97. Available: https://doi.org/10.1080/13562517.2018.1461621 (Accessed 20 June 2024).

Mehrad, A. and Zangeneh, M. H. T. 2019. Comparison between qualitative and quantitative research approaches: Social sciences. *International Journal for Research in Education Studies,* 5(7): 1-7.

Micheli, P., Wilner, S. J. S., Bhatti, S. H., Mura, M. and Beverland, M. B. 2019. Doing design thinking: conceptual review, synthesis, and research agenda. *Journal of Product Innovation Management,* 36(2): 124-148. Available: https://doi.org/10.1111/jpim.12466 (Accessed 20 June 2024).

Middleton, F. 2023. *Reliability vs. validity in research | Difference, types and examples*. Available: https://www.scribbr.com/methodology/reliability-vs-validity/ (Accessed 23 October 2023).

Middleton, K. W. and Donnellon, A. 2014. Personalizing entrepreneurial learning: A pedagogy for facilitating the know why. *Entrepreneurship Research Journal,* 4(2): 167-204. Available: https://doi.org/10.1515/erj-2013-0040 (Accessed 20 June 2024).

Mishra, S. B. and Alok, S. 2017. *Handbook of research methodology: A compendium for scholars and researchers.* New Delhi: Educreation Publishing. Available: http://74.208.36.141:8080/jspui/bitstream/123456789/1319/1/BookResearchMethodology.pdf (Accessed 18 October 2023).

Murphy, C. B. 2021. *Stratified random sampling: Advantages and disadvantages.* Available: https://www.investopedia.com/ask/answers/041615/what-are-advantages-and-disadvantages-stratified-random-sampling.asp (Accessed 19 October 2023).

Ndlovu, S. G., Radebe, T. N., Xulu, N. C. and Mlambo, V. H. 2023. Entrepreneurial mindset as a facilitator and barrier to entrepreneurship development: The mediating role of entrepreneurial culture. *International Journal of Social Science Research and Review,* 6(9): 170-182. Available: https://doi.org/10.47814/ijssrr.v6i9.1492 (Accessed 20 June 2024).

Nkomo, S. M. 2015. Challenges for management and business education in a "developmental" state: The case of South Africa. *Academy of Management Learning and Education,* 14(2): 242-258. Available: https://doi.org/10.5465/amle.2014.0323 (Accessed 20 June 2024).

Noor, S., Tajik, O. and Golzar, J. 2022. Simple random sampling. *International Journal of Education & Language Studies*, 1(2): 78-82. Available: https://doi.org/10.22034/ijels.2022.162982 (Accessed 20 June 2024).

Onodipe, G., Robbins, M., Ayuninjam, G., Howse, T., Cottrell-Yongye, A. and Curry-Savage, J. 2020. Growth of pedagogical practice in an active multidisciplinary FLC on flipped learning. *International Journal for the Scholarship of Teaching and Learning,* 14(2). Available: https://doi.org/10.20429/ijsotl.2020.140202 (Accessed 20 June 2024).

Patil, P. 2016. Artificial intelligence education: Emotional computation. *International Journal of Research in Computer Applications and Robotics,* 4(2): 24-28.

Pellegrini, M. 2021. Composing like an entrepreneur: The pedagogical implications of design thinking in the workplace. *Journal of Technical Writing and Communication,* 52(3): 316-333. Available: https://doi.org/10.1177/00472816211031554 (Accessed 20 June 2024).

Rajabzadeh, A. R., Mehrtash, M. and Srinivasan, S. 2022. Multidisciplinary problem-based learning (MPBL) approach in undergraduate programs. In: Auer, M. E. and Tsiatsos, T. eds. *New realities, mobile systems and applications*. Venue of conference, City of conference, 4-5 November 2021. Cham: Springer International Publishing. 454-463. https://doi.org/10.1007/978-3-030-96296-8_41

Ratten, V. and Usmanij, P. 2021. Entrepreneurship education: Time for a change in research direction? *The International Journal of Management Education,* 19(1): 100367.

Razzouk, R. and Shute, V. 2012. What is design thinking and why is it important? *Review of Educational Research,* 82(3): 330-348.

Revano, T. F. and Garcia, M. B. 2020. Manufacturing design thinkers in higher education institutions: The use of design thinking curriculum in the education landscape. In: *2020 IEEE 12th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)*. Venue of conference, Manila, Philippines, Day December 2020. Place of publication: Publisher, 1-5.

Robinson, S., Neergaard, H., Tanggaard, L. and Krueger, N. F. 2016. New horizons in entrepreneurship education: From teacher-led to student-centered learning. *Education + Training,* 58(7/8): 661-683. Available: https://doi.org/10.1108/ET-03-2016-0048 (Accessed 20 June 2024).

Sari, E. and Zulaikha, E. 2021, May. Disrupting tertiary user-centered design course with design thinking 2.0. In: Tedjasaputra, A., Samson, B., Ghazali, M., Sari, E.,

Sacar, S., Gamage, D. and Kurniawan, Y. eds. *CHI '21: CHI Conference on Human Factors in Computing Systems.* Venue of conference, Yokohama, Japan, 8-13 May 2021. New York: Association for Computing Machinery. 41-47.

Sarooghi, H., Sunny, S., Hornsby, J. and Fernhaber, S. 2019. Design thinking and entrepreneurship education: Where are we, and what are the possibilities? *Journal of Small Business Management*, 57(Suppl. 1): 78-93.

Shakeel, S. I., Mamun, M. A. and Haolader, M. 2023. Instructional design with ADDIE and rapid prototyping for blended learning: Validation and its acceptance in the context of TVET Bangladesh. *Education and Information Technologies,* 28(6), 7601-7630. Available: https://doi.org/10.1007/s10639-022-11471-0 (Accessed 20 June 2024).

Sharif, A. and Cho, S. 2015. 21st-Century instructional designers: Bridging the perceptual gaps between identity, practice, impact and professional development. *RUSC Universities and Knowledge Society Journal*, 12(3): 72-85.

Sharp, G., Bourke, L. and Rickard, M. J. F. X. 2020. Review of emotional intelligence in health care: An introduction to emotional intelligence for surgeons. *ANZ Journal of Surgery,* 90(4): 433-440. Available: https://doi.org/10.1111/ans.15671 (Accessed 20 June 2024).

Shé, C. N., Farrell, O., Brunton, J. and Costello, E. 2022. Integrating design thinking into instructional design: The #OpenTeach case study. *Australasian Journal of Educational Technology,* 38(1): 33-52. Available: https://doi.org/10.14742/ajet.6667 (Accessed 20 June 2024).

Sikström, P., Valentini, C., Sivunen, A. and Kärkkäinen, T. 2022. How pedagogical agents communicate with students: A two-phase systematic review. *Computers and Education,* 188: 104564. Available: https://doi.org/10.1016/j.compedu.2022.104564 (Accessed 20 June 2024).

Sileyew, K. J. 2019. Research design and methodology. In: Abu-Taieh, E., Al Hadid, I. H. and El Mouatasim, A. *Cyberspace.* London: IntechOpen. Available: https://books.google.co.za/books?hl=enandlr=andid=eqf8DwAAQBAJandoi=fndandpg=PA27anddq=research+designandots=cKV35Wb8Lcandsig=RHfJxbhTxgAvbyjXtPNk47KGZhoandredir_esc=y#v=onepageandq=research%20designandf=false (Accessed 16 October 2023).

Simkus, J. 2023. *Pilot study in research: Definition and examples.* Available: https://www.simplypsychology.org/pilot-studies.html#:~:text=Pilot%20studies%20are%20a%20fundamental,out%20the%20study%20on%20them (Accessed 18 October 2023).

Spatioti, A. G., Kazanidis, I. and Pange, J. 2022. A comparative study of the ADDIE instructional design model in distance education. *Information*, 13(9): 402. Available: https://doi.org/10.3390/info13090402 (Accessed 20 June 2024).

Svihla, V. 2018. New trends or just good designs? In: West, R. E. ed. *foundations of learning and instructional design technology*. Place of publication: EdTech Books. Available: https://pressbooks.pub/lidtfoundations/chapter/design-thinking/ (Accessed 20 October 2023).

Taherdoost, H. 2021. Data collection methods and tools for research; a step-by-step guide to choose data collection technique for academic and business research projects. *International Journal of Academic Research in Management (IJARM),* 10(1): 10-38

Tham, J. C. K. 2020. Engaging design thinking and making in technical and professional communication pedagogy. *Technical Communication Quarterly,* 30(4): 392-409. Available: https://doi.org/10.1080/10572252.2020.1804619 (Accessed 20 June 2024).

Tham, J., 2022. Pasts and futures of design thinking: Implications for technical communication. *IEEE Transactions on Professional Communication*, 65(2): 261-279.

Universities South Africa. 2023. *Universities are key actors in creating vibrant entrepreneurship ecosystems for sustainable prosperity and development*. Available: https://usaf.ac.za/universities-are-key-actors-in-creating-vibrant-entrepreneurship-ecosystems-for-sustainable-prosperity-and-development/ (Accessed 10 January 2024).

van Reine, P. P. 2017. The culture of design thinking for innovation. *Journal of Innovation Management*, 5(2): 56-80. Available: https://doi.org/10.24840/2183-0606_005.002_0006 (Accessed 20 June 2024).

Vladasel, T., Lindquist, M. J., Sol, J. and van Praag, M. 2021. On the origins of entrepreneurship: Evidence from sibling correlations. *Journal of Business Venturing,* 36(5): 106017.

von Thienen, J. P. A., Weinstein, T. J. and Meinel, C. 2023. Creative metacognition in design thinking: Exploring theories, educational practices, and their implications for measurement. *Frontiers in Psychology,* 14. Available: https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1157001 (Accessed 20 June 2024).

Wadhwani, R. D. and Viebig, C. 2021. Social imaginaries of entrepreneurship education: The United States and Germany, 1800-2020. *Academy of Management Learning and Education,* 20(3): 342-360. Available: https://doi.org/10.5465/amle.2020.0195 (Accessed 20 June 2024).

Withell, A. and Haigh, N. 2013. Developing design thinking expertise in higher education. In: Reitan, J. B., Lloyd, P., Bohemia, E., Nielsen, L. M., Digranes, I. and Lutnæs, E. eds. *2nd International Conference for Design Education Researchers*. Venue of conference, Oslo, Norway. 14-17 May 2013. Place of publication: Design Research Society // CUMULUS, 238-250.

Wrigley, C. and Mosely, G. 2022. *Design thinking pedagogy: Facilitating innovation and impact in tertiary education*. London: Routledge.

APPENDICES

APPENDIX A: LETTER OF INFORMATION AND CONSENT

LETTER OF INFORMATION

Title of the Research Study: The Inclusion of Design Thinking as a tool for entrepreneurship at the Durban University of Technology.

Principal Investigator/s/researcher: Owami Ntobeko Shane Thiba. Postgraduate Diploma: Business Administration.

Co-Investigator/s/supervisor/s: Prof. Keolebogile Motaung

1. Brief **Introduction** and Purpose of the Study:

Entrepreneurship has traditionally been taught from a business administration perspective, where predicting the future is central and where the world is seen as linear with known inputs and outputs. The world of entrepreneurs is a quite different, usually highly uncertain environment, and therefore requires a different type of skill set. This study conceptualizes entrepreneurial learning through a method- and design-based approach called design thinking. It is argued that by utilizing design thinking and a methods approach, learning from a "through" approach can be achieved. This learning is more focused on the entrepreneurial process, highlighting the role of skills and mind-set. This learning approach enables student-centred learning and focus on skills more applicable to entrepreneurs. Design thinking emphasizes a practical approach where students step outside the classroom. The study aim is to evaluate the inclusion of Design Thinking as an entrepreneurship and business development tool at the Durban University of Technology. In order to achieve this, the study will adopt a quantitative research approach using the simple random sampling method. This is going to be a comparative study on students who have done Entrepreneurship module following the Design Thinking (DT) format versus a more generic entrepreneurship program which does not use design thinking in order to determine whether DT should be adopted as a teaching and learning strategy or not. Data will then be collected using a questionnaire and data will be analysed using the SPSS and Microsoft Excel method.

2. Introduce yourself to the participant

Dear Respondent. My name is Owami Ntobeko Shane Thiba. I am a Master's student in Business administration, under the Faculty of Management Sciences at the Durban University of Technology (DUT). My master's research topic is: The inclusion of Design Thinking as an entrepreneurship and business developmental tool at Durban University of Technology (DUT).

3. Invitation to the potential participant

I would like to invite you to participate in this study which aims at researching about the use of design thinking to create sustainable businesses at the University.

Outline of the Procedures: This research aims at evaluating the inclusion of design thinking as an entrepreneurship and business tool at DUT. This research envisage in reviewing the content provided towards assisting students in becoming entrepreneurs, addressing the perception of students towards entrepreneurship and assessing if entrepreneurship approaches used are beneficial to students and the University at large. I will distribute questionnaires to students doing entrepreneurial edge modules

(approach that use Design Thinking and the one that does not). All data collected from the participants will be exclusively used for the purpose of this research and confidentiality will be guaranteed.

4. Risks or Discomforts to the Participant:
Participants in this study will not result in any physical risks or discomfort.

5. Explain to the participant the reasons he/she may be withdraw from the Study:
Participation in this study will be voluntarily and the participants can withdraw at any time of the research. **(**That the research may be terminated early in particular circumstances viz. Non-compliance, illness, adverse reactions, etc. State that the participant is entitled to withdraw from the study at any time should they wish to do so and will still continue to receive the appropriate standard of care; Explain to the potential participant that the research may be terminated early in particular circumstances. That the researcher may, under certain circumstances, decide to withdraw the participant from the study; explain what procedures are in place for an orderly termination of participation by the participant.)

6. Benefits:
This research will benefit the University in cementing it approach to entrepreneurship and students will be exposed to entrepreneurial learning, contributing towards creating orientated graduates.

7. Remuneration:
There will be no remunerations paid for participating in this study. Participation is strictly voluntarily.

8. **Costs of the Study**:
There will be no costs incurred by the participants in this study.

9. Confidentiality:
Please rest assured that your responses will be treated with utmost confidentiality and no names will be divulged to any third party. The collated responses will only be used for statistical analysis.

10. Results:
The results of this study will be made available to participants should they request them.

11. Research-related Injury:
This study does not have any risks to physical injury. Summary of the findings will be sent to the participants on the completion of the study.

12. Storage of all electronic and hard copies including tape recordings
DUT's requirement of 5 years storage will be adhered to, accessible only to the researcher and the supervisors. Thereafter, all data will be destroyed.

Persons to contact in the Event of Any Problems or Queries: Please contact the researcher (031 373 5695/ Ntobeko.thiba1@gmail.com), my supervisor Prof. Keolebogile Motaung (031 373 2092/ ttidirector@dut.ac.za) or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Acting Director: Research and Postgraduate Support Prof K Motaung on TtiDirector@dut.ac.za

13. CONSENT

Full Title of the Study: The Inclusion of Design Thinking as a tool for entrepreneurship at the Durban University of Technology.

Names of Researcher/s: Owami Ntobeko Shane Thiba

14. Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Owami Ntobeko Shane Thiba, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: 21600267

    - I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
    - I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
    - In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
    - I may, at any stage, without prejudice, withdraw my consent and participation in the study.
    - I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
    - I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant	**Date**	**Time**	**Signature/Right Thumbprint**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

APPENDIX B: RESEARCH INSTRUMENT

The inclusion of Design Thinking as a tool for entrepreneurship at DUT

Section 1: Demographics
What is your age? What is your gender?
What is your field of study? What is your year of study?
Have you previously taken any courses on entrepreneurship? (Yes/No)

Section 2: Design Thinking and Entrepreneurship
Have you heard of Design Thinking? (Yes/No)
Have you participated in any Design Thinking workshops or courses? (Yes/No)
How confident do you feel about your ability to generate new ideas? (1-5 scale)
How confident do you feel about your ability to execute on new ideas? (1-5 scale)
Have you started any entrepreneurial ventures while in university? (Yes/No)
If yes, did Design Thinking help spark the idea for your entrepreneurial venture? (Yes/No)
How valuable do you believe Design Thinking is in the process of starting an entrepreneurial venture? (1-5 scale)
How likely are you to use Design Thinking in the future when starting an entrepreneurial venture? (1-5 scale)

Section 3: Open-ended Questions
Can you describe a time when you used Design Thinking to generate a new idea for an entrepreneurial venture?
What are some ways that university programmes could better incorporate Design Thinking into their entrepreneurship curriculum?
How do you think Design Thinking could be used in other fields of study beyond entrepreneurship?

Thank you for participating in this survey!

APPENDIX C: REQUEST FOR GATEKEEPER'S LETTER

Appendix A

DUT

DURBAN UNIVERSITY OF TECHNOLOGY
INYUVESI YASETHEKWINI YEZOBUCHWEPHESHE

5 April 2023

70 Gardens Drive
Cato Manor
Durban
4091

Request for Permission to Conduct Research

Dear Research Director

My name is Owami Ntobeko Shane Thiba, a Master's in Management Sciences: Business Administration student at the Durban University of Technology. The research I wish to conduct for my Masters dissertation involves The Inclusion of Design Thinking as a tool for entrepreneurship at the Durban University of Technology

I am hereby seeking your consent to send my questionnaire to students studying Entrepreneurial Edge/ Introduction to Technopreneurship across the University.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact me at OwamiT@dut.ac.za / 062 122 7957. Thank you for your time and consideration in this matter.

Yours sincerely,

Ntobeko Thiba
Durban University of Technology

APPENDIX D: GATEKEEPER'S PERMISSION

Directorate for Research and Postgraduate Support
Durban University of Technology
Open House
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946

5 June 2023

Mr Ntobeko Thiba
c/o Department of Entrepreneurial Studies and Management
Faculty of Management Sciences
Durban University of Technology

Dear Mr Thiba

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Gatekeeper Permission** for you to conduct your research "The Inclusion of Design Thinking as a tool for entrepreneurship at the Durban University of Technology" at the Durban University of Technology. **Kindly note that this letter must be issued to the IREC for approval before you commence data collection.**

The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

Upon completion of your research project, you are requested to share the summary of your key research findings.

Kind regards.
Yours sincerely

DR V GOVENDER
ACTING-DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT DIRECTORATE

APPENDIX E: ETHICS CLEARANCE

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavtshad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

7 June 2023

Mr O N S Thiba
70 Gardens Drive
Cato Manor
Durban
4091

Dear Mr Thiba

The Inclusion of Design Thinking as a tool for entrepreneurship at the Durban University of Technology
Ethical Clearance number IREC 095/23

The DUT-Institutional Research Ethics Committee acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the DUT-IREC according to the DUT-IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the DUT-IREC as outlined in the DUT-IREC SOP's.

It is compulsory for a student or researcher to apply for recertification on an annual basis. The failure to do so will result in withdrawal of ethics clearance. It is the responsibility of the researcher and the supervisor to apply for recertification.

Please note that you are required to submit a Notification of Completion of Study form together with an abstract to the DUT-IREC office on completion of your study.

Prof J K Adam
Chairperson: DUT-IREC

APPENDIX F: ETHICS CERTIFICATE

TRREE

Zertifikat
Certificat
Certificado
Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants

Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Clinical Trials Centre
The University of Hong Kong

Owami Thiba

a complété avec succès - has successfully completed

Introduction to Research Ethics

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2022/08/19

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator

APPROVED BY
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APPENDIX G: TURNITIN REPORT

Design Thinking as a catalyst for entrepreneurship in university students

ORIGINALITY REPORT

8%	6%	1%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Durban University of Technology Student Paper	1%
2	vital.seals.ac.za:8080 Internet Source	<1%
3	www.researchgate.net Internet Source	<1%
4	docplayer.net Internet Source	<1%
5	libdspace.ufh.ac.za Internet Source	<1%
6	Submitted to Mancosa Student Paper	<1%
7	mail.mjltm.org Internet Source	<1%
8	Submitted to University of Witwatersrand Student Paper	<1%