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EFFECTIVENESS OF DIGITAL TECHNOLOGY IN IDEATION:

A CASE OF GHANAIAN GRAPHIC DESIGN STUDENTS

A Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Visual and Performing Arts in the Faculty of Arts and Design at the Durban University of Technology – South Africa

BY

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ABSTRACT

This study explores how digital technology can be effectively utilized to enhance graphic design ideation among graphic design students in two selected Ghanaian universities. The study also seeks to create awareness about the need to integrate digital technologies into graphic design ideation and to develop a model for effective digital ideation.

Areas explored by the research questions in the study include how graphic design ideas are generated by design students in Ghana; how digital technologies affect design output by examining the various technologies used by the design students in the design ideation process; and the perceptions of graphic design students about the use of digital technologies during ideation.

The study assumes the constructivist and interpretivist paradigm on the premise that the use of digital technology in design ideation among students has to do with students with varying design experiences, backgrounds, and environments based on their interaction with design tools. Phenomenology and case study approaches were used to interrogate students to have an in-depth understanding of the effectiveness of digital technology utilization in the ideation process. Twenty-eight (28) participants, made up of twenty- four students and four lecturers were selected from the Graphic Design Departments of two Ghanaian universities for the study. Purposive and random sampling were adopted for the selection of the participants.

Findings indicated that students from the selected universities predominantly used a combination of the pencil and paper approach and digital technology in design ideation. During ideation, they conducted research on design briefs they received; embarked on mind mapping; engaged in brainstorming; created ideas with pencil and paper; selected some of the pencil ideas and illustrated them digitally in computer software; and evaluated the ideas for final selection. The design students relied heavily on the internet during the

ideation process. The digital devices used by the design students included laptops, smartphones, tablets and digital cameras.

Despite the divergent views expressed by the participants about the use of digital technology for ideation, the majority of them believed that the integration of pencil and digital technology is the ideal approach for design ideation. They considered technology very relevant, especially in increasing idea counts (quantity of ideas generated) that lead to creative ideation outputs. Overall, the students had a positive attitude about the use of digital devices; however, quite a few of them did not have the necessary skills in using vector software needed for design idea creation simply because they were not taught how to use the software or were not compelled to use the software in design ideation.

Based on these findings of the study, the Digital Design Ideation Model, which outlines the steps to follow for effectiveness in digital idea development, was developed. The development of the model was typically influenced by the findings in the study and was based on design practices discovered in the review of the literature related to this study.

Keywords: Design ideation, digital technology, digital skills, quantity of ideas and novelty.

DECLARATION

I, **Sylvanus Ametordzi**, declare that the work presented in this thesis, except where otherwise indicated, is my own and has not been presented for any degree work in another university.

Where use has been made of the work of others, it has been duly acknowledged in the text.

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DEDICATION

I dedicate this thesis to my Mum and Dad who were very supportive during my studies.

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CHAPTER ONE

INTRODUCTION TO THE STUDY

1.0 Overview

Design ideation is a crucial stage in the design process, which starts with a design brief and produces a variety of design possibilities that are expressed in the form of thumbnail sketches and/or rough sketches (Taegyun 2020). This research is focused on exploring the effectiveness of digital technology utilization in the ideation process in design ideation. The exploration is meant to uncover how graphic design ideas are generated by design students in Ghana. The design activities students engaged in, the ideation process adopted and the tools used were examined. The study seeks to find out how digital technologies affect design output. This is done by examining the various technologies used by the design students in the design ideation process and their perceptions about the use of digital technologies during ideation.

This chapter introduces the reader to the concepts of design ideation as an essential phase of the design process and digital technologies, which according to ECLAC (2021), have grown exponentially in recent times. The chapter expresses the need for digital technology integration in design ideation which is expected to facilitate the generation of creative ideas. The background to the study is discussed in this chapter. It focuses on a brief description of design ideation; current topics of interest related to digital ideation; why the study is important; and how it adds to existing knowledge by identifying the gaps that the study seeks to address. The chapter also states the problem statement, the goals and objectives of the research, the research questions, and the scope of the study. The chapter outlines six key areas in which the research is deemed to be useful under the heading ‘Significance of the Study’. Finally, the chapter provides brief summaries of each chapter of the thesis under the heading ‘Structure of the Thesis’.

1.1 Background to the Study

Successful innovations depend on what input is made to the development process. In much the same way, successful design outputs depend heavily on preliminary inputs that are made by the designer which are not usually perceived by the public. Idea development, usually referred to as ideation by many design professionals, starts as [an] abstract [process] in the cognitive domain with no physical or concrete evidence. According to Rikke and Teo (2020), ideation seeks to create a significant number of concepts that may be selected and reduced to the best, most useful, or most inventive to encourage enhanced design solutions and products. It is the most exciting stage of the design thinking project (Rikke and Teo 2020). In graphic design, abstract ideas are communicated through a series of sketches on paper among which one may be selected for the actual design execution. This helps in visualizing and concretizing concepts and insights so that novel solutions may be developed more effectively and efficiently (Dell'era *et al*. 2020). The effectiveness of the design process as a whole and its results greatly influence the quality of concepts created during the design ideation stage. (Orthel and Day 2016). The main objective of design ideation is to come up with original or imaginative answers to the design requirement.

Digital technologies, according to ECLAC[1] (2021), have increased rapidly, and their usage has spread throughout the world. Easy access, [easy] use and constant improvement of these technologies have completely transformed how things are done in today's world. 'Technological revolution has combined with a change in the strategies that the companies at the forefront of digital technology use to greatly increase the role of global platforms' (ECLAC 2021:7). This statement means that the advent of digital technology has triggered an evolution in business approaches. This corresponding response is what is expected to take place in every area of life including the social, industrial and educational sectors. Undeniably, great transformation has been seen in educational sectors all over the world as a

[1] Economic Commission for Latin America and the Caribbean

result of technology integration into pedagogy. This has affected most aspects of education including instructional space design, and the approach to imparting skills and knowledge into students' academic practices such as the execution and presentation of tasks.

Technology has also affected current design approaches among students in institutions of higher learning as Sreekanth and Viswanathan (2019) and Camba, Kimbrough and Kwon (2018) observe that new designers and graduates are more proficient in the use of CAD packages even in the ideation stage of product design. This corroborates with an earlier study conducted by Veisz *et al.* (2012) which reported a significant decline in the use of pencils in the early stage of the design process among engineering students as they prefer computer-aided design. Digitization has changed the face of design ideation in the sense that the traditional approach of dependence on paper and pencil for idea generation is gradually being replaced with the digital approach, where digital devices are used during the ideation stage. As stated by Barnes (2017), the practice of hand sketching is gradually being replaced by computer programs for innovative design, which is an unavoidable tendency. In their study, Aboalgasm and Ward (2014) identified laser pointers, laptops, tablets, Modbook, iPod, Wacom Cintiq iPads and tablets as the commonly used digital devices among graphic designers during design processes.

Some of the advantages of digital approach, according to Wang and Wang (2021) are that it is easily published, printed and shared in many places and most importantly, mistakes are easy to correct.

Design is best understood as an effort to determine the most effective means of expressing a concept, a mental representation or a result (Appiah 2014). Professionals and academics agree that design plays a crucial role in fostering creativity and transformation (Forrester 2018; Sarrazin, Kouyoumjian and Dore 2018 and Liedtka 2015). A design will be desirable

and usable only if the outcome satisfies the intended purpose. Design is not created just for design's sake but to solve a particular problem. It must, essentially, bring a positive change of improvement and must be innovative. It is therefore important for a designer to be solution-focused and this can be achieved through design idea development, or ideation.

Design ideation has been a subject of interest to scholars over the past seven decades. Some early researchers on the subject include (Wallas 1926; Allen 1962;Osborn 1963; and Amabile 1983). In recent times the issue of design ideation has been debated much more than before owing to the transition from analogue to digital technology.

While some researchers are of the view that freehand sketching is an ideal medium for design idea communication (Kang 2019 *et al.*), others believe that the use of digital technology offers a better alternative (Sreekanth and Viswanathan 2019; Camba, Kimbrough and Kwon 2018). New designers, especially graduates with an engineering background are more proficient in the use of CAD packages even in the ideation stage of product design (Evans and Aldoy 2016; Veisz *et al.* 2012). In a similar vein, Evans and Aldoy (2016) reported in a study they conducted into the ways tablet PC use facilitates drawing that digital sketching technologies significantly improve the process of coming up with design concepts.

An earlier investigation into visual ideation and instruction was carried out at a public institution, focusing on the utilization of ICT for graphic design instruction. Drawing data from the university, the study explored how information and communication technology affected the teaching and learning of graphic design ideation. Communication technology and pedagogical approach were the major focus. As a result, the research explored perspectives and instructional strategies that have influenced graphic design instruction (Appiah 2014). Unlike the study conducted by Appiah (2014), this current study focuses on two universities located in two separate regions of Ghana and are in different university categories.

Ghanaian public universities are categorized into two main groups namely, Universities (usually referred to as traditional universities) and Technical Universities. The two universities in this study are purposively selected because they produce the largest number of graphic design graduates in their respective categories. Findings from these institutions will, therefore, be highly representative of graphic design ideation practices among Ghanaian university students.

Again, while the preceding research investigated the impact of information and communication technology (ICT) on the instruction and acquisition of graphic design ideation, this study explores how digital technology can be effectively utilized to enhance graphic design ideation among students.

While the previous study (Appiah 2014) adopted the mixed method for data gathering and analysis, this study employed a purely qualitative approach. This approach was chosen because it is in line with the aim of the study to explore in depth, the effectiveness of digital technology utilization in the graphic design ideation process. The approach supports the design phenomenon to be explored from the perspective of the research subject, which is essential to phenomenological investigations (Qutoshi 2018).

Having reviewed the literature on digital ideation in detail, it was observed that the use of digital technology in the ideation process, especially in the area of graphic design, has not been researched. Given the nature of today's technology-driven world with the high demand for quality design outcomes, there is a need to explore the effectiveness of digital technologies in the ideation process. It is against these gaps that this study seeks to explore how digital technology can be effectively utilized to enhance design ideation in graphic design in selected Ghanaian universities. The study also intends to create awareness on the need for digital technology integration into design ideation and to develop a conceptual model for an effective digital ideation process. The conceptual model developed at the end of this study will serve as a digital graphic design ideation model and as a paradigm that will inform

designers of current design practices that will bring about considerable transformation in the ideation process for improved ideation outcomes.

This study adopts the Generic Creative Process Model developed by Warr and O'Neill (2005) which outlines three important areas of ideation which are problem preparation, idea generation and idea evaluation. Digital devices are considered to be very useful in these areas. Problem preparation refers to the preliminary preparations such as understanding the problem, researching about it and reframing it. Digital technology is seen to be essential for effective research towards creative idea creation. Digital devices such as smartphones, tablets and laptops are heavily depended upon for information gathering during the research stage, usually with internet connectivity.

Idea generation is the stage at which ideas are physically projected by the designer in the form of writing, drawing or modelling that can communicate the designer's intention to solve the problem (Warr and O'Neill 2005). Design software is usually installed on digital devices to help exteriorize ideas, and the digital devices used for drawing, as stated by Aboalgasm and Ward (2014), include laptops, iPads, and tablets.

Idea evaluation refers to the selection of quality solutions to design problems based on appropriateness and novelty. The graphic designer, at this stage, subjects the ideation outcomes to some form of judgement in order to choose the most appropriate design for further development. According to the Metrics for Assessing the Effectiveness of Ideas (Shah *et al.* 2003), effectiveness of ideation can be evaluated in terms of quantity, quality, variety and novelty. Digital technology utilization in the problem preparation and the idea generation stages greatly influences these outcomes as Evans and Aldoy (2016) concluded in a study they conducted into how technology used for digital sketching significantly improves the process of developing design concepts. Aboalgasm and Ward (2014) indicated that technologies enable and greatly simplify the processes of reorganizing, choosing, adding, removing, adding colour, storing, and transmitting work. Radhika (2018)

indicated that the primary objectives of digital technology are to facilitate teamwork among users in order to accomplish shared objectives, increase output, and develop human resource skills, talents, and knowledge. In this study, digital technology represents the use of digital devices and design application software, with or without the internet to solve a design problem. Digital devices include but are not limited to computers, laptops, cameras, stylus, tablets and mobile phones and the design software includes CorelDraw, Adobe Photoshop, Adobe Illustrator and Rhinoceros. Design ideation, in this study, is referred to as the creative design process during which ideas are generated, evaluated based on some criteria, and a final idea is selected for implementation. The use of digital technology during the idea generation process is referred to as digital ideation.

1.2 Statement of the Problem

Technology has advanced significantly and the needs and expectations of consumers have changed considerably over time. In response to the technological changes and the ever-changing tastes of consumers worldwide, graphic designers have been trying to keep up with the latest developments and updates in their field. As stated by Al-Qudah and Al Shari (2020), technological advancement has brought many advantages to graphic design. This has been reflected in the interest of graphic designers by directing their energies, stimulating them to creativity in different ways. There is no doubt that this new trend in graphic design necessitates that university design students use the appropriate technological approaches from design ideation to production.

Inadequate use of digital technology during the design ideation stage among graphic design students in Ghana was discovered in research conducted by Appiah (2014). This resulted in digital skills deficiencies and students' lack of confidence in the use of digital technology for design ideation purposes. In voicing his concern, the author emphasized the significance of investigating contemporary ICT practices in graphic design instruction, particularly concerning ideation-related concerns.

Again, as mentioned by Amarakoon (2017), the transition from analog to digital technology has had an influence on the creative process and working environment in the graphic design field as the education system undergoes gradual changes.

The inadequate use of digital technology must be addressed because easy access and the use of technology in today's world has led to a complete transformation of how various tasks are executed (ECLAC 2021). This has resulted in a considerable change in the expectations of consumers over time. The use of traditional approaches to problem-solving are not recommended anymore as these approaches fail to meet the standards expected by today's clientele.

If this remains unsolved, there will be a mismatch between the skills acquired by design students and the quality expectations of clients. Consequently, this may render design graduates unproductive in the design industry. Therefore, the purpose of this study is to explore how graphic design ideation can be improved through effective utilization of digital technology.

1.3 Research Aim

This study aims to provide solutions on how digital technology can be effectively utilized to enhance graphic design ideation among graphic design students in two selected Ghanaian universities.

1.4 Research Objectives

The specific objectives of the research are to:

i. investigate how graphic design students in Ghana generate design ideas.
ii. explore how utilization of digital technology affects the process of designing ideas and output.

iii. examine the perception of graphic design students on the use of digital technologies during design idea development.
iv. develop a conceptual model for an effective digital ideation process that improves students' design outputs.

1.5 Research Questions

i. How do design students in Ghana generate graphic design ideas?
ii. How do digital technologies affect students' ideation process and design ideation output?
iii. What is the perception of graphic design students regarding the use of digital technologies during the ideation stage of the design process?
iv. How can digital technology be effectively used to improve the design ideation process among students?

1.6 The Scope of the Study

The study is limited to exploring how digital technology can be effectively utilized to enhance design ideation in graphic design in selected Ghanaian universities. The study seeks to gain an in-depth understanding and interpretation of the phenomenon. It does not focus on the graphic design process and in view of this, idea refinement and production fall outside the study scope.

The study is focused only on two (2) selected public universities in Ghana and these are Kwame Nkrumah University of Science and Technology, and Takoradi Technical University. They were selected because they are well established, produce the greatest number of graduates in the country and are recognized. Only graphic design students in the second (2nd), third (3rd) and fourth (4th) years were considered for the study as they may have been more exposed to the use of technology and are likely to adopt digital technology in the ideation process.

The study adopts the case study design under the qualitative methodology and [uses] phenomenology as a tool to interrogate the interactions among students in order to understand the situations. Thematic analysis is used as the major data analysis and presentation approach.

1.7 Rationale of the Study

As earlier discussed in this chapter, design ideation is a crucial phase of the design process (Taegyun 2020) with the aim of generating a large number of ideas. The ideas are reduce to the best, most innovative ones to inspire a better design solution and product (Rikke and Teo 2020). Literature clearly establishes that technology has changed how things are done (ECLAC 2021). Technological influences have also affected design approaches. Technology has been integrated into the design process to achieve improved outcomes as Evans and Aldoy (2016) reported that technology for digital sketching significantly improves the process of developing design concepts. With the current demand for quality from consumers, coupled with digital gratification of today's consumers, it is necessary for designers to acquaint themselves with the technological skills required for effective design ideation.

Given the concern raised by Appiah (2014) about the inadequate use of digital tools in design ideation, it is crucial to explore how digital technologies are used during the design ideation process among Ghanaian graphic design students. This will help us understand how students are being prepared for today's digital world for effective design outputs and customer satisfaction.

Digital technology, according to Min and Hao (2008), reduces the time needed for design projects compared to conventional methods; makes it easier to provide fresh, alternative options; provides more adaptability for changing options and the design process; and uses enhanced data retention and access to support the management of processes. Again, Min and Hao (2008) observed that digital technology guarantees better quality of design outcomes. This means that when students acquire the necessary digital skills

they will [more easily] be able to create designs, and make alterations to designs with ease if need be and this will lead to the creation of multiple ideas in a relatively short time period.

Once students have learnt the skills of digital ideation and it forms part of their design practices, they will be able to make optimal use of digital devices to improve design ideation by generating varied and novel ideas. This will have ripple effects on other people as the students may also impart the skills to others (Desimone and Stuckey 2014). Designers will then develop new and effective ways of design ideation that will positively affect the outcomes that will lead to customer satisfaction.

1.8 Significance of the Research

Graphic design is a dynamic field and the design practitioner must consider many aspects such as interpreting briefs, delivering on deadlines, and maintaining a creative approach in order to be successful within the field (Shaughnessy 2005). The dynamism in graphic design practice is usually the result of the constant change in the tastes and demands of consumers. Undoubtedly, technology has brought and is still bringing about diverse, dramatic and significant changes in graphic design practices that cannot be ignored. This requires that the graphic designer keeps upgrading himself to keep pace with current trends in order to remain in business. It also requires a distinct revolutionization in the skills training approach in design institutions to produce graduates that will be productive in the industry.

i. This research explores the effectiveness of digital technology in graphic design ideation among Ghanaian university students. It exposes the reader to the usefulness and the integral essence of digital technology in today's design ideation in particular, and graphic design in general. Practical information that is self-explanatory is provided for anyone desiring to integrate digital technology into the design ideation process.

ii. The major goal of higher education in Ghana is to provide graduates with the professional, technical, and knowledge-based skills that will increase their employability and relevance to the nation and industry. University and stakeholder communities in Ghana will benefit from the empirical and theoretical contributions provided by this study as they make important decisions for improved skills acquisition in graphic design.

iii. This study will be of great importance to educational policy makers, design educators, design students, and professionals. It will help design students and professionals to make informed decisions regarding design ideation. They will develop new and effective ways of design ideation that will positively affect design outcomes leading to customer satisfaction.

iv. Periodic curriculum review is conducted in order to update the academic contents to suit ever-changing standards. This increases the productivity of graduates after completion of their studies. In the Ghanaian educational system, the curriculum of every tertiary academic programme is reviewed every five (5) years before an institution is granted an accreditation to continue running the academic programme of study. This study offers useful information that will inspire institutions of higher learning to review their design curriculum by inculcating vital contemporary design practices that will help produce high-quality graduates.

v. The limitations and recommendations outlined in the study will serve as a reference for subsequent scholars who might want to look into a related subject.

1.9 Structure of Thesis

This thesis consists of seven chapters. Each chapter focuses on unique areas of the research but are connected.

Chapter One

Chapter one introduces the reader to the concepts of design ideation and is a crucial phase in the design process and digital technologies which according to ECLAC (2021) have grown exponentially in recent times. The chapter expresses the need for digital technology integration into the ideation [process] which is expected to facilitate the generation of creative ideas. The background to the study is discussed next, focusing on a brief description of design ideation; current topics of interest related to digital ideation; why the study is important; and how it adds to existing knowledge by identifying the gaps that the study seeks to address, and ends with a summary. Also covered in this chapter are the problem statement, the study's objectives, the research questions, and the study's scope, significance, and organization.

Chapter Two

This chapter focuses on a review of the literature related to the study. Areas covered in the review include graphic design ideation processes; and technologies related to graphic design ideation and their influence and impact on the overall design output. Various scholarly works on design processes, design ideation and useful technologies in graphic design ideation processes are explored and discussed. Various theories were reviewed. Other areas covered are design metrics, design inspiration and paradigms of thinking in design. The chapter concludes with implications of the review and the way forward. This review establishes a strong background needed to find answers to the research questions.

Chapter three

This chapter discusses the conceptual framework that underpinned the study. First of all, the conceptual framework of –various studies was examined in order to establish a strong foundation of knowledge on which

the chapter is based. The chapter then delves into issues related to design ideation models, and components of ideation which include design briefs and design Inspiration. The chapter also covers digital technology as a tool for idea generation and Shah's theory of ideation effectiveness. Other areas explored are design cognition which outlines some mental activities that occur in the design process, and digital competence which covers the essential digital skills and competencies needed for digital content creation and design problem-solving. Finally, a conceptual framework was developed based on ideation inputs such as the design brief and inspiration; the ideation process which includes design cognition, digital skills and digital technology, and lastly, ideation output which covers Shah *et al's* (2003) theory of ideation effectiveness measurement.

Chapter Four

This chapter discusses in detail the philosophical assumptions (the ontological and epistemological assumptions) that influence the choice of the research methodology adopted for the study. The methodological choice, the research method employed for data collection, population and sampling for the study were also clearly outlined. Phenomenology, as an approach for data collection and interpretation and thematic data analysis is also discussed in this chapter. These philosophical assumptions and methodological choices were used to answer the research questions.

Chapter Five

The chapter discusses the presentation, analysis, and interpretation of the results. The six-step theme analysis developed by Braun and Clarke (2006) was used to analyze qualitative data on the effectiveness of digital ideation combined with a phenomenological data analysis approach. From the phenomenologist's point of view, the researcher explored the 'noema,' 'noesis,' and 'essence' of the data. This can also be referred to as 'the what', 'the how', and 'the why' of the data. The research analysis purposefully was guided by phenomenological reductions to take an impartial look at the digital ideation phenomenon and to report issues as they really are.

The four research questions in this study are presented in three different chapters. Research questions one, two and three are covered in this chapter because they are associated with how graphic design ideas are generated, the tools used to generate the ideas, and students' perceptions of these tools. A conclusion, which draws together the key findings related to how students generate design ideas, concludes the chapter.

Chapter Six

Based on the findings in chapter five, a conceptual model for effective digital ideation was developed to facilitate the ideation process. The constructs of the model are discussed for easy understanding and application. The need for the use of vector-based software for effective design ideation is emphasized.

Chapter Seven

This chapter covers the summary, conclusions and recommendations and was systematically approached. A summary of the findings on each of the research questions is provided , conclusions are drawn on each of the findings and recommendations are made based on the conclusions.

CHAPTER TWO

Review of Related Literature

2.0 Overview

The previous chapter presented a general introduction to this research. This chapter focuses on graphic design ideation processes; technologies related to graphic design ideation and their influence and impact on the overall design output. Various scholarly works on design processes, design ideation and useful technologies in graphic design ideation processes are explored and discussed. Various theories were reviewed. Other areas covered are design metrics, design inspiration and paradigms of thinking in design. This review creates a strong ground necessary to find answers to the four (4) major research questions:

i. How do design students in Ghana generate graphic design ideas?
ii. How do digital technologies affect students' ideation processes and design ideation outputs?
iii. What is the perception of graphic design students regarding the use of digital technologies during the ideation stage of the design process?
iv. How can digital technology be effectively used to improve design ideation process among students?

This research is categorised into two major aspects. The first aspect focuses on how technology can be effectively used to enhance design ideation and the second aspect generates an intervention approach in a form of a model for effective digital ideation.

2.1 Etymological Perspective of Keywords in the Study

According to Ross (1969) etymology is the study of the beginning and development of a word's many forms and meanings across time. To better appreciate and understand what this study is generally about, there is a need to delve into the etymology of some keywords such as design, graphic, and technology.

2.1.1 Design

Linguistically and etymologically, design covers a wide scope that makes it difficult to focus on a generic definition. This notwithstanding, various definitions in literature focus on ‘design’ from different perspectives (Terzidis 2007). The term "sign," which means "to mark out" in its verb form "signare," is where the word ‘design’ first appeared in 14th-century Medieval Latin. The verb ‘de+signare’, which is "to create, to contrive, and to intend," is the source of the term ‘signare’, which means to fashion, create, construct, or execute according to plan” (Terzidis 2007).

In the 1540s the word design meant "to plan or outline, form a scheme". Again, in the area of art in the 1630s, the word, ‘design’ was referred to as ‘a drawing, especially an outline. In 1703, it meant ‘to contrive for a purpose’ (Bilge and Alpay 2003).

From these definitions, it is clear that ‘design’ has to do with mark-making, creating, and constructing according to a plan or intention to do something. The dictionary definition of the word, ‘contrive’ as used in the preceding sentences is to *invent, concoct*, construct, *plan*, devise, drum up, excogitate, fabricate, makeup, manufacture, and *think (up).* With reference to the definition of ‘contrive’, especially according to those words in italics, it is clear that design as a concept is heavily dependent on the process of creating something by way of drawing for a purpose and this process involves some level of thinking and planning. The word ‘choose’ as used in the 1630s definition expresses the plurality and multiplicity of designs from which selections could be made for processing. A choice is always made when there are multiple options. This means that there is need to make multiple samples of design from which one is selected for final production.

Design: is the artist's first design or drawing of a painting, or it can generally mean the idea behind any outstanding work of art, including the shadows and colours as well as the curves and outlines (Bailey 1736).

To Desi´gn: to plan, construct a concept, or sketch a design (Bailey 1736).

It is evident that by the 18th century the terms ‘deseigne’, ‘deseignment’, ‘dessine’, and ‘designe’ were no longer used in English vocabulary as seen in Bailey’s (1736) dictionary. Only the word, ‘design’ is used in modern day English to represent the verb and noun forms. How the term is utilized in context informs the reader about its form as it is today. In its noun form the word means scheme, plan of action, intention and purpose but when used as a verb it means to draw, to plan, or to form an idea.

American Dictionary of English by Webster (1828).
This dictionary was published in 1828 as the first American English dictionary:
Design, vb.

1. To outline a form or figure; to sketch as in paintings and other artistic creations.
2. To organize; to create a sketch or model of anything.
3. To formulate a concept into a plan or initiative.
4. To have a goal or intention; for example, to plan to study law or compose an essay.
5. To use tokens for marking.

(Webster, 1828)

Design, n.

1. A plan, outline, or initial concept shown by lines; a picture of a building.
2. A scheme or strategy. An intelligent individual can be identified by the discernment in his plans.
3. Purpose, objective, aim; suggesting a mental blueprint or strategy. I intend to prepare my child for the bar.
4. The concept or plan that an artist aims to convey, such as medal designs.

(Webster 1828)

The similarity between Bailey's (1736) and Webster's (1828) dictionary [definitions] is that only one word, 'design' was used and the difference is that the word begins to have more meanings. The meaning cuts across different disciplines ranging from art and manufacturing to music in Webster's (1828) dictionary. Even though the word, 'drawing' is not found in Cawdrey's (1604) *Table of Hard Words* dictionary, the word 'mark out' as it is] used is referring to making an artistic expression on a surface with a drawing tool.

According to Friedman (2013), the term "design" was initially utilized in writing in 1588. Merriam-Webster (1993: 343) describes the term as "a specific objective pursued by a person or group; a purposeful plan and intention; a conceptual project or scheme that lays out the means to an aim. The clause, 'scheme that lays out the means to an aim' as used in the definition means the procedure, the process, or the plan through which a goal can be achieved. Closely preceding this clause in the definition is the phrase, 'purposive planning'. This indicates that more emphasis is being placed on planning in design. The words, 'scheme and 'plan' were also found in the *Universal Etymological English Dictionary* by Bailey (1736) and in the *American Dictionary of English* by Webster (1828). It is therefore certain that purposive planning towards desired outcomes is important in design. In graphic design, this plan and scheme are design processes undertaken in preparation for design problem-solving. This requires design idea development which leads to the externalization of design concepts that are mentally conceived.

Even though the definitions of the word 'design' are varied, one thing is clear: it has to do with creating something. Phrases and words such as 'to plan something by creating an outline or depiction of it'; 'contrivance', and 'project' as used in the various definitions suggest that 'design' is about creating one thing or the other. Even if 'design' is considered to be a plan or scheme, there is a need to create the scheme. An idea about the scheme is

conceived in the mind and later expressed visually. In other words, the designer has to exteriorize the internal mental representations in a visual form for effective communication. As established by Laing and Masoodian (2015), there is a general realization that design is a creative endeavour.

2.2 Design as a Creative Process

Kostas (2001) defines design as a mental process that entails developing a concept that will either be implemented or communicated visually. Conceptualization, creativity, and interpretation are key components of design. The author again considers design as an unclear and undefined process that gives rise to anything that has to be done, but whose beginning, middle, or end are frequently unknown.

Kostas (2001) begins by saying design is ‘an idea intended to be expressed in a visible form’ and in another statement he says ‘design (which is an idea) gives the ignition of an idea’. Putting this in its simplest form, the author is saying ‘an idea gives the ignition of an idea. Looking at it from another perspective, ‘design gives the ignition of an idea’ means design is already in existence. If the design is already in existence, what will the ideas and the development of a mental picture (in the first line of the definition) intend to solve? Clearly, the definition has fallen short in terms of clarity.

In two different instances Gunay (2021) defines design as:

1. a language of visuals that is capable of understanding the intended message to be sent or the issue to be resolved via the use of graphic elements.
2. a language of visuals that uses visual elements to solve problems or expresses information to be conveyed (Gunay 2021).

Graphic design thinking in recent times is based on the fundamental components of visual communication which are dots, lines, forms, colours and textures. It can be deduced from the literature that design is creating concepts in the mind and presenting them to others in an understandable way. Design is the act of conceptualizing or creating concepts in the mind

and presenting them to others in an understandable way. It is a methodical process that finds and provides answers to the problems of humanity.

In terms of Kostas' (2001) definition, 'design' remains abstract, intangible, invisible and conceptual and has not been given any physical representation or form to be perceived visually. Design, in his view, remains an idea yet to be given formation. This is in a sharp contrast to the perception of other researchers (Gunay 2021; Ahmed 2009) on design as they establish that design is a visual language that can transmit a message through the usage of visual components.

As stated by Bilge and Alpay (2003), design covers a broad scope that renders it problematic to focus on a general definition. Paul and Yair (2009) share the same view when they stated that there has not been a commonly accepted and confirmed definition of design. They conducted a study and identified seven elements necessary to give the word 'design' a wholistic definition and these are agent, object, environment, goals, primitives, requirements and constraints. They believe that understanding these elements of design will help in determining the important issues and information for the design planning and process.

Design, according to the Paul and Yair (2009)is a description of an object, expressed by an agent, that is meant to achieve objectives in a certain setting, using a set of basic elements and meeting a set of specifications, under certain limitations.

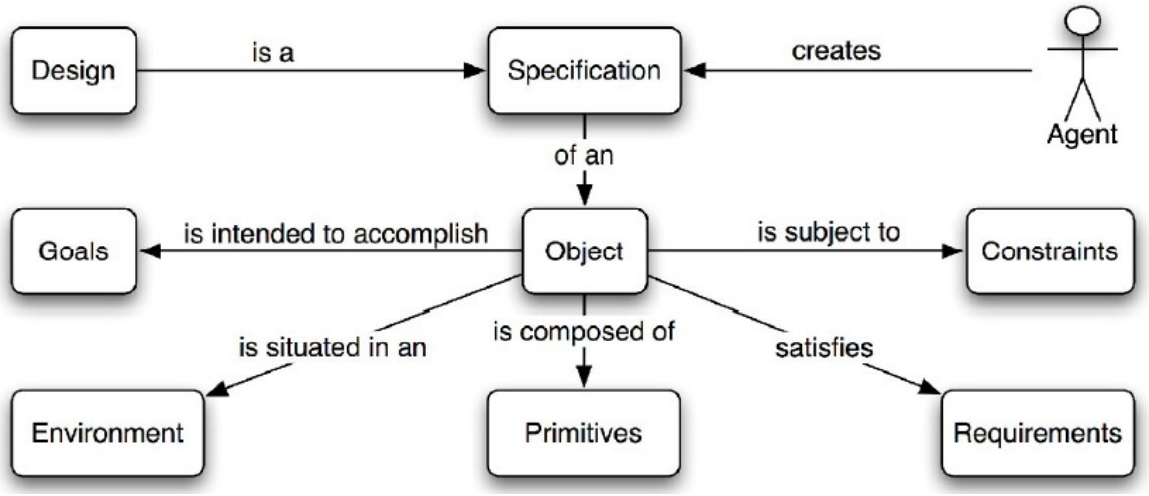

Figure 2.1 Conceptual Model of Design by Paul and Yair (2009)

A specification, according to Paul and Yair (2009), *is an in-depth description of the structural characteristics of a design* which focuses on the elements (primitives) that are put together and their connections. The authors point out that the design specifications are basically about the desired behaviours and structural properties of the design. The particular thing under design is the design object. Keep in mind that this thing does not always need be a tangible thing. A design object can be an actual thing, but it can also be a mental image, a scheme, an abstract representation, or an idea in a designer's mind. It must be established here that the design outcome of a work (object) is not automatically the object itself.

- The ‘design agent’ is the person that defines the structural characteristics of the design product.
- Goals contain the intended effects of the design object on its surroundings.

- The ‘object environment’ is the setting where the object is meant to function.

- The ‘design primitives’ are the set of elements that make up the design object.

- A ‘requirement’ is a behavioral, or functional characteristic that a design item is required to have. A functional characteristic is the attribute the object must have independent of its surroundings.
- A ‘constraint’ is a mechanical or behavioral limitation on the design object. For example, they are associated with cost, size, appearance, lifespan, and other factors. Every problem has a unique constraint.

Paul and Yair (2009) have done well by coming up with a broad definition of design. However, even though their extensive work is commendable, it is important to recognize that the definition is wide and complicated. This is because they intend to provide a general overview of design that encompasses all design disciplines, including engineering, environmental, product, textile, software, fashion, information, interior, and architectural design. The seven constructs used in this definition may not necessarily be applicable to all fields of design; however, every design discipline can make use of a selected number of the constructs they deem right to define design.

Paul and Yair consider design to be the specification of an object (a finished design product) which is created by an agent (designer) to accomplish goals (to solve a problem) in a certain setting (sphere of life), using a set of primitive components (design components) to satisfy requirements, subject to constraints. Design (vb) is the recognition of a problem and the mental artistic work of the creator, expressed through blueprints or drawings that contain ideas and procedures for resolving the issue (Simlinger 2007). The author added that the term ‘design’ also refers to the results of certain design procedures, including systems, services, products, and procedures. In one sense, graphic design is a process (verb); in another, it is a product (noun) of a process (Pettersson 2021:8). In much the same way the term ‘design’ is both a verb (process) and a noun (outcome). A critical look at Simlinger’s definition of design reveals that the word, ‘design’ is being used as a verb (process). The word as a verb describes the process of design or the design process. The author probably includes design problems in the definition to

emphasize the fact that design is a response to a problem. With a little modification, Simlinger's definition can metamorphose into an excellent definition of the design process and that is: the design process is the identification of a problem (design brief) that triggers the creative process of a designer and which involves planning and drawings guided by specifications and constraints to solve the problem. In its noun form, however, 'design' can be considered as an outcome of a creative process triggered by a problem which is composed of design elements (primitives) guided by specifications and constraints to solve a problem in a particular environment, field or context**.** It is interesting to note that the words, 'mark out', 'drawing' and 'plan' have vanished from the contemporary definition of design.

Schon and Wiggins (1992) considered the process of designing to be an interaction of creating and observing, undertaking and uncovering. The authors stressed the significance of visual expression procedures to develop, alter, and express ideas in design practice. They state that a designer uncovers elements and relationships that together provide a more comprehensive knowledge through mental interaction during sketching.

Koskinen and Thomson's (2012) report posits that 'design' is a human-centered, creative process that defines and provides appealing, useable goods and services. Professionals and academics agree that design plays a crucial role in fostering creativity and transformation (Forrester 2018; Liedtka 2015 and Sarrazin, Kouyoumjian, and Dore 2018). These two statements indicate that design is not created just for design's sake but to solve a particular problem in the life of human beings. It means the design must serve the needs of people or fulfil the purpose for which it is created. A design will be desirable and usable only if the outcome satisfies the intended purpose. This means 'design' must bring a positive change of improvement and must be innovative. It is therefore important for a designer to be people-centred or, in other words, solution-focused in order to achieve design purpose.

2.3 The Concept of Graphic Design

The term "graphic design" was used in 1922 by the well-known book designer William Addison to differentiate between several printing-related design forms, such as calligraphy, book design, illustration, typography, and lettering (Aynsley 2001). According to Aynsley, graphic design is the organization of words, symbols, or pictures for public communication and it is part of the design discipline. The author notes that the automation of the printing process, which led to advertisements reaching broad audiences, is a key historic achievement. As a result, there was an increase in the number of highly qualified individuals handling the illustrations for various print media, supporting the communication need of business. Communication design, or graphic design, is the art and practice of organizing and presenting concepts using written as well as visual elements. (Kanupriya 2019).

According to Pettersson (2021), graphic design is the skill of giving various types of words and graphics a structured, aesthetically pleasing, and practical organization. The author posits that the primary goal of graphic design is to give various types of information a logical, aesthetically pleasing, and well-structured framework. Graphic design is the act of illustrating and producing concepts using the skill of combining written content with visual content in brochures, books, magazines, or any other types of ads (Ang 2014).

Apart from Aynsley (2001), who mentions that ‘signs, symbols, words and images’ as four core elements are used for graphic design, the rest of the authors restricted the elements to texts (words) and images only. It is important to maintain ‘signs’ in the definition because signs and symbols are still used in graphic design. Again, the early definition of design in the 14th Century originated from the word ‘*sign*’ which, in its verb form is ‘*signare*’ meaning ‘*to mark out*’. Graphic design is therefore a visual communication in which signs, symbols, words and images are creatively organized to

communicate (inform, direct, warn, persuade, identify, instruct, or advise) with an audience.

The graphic design process, in effect, can be considered as a tripartite activity that begins with idea formation which is completely in the abstract form, hidden in the mind, projecting the abstract ideas into vision for communication with the outside world and finally, the concretization and construction of the communicated ideas into a tangible and visually perceived finished product as a solution. This study focuses on the second aspect of the tripartite activity, which is the projection of abstract ideas into vision for communication with the outside world.

According to Pettersson (2021), graphic design works include cards, parcels, exhibits, publications, books, bulletins, advertisements, posters, and others. The author stated that graphic design is a general phrase that refers to a wide variety of displayed and published visuals. The three purposes are persuasion, identification, and information. In his study, Pettersson also focused on effective ways of communication in graphic design. Kahn, Tan and Beaton (1990), as cited by Pettersson, observed that readers find it simpler to break down material if words and images are arranged into coherent logical groups. This means that poor organization of design components makes it difficult for readers (the audience) to understand, interpret and retain the message being put across by the designer. Sadoski and Paivio (2001) maintain that consumers are successfully engaged when text and images are carefully integrated rather than when they are used separately.

2.3.1 The Role of Graphic Design

The primary purpose graphic design, according to Gunay (2021), is to utilize imagery to present products or messages to people. The use of graphic design in advertising communication is growing due to the increasing demand on advertising specialists to persuade consumers to purchase

goods or services (Bostic, 2014). Excellent graphics and fonts usually elicit a [more] favourable response from viewers.

The entire visual appearance influences consumers' views about accuracy and generates consumer satisfaction. The general visual appearance of a work influences a user's opinion of dependability and fulfilment (Ozok and Salvendy, 2000). This suggests that graphic design should be creatively crafted to inspire the audience to patronize, or appreciate it. This can be achieved with the right choice and integration of the various elements (signs symbols, images and words). As indicated by Kahn, Tan and Beaton, (1990), when words and images are arranged and combined into coherent thematic groups, readers find it simpler to grasp the message.

In much the same vein, Sadoski and Paivio (2001) state that the consumers' attention is caught much more easily when both images and words are carefully combined in a piece of work than when images or words are used separately. Research on the effects of graphic design on marketing has shown that it improves consumer retention and ensures that promotional communications are consistent across all platforms.

Ideas, concepts, words, and pictures are presented in a visually appealing way by graphic designers by means of electronic, print, or other media. Graphic design gives the information a framework and sequence to make communication easier and more efficient whilst increasing the chance that the intended recipients will be able to comprehend the message (Pettersson 2021).

According to McGlashan (2017), visual communication approaches are the fundamental techniques of creative design activity. This may come in the form of freehand sketches and adapted to capture, manipulate and communicate ideas. McGlashan maintains that visual communication techniques could be applied from the beginning of a design work all the way through to successful completion. Students who use these approaches also

tend to strengthen their graphic literacy abilities since they quickly learn the ability to sketch and articulate concepts.

2.4 Design Process

Design, as a word, is used in two senses. It can be used as a verb to refer to the process of creating artifacts or bringing such entities or pictures into existence, or it can be used as a noun to refer to an object, entity, or picture that has importance with regard to appeal (aesthetics), function or objective (teleology), or meaning (semiotics) (NCERT 2011). In other words, the noun (in the form of the artifact, or a product) is created by the verb ‘design’ which is an activity. Graphic design is a method of creativity (Ambrose and Harris 2009).

This procedure, which has multiple stages and related tasks, is sometimes called the design process. Every design process requires the designer to progressively make a series of choices. A crucial component of every design procedure is design judgements. What separates a great designer from a poor designer is the capacity for sound design judgement (Nelson and Stolterman 2003).

The design process is made up of multiple stages. It has the non-creative aspects and the creative aspects. The non-creative aspects are observation, investigation, administration, technical expertise, and persuasiveness. The creative aspects on the other hand, involve idea generation, prototypes and final production. According to Ambrose and Harris (2009), the graphic design process covers all the steps required to create a piece of printed or digital work. That is, design process starts from receiving a customer’s brief to generating concepts and communicating with production team members including printers and programmers. This section of the study, therefore, examines some design processes that apply to graphic design.

Design processes cover both mental and practical activities and the intention of an overall process is to help in the development of an idea into a final

product (Pettersson 2014). The creative process, as stated in Communications Toolkit (2000), involves five stages or processes and these are outlined as follows: Gathering Information, Brainstorming Ideas, Fine-Tuning Ideas (Getting Feedback and Planning Production), Producing the Final Piece, and Evaluating Results.

Stage 1: Gathering information

Before the design is developed, it is important to gather as much information as possible about the brief and this includes finding answers to questions like: What is the message? What action do you want the audience to take? Who is the audience? Again, the designer must answer such questions as: Which of the several forms (brochures, pamphlets, presentations, and adverts) would work best for your goal? In what context will your design be displayed? What will be vying for attention with it? Other questions that must be answered include: Which of the production or replication methods will work best for your needs? How long will your design component last? What is your budget and timeframe?

Stage 2: Brainstorming ideas

The brain is capable of solving a creative challenge even when a designer is not focusing on it. It is required of the designer to be ready at any time since sometimes, even when working on tasks unrelated to the project, brilliant ideas could come up. One helpful method for coming up with ideas quickly is brainstorming. Remember that all the ideas are good at this point.

The designer may take inspiration from magazines, books and other sources such as images and photographs that might correspond with the message. The designer is encouraged to make lots of thumbnail sketches, and write a number of briefs, action-packed headings or phrases. Consider the emotion or atmosphere you want to portray and use colours and styles that work well to represent it.

Stage 3: Idea refinement, feedback, and production

At this stage the designer makes a more complete version of the concept. This might be a miniature or actual size illustration that attempts to replicate the final product as closely as is feasible. It may be intended to communicate with clients about time and cost estimates for offset printing or other forms of replication, give input, and act as a guide for creating the final design.

Stage 4: Production of work

When the design is accepted and it is within budget, production can be carried out. Production techniques differ based on the nature of the work and the intended consumers. The production can be shown on a computer or television screen, printed by a photocopier, offset printing press, or silkscreen printer, or painted on a wall, car, or other item. It might be created as an exhibition.

Stage 5: Evaluating results

At this stage, the designer has evaluated the work based on the responses of the target audience. In other words, did the audience get the message and respond the way the designer expected?

There are varied design processes but this study seeks to limit discussion to only two different processes hence the need to consider a seven-stage design process developed by NCERT (2011) which includes 1. Design brief 2. Creative process 3. Planning and execution 4. Prototype or Dummy 5. Implementation 6. Review and 7. Assessment.

i. Design brief

The design project description is usually given to the designer by the client. Occasionally, though, the customer requests that he works with the designer in drafting the brief. The project brief provides a comprehensive overview of the project's concept, intended consumer, available resources, project length, and funding. (NCERT

2011:17). The designer at this stage formulates the initial design problem and conducts research about similar projects for more information and consider all existing solutions. This is done through the internet or library. The designer then analyzes the strengths and weaknesses of the existing design to strategically develop and come out with a better design solution.

The designer conducts an initial survey of the users, or the target audience to acquaint himself with their requirements as this helps the designer to realistically understand the project. Next, the designer considers the original brief and, if needed, makes the appropriate adjustments. The modifications are incorporated by way of changing the topic and outlining the project's scope with a more accurate estimate of resources, time, expenses, and budgets. Other aspects that may be factored into the brief are branding and identity standards provided by the client.

ii. Design ideation

The designer begins the creative process with a search for ideas. The designer makes a conscious effort to gain design ideas from things around him or her. This may be something related to the environment, social issues, cultural events, seasonal variations in the natural world, events in politics, or anything else from daily life. A designer has to critically reflect upon any interesting thing he comes across during the search to identify anything new, distinct, significant, or distinctive. A record is then kept of this in the form of recording such thoughts, whether by drawing, taking pictures, recording, or just storing them in the mind.. Some designers take ideas from their previous work or the works of other designers. It is important for the designer to brainstorm ideas. This can be conducted through a brain-storming session among a group of individuals from a variety of backgrounds. Designers are advised not to be too critical in evaluating idea ideas generated as this

may limit the flow of ideas. It is worth mentioning at this point that the creative process always requires that:

a. several different ideas are generated,

b. ideas are evaluated based on some criteria, and

c. final idea/s are selected for implementation.

The designer is required to generate several ideas (NCERT 2011) so the design investigation should be as open-ended and varied as feasible. For a designer to generate original, novel and unique ideas a particular way of thinking is required. Generation of creative ideas requires some cognitive processes considered as associative thinking.

This way of thinking facilitates the designer's ability to make connections between concepts haphazardly but with a clear goal in mind. It is therefore necessary for a designer to prepare himself mentally for this process as he has to follow some well-defined patterns of thinking. During this stage of idea generation, the designer has to document design ideas and this is usually done by means of thumbnail sketches. They are quick sketches allowing rapid idea iteration.

After a good many ideas have been generated, they should be critically analyzed and evaluated to eliminate unnecessary and unrelated ideas. The designer at this stage applies different standards for the rejection, or selection of ideas. These might include things such as "attractiveness, functionality, ease of use, communication, publishing issues, ethical concerns, and other matters related to the project" (NCERT 2011:25). Selected ideas may be modified to improve them further. The process goes on until the designer and the clients are satisfied. The design process is typically recursive and iterative in nature (NCERT 2011).

iii. Planning and execution

At this stage, the concept is generated in the form of the general visual theme, and the language of visuals, and the approach are defined. Practically, a minimum of five concepts are created from which the customer chooses the best. The designer works further on the selected final idea by creating everything required to carry out the design, such as words, graphics, and animations depending on the task being undertaken.

The visual composition is very critical and has to be planned and executed in a well-balanced manner. All the word and graphic components must be appropriately ordered for the entire layout to have the best result. Design principles like balance, proportion, contrast, and rhythm must all be taken into consideration when planning to execute a design work. This aids in achieving the intended results. The creative phase of the design process is the most fascinating and cannot be compromised (NCERT 2011:29).

iv. Prototype or Dummy

A dummy is a sample product and it is usually expected to be of the same size as the final product. At least three dummies should be prepared to look exactly like the finished product and presented to the client for final approval. A client may select one with or without recommendations depending on his needs.

When recommendations are made by a client, the designer must ensure that all the recommended details are incorporated and approved again by the client. When creating a product of this kind, it is important to consider usability issues. At any time in this process, extra design iterations, evaluations, approval rounds, and user testing can be carried out. The design has to go through testing. It is done by the designer and colleagues and later tested by some expected users of the product. This is done to check the functionality of the product and if necessary,

make corrections. When the design meets the specifications in a satisfactory manner the product is released.

v. Implementation

The designer, at this stage, presents the artwork either in a digital or file form and provides a printed copy called a ‘proof’ to the client for approval by signing it or pointing out any changes to be considered. Another proof is provided if a change is affected. Depending on the kind of design, it is sent to a commercial printer for printing in case of traditional media, or if there is newer media, it is and sent online to a multimedia developer. A printed copy from the commercial printer is sent to the customer for approval. After any recommendations are addressed, the work is published.

vi. Report

Some designers prepare a report for future use while others create a document with design specifications. This contains the entire design process together with details of the design requirements, technical standards that were adhered to, crucial codes, and the hardware and software that was utilized.

vii. Review Assessment

Finally, a review is conducted either by a third party or the designer to assess the impact of the product on the users or the target audience.

These two design processes try to give a fair idea of what design creation and production entail from start to finish. While they vary in terms of the number of stages, and the content details of the stages, both process some initial preparations related to the design to be created, the actual design creation and the design production. The design process, as outlined in Communications Toolkit (2000), starts with Gathering Information while NCERT’s (2011) design process starts with the Design Brief. Even though the Communications Toolkit provided very good details of necessary

preparations to make such as research about the audience, the most suitable design format to use, the expected life span of the design piece, timeline and budget, it fails to address what triggers all of this research, which is the design problem. As stated by Taegyun (2020), the design process is a response to a design brief which is positioned at the beginning phase of the design procedure (Camburn *et al.* 2017) and outlines the objectives and intended outcomes of a design project (Kang *et al.* 2019). This shows how important the design brief is and if it is not adhered to it renders the design process is incomplete.

A designer decides on the creative process he will use at each given time depending on the kind of project to be executed. While one designer may want to brainstorm for creative insight, another designer may decide to adopt NCERT's creative process (second stage). In this case, the designer must make a conscious effort to gain design ideas from things around him or reflect on any interesting thing he deems appropriate that could help in creating a novel idea.

It is observed from NCERT's (2011) design process that throughout all the phases of the design procedure, the designer is in constant interaction with the client, basically concerned with quality issues. It has been noticed that even at the implementation stage, the designer still has to take a printed copy from the commercial printer to the client for approval. No stage of the design process bypasses the client. It therefore stands to reason that the client's satisfaction is paramount and he should be given all the required attention by every designer.

Creativity is a natural gift but at the same time, it can be nurtured. NCERT (2011) posits that intuition and inspiration certainly aid and enhance creativity but generally, a designer can follow a process and reach a creative output. In connection with this, Breivik (2016) argues that expertise is developed through training and experience. It is something that can be taught and learned (Ericsson *et al.* 2007). NCERT is of the view that any designer who

keenly follows the design process is likely to achieve outstanding results. The author also added that some of the stages can be reviewed to suit individual designers or be overlooked depending on the work environment. Although some people are indeed naturally fluent in generating creative ideas, it is also true that making a conscious effort to understand the procedures of creative thinking and following them meticulously can lead to creative outputs.

2.5 Creative Process as the Study Focus

From these seven stages of design process outlined by NCERT (2011) this study is focused only on the second stage which is the 'Creative Process'. Also known as the ideation process, it is the stage at which ideas are generated, evaluated based on some criteria, and a final idea is selected for implementation. It is the phase of the design process that is most creative. Design ideation is an essential first stage in the design process which investigates and creates concepts to find a solution in response to a brief. It is an essential component of design thinking (Kim 2020). After rewriting or framing the design brief and having an understanding of what the brief is all about and what is expected by the client, the designer has to generate design ideas. Ideation is the process of coming up with novel, workable solutions to problems. (Bourgeois-Bougrine *et al*. 2017). According to Casakin, Koronis and Silva (2019), the primary goal of the ideation phase is to investigate as many concepts as possible from novel and diverse angles. It is "the process of generating new and sometimes creative ideas" (Kerne *et al.* (2007:118). The effectiveness of the design ideation phase greatly influences the entire effectiveness of the design process and its results (Orthel and Day 2016).

Ideation is an early stage of design when concepts for solutions are developed. This step is crucial because, rather than concentrating on the minutiae, a good final solution is probably going to come from examining a range of solution concepts. (Pahl *et al.* 2007). It provides for more creative

freedom because it is easier to make modifications that are less costly than at the later stages where the cost implications are higher (French, 1988).

This stage is also referred to as the concept generation, idea development or ideation stage. The best time for team cooperation is during ideation. At this point, criticisms are avoided to encourage a dialogue that flows and can guarantee the creation of concepts and remedies for a specified issue (Mazur 2018). Design ideation is a free-form process where it's critical to be able to see beyond the visible. It may entail formulating and refining thoughts and pictures that are discovered outside of the real design industry. (Goldschmidt, 2003). Being open-ended allows the designers to be expressive. That is, the designer is allowed to artistically express himself freely without being restricted. This allows the designer to come up with many ideas from which the most creative ones are selected. Designers usually combine concepts from many sources to create a good design. In this study, design ideation is referred to as the creative design stage at which ideas are generated, and evaluated based on some criteria, and a final idea is selected for implementation.

It must be established at this point that the ideation process is different from the design process in the sense that ideation leads to the generation of creative ideas while the design process leads to the production of a generated idea. In effect, ideation is a subset of the design process. Piya *et al.* (2017) observed that the ideation process is a set of steps used to direct designers' thoughts to facilitate a methodical and efficient conception to obtain creative results that meet specific requirements. Stevenson (2020) states that ideation, in a general perspective, may be considered as the process of forming thoughts or ideas. However, with specific reference to graphic design it may be regarded as the imaginative process of creating, refining, and passing on new concepts. According to Stevenson (2020), ideation is the first skill that a designer uses when he has a brief from a client or wants to start a new project. Stevenson identified four stages, necessary for effective idea generation and these are:

i. Research — It provides a clear knowledge of a brief, aids in choice-making, and influences design direction. At this point, there are three different kinds of study: research to comprehend (the brief), research on a concept, and research on visual language, that can shed light on a project's aesthetics and overall appearance.
ii. Idea generation — This entails creating design concepts. At this stage, the designer must be open to everything and make connections, and create design concepts.
iii. Evaluation — At this point, the designer has to filter through the ideas generated to see what works and what does not by analyzing their viability and editing them if need be.
iv. Apply — At this stage, the designer needs to be well aware of the final product's aesthetic.

Stevenson’s four stages of the ideation process begin with research which necessitates that the designer conducts some investigation to understand the brief and other important background information needed to design a solution to a brief. This means that when a brief is up for consideration, the designer must comprehend the issue, locate pertinent data, choose the requirements, identify the expected results, create the issue in his head, and come up with a plan of action to put the outcome into practice until a solution is obtained.

Laing and Masoodian (2015) conducted a qualitative study on the function of graphics in conveying information. Fifteen experts from ten firms, all situated in the North Island of New Zealand, participated in fourteen interviews. Eight men and seven women, with a median work experience of 12 years, constituted the participants. Their job experience varied from three to 25 years. The firms varied in size from being sole proprietorships to having teams of five or more designers and other employees. Of the two freelance workers among the participants, both had previous work experience with

larger companies. The authors reported that the participants adopted different models of the design method with varying degrees of formality and intricacy. While a number of participants relied on a model that they had internalized and could express clearly during the interview, others embraced clear models of the design process that were diagrammatically illustrated.

Designers' sources of inspiration include computer screenshots, electronic photographs, illustrations, [text] fonts, and connections to webpages; printed works, including books, periodicals, and photos; and other tangible items, such as toys, packages, paper samples, and sketches and drawings. Other sources are sketchbooks, mood boards, colour specimens, previous designs by the artist, prior designs by associates, sample materials, and artifacts. In this study, Laing and Masoodian (2015) identified and classified the role of visual information into themes:

a. personal development (assembling visual resources to support their work in general),
b. cognitive aid (collecting visual material specifically to execute certain jobs within the immediate workspace),
c. concept communication (with the use of visual elements to communicate with co-workers, clients, and any subcontractors during the design phase),
d. aesthetics of the client (looking for clients' design tastes by taking clues from visual materials they use),
e. aesthetics of the audience (visual information that appeals to the sensitivity of the target audience), and
f. aesthetics of the market (investigating the visual materials and aesthetics of client's competitors in the market).

It is evident from this literature that there are many sources of design inspiration for designers to explore. The more inspirational sources a designer explores, the more likely it is that he will generate creative ideas.

Graphic design students take advantage of these inspirational sources to maximize their creative potential.

Stevenson's (2020) four stages of the idea generation process have some links with Laing and Masoodian's (2015) classification of visual information into themes. Designers usually investigate and acquire knowledge about the aesthetics of the client (theme 4), and the aesthetics of the audience (theme 5). Next, they gain understanding about the aesthetics of the market (theme 6) before moving on to the commencement actual design creation (ideation) with the sole purpose of incorporating vital details into the design. Knowledge of these visual information themes is gathered from Stevenson‘s (2020) first stage of design ideation, which is the research stage. ;It is therefore very important for design students to factor aesthetics of the client (theme 4), aesthetics of the audience (theme 5) and aesthetics of the market (theme 6) into their research in order to have a complete understanding of the brief before moving to the ideation stage. It has been observed that Personal Development (theme 1), Cognitive Aid (theme 2) and Communication of an Idea (theme 3) are post-research activities. These activities that focus on the actual design creation fall under Stevenson‘s (2020) second stage of Idea Generation. This means Stevenson (2020) and Laing and Masoodian (2015) are basically projecting the same idea but in different ways and this also establishes the fact that visual information is very important during idea development. Design ideation will be effective if the visual information about all three categories (client, audience and market) is gathered and skillfully integrated into the design.

In their study on Professional Designers' Ideation Approaches, Tarja-Kaarina and Pirita (2014) carried out in-depth interviews with nine (9) experienced designers in the textile, fashion, and interior design industries to learn more about how they generate ideas, where they get motivation, and how their prior experience influences their process. The researchers analyzed designers' interview data by identifying two broad groupings: supportive

practices and triggers that help frame the design space during the ideation stage. Tarja-Kaarina and Pirita (2014) consider ‘supporting practices’ as methods that assist the designers in searching, examining, generating, and transforming the idea space. ‘Triggers’, on the other hand, provide direction, guidance, and an overview of the ideation procedure and objective(s).

The first classification, ’supporting practices’, outlines the tasks to be executed by designers in the process of generating ideas. The following five codes are included in this category: (1) material experimentation and sketching; (2) gathering; (3) verbalizing (noting, mind mapping, evaluation of user); (4) narrowing down; and (5) cooperating. The second classification referred to as ‘triggers’, consists of four sections that serve as catalysts for the ideation process: (1) inspirational sources; (2) outside limitations; (3) main generators; and (4) cognitive images. Following on that, the function of triggers and supporting practices was further divided into four design strategies: (1) cognitive; (2) materials; (3) word; and (4) visual.

The understanding gained from this literature is that *triggers* inform the designers about design expectations or expected solutions and the *supporting practices* are the methods or approaches that the designers adopt in order to meet the expectations.

The study also discovered that designers obtain motivation from a variety of multimodal sources, including similar designs within their own field, artifacts from other fields, materials, photographs, and artwork, as well as objects and natural events from daily life. Various materials play significant roles in the creative process of the designer. When visual materials do not form part of a project, they improve the working atmosphere.

This information has drawn the researcher’s attention to the need to examine how effectively students utilize digital devices in search of multimodal sources of inspiration for creative ideas.

2.6 Skills, Ability and Expertise in Creative Design

2.6.1 Creativity as a Key Word in Design

The word ‘creativity’ is understood differently and controversially in cognitive and intelligence science (Leahey 1997; Matlin 1998; Wang *et al.* 2009). Bruner (1962) considers creativity as an activity that demonstrates a distinctive and successful surprise. Design creativity refers to an agent's capacity to provide results that are both innovative and practical in order to tackle a design problem (Sarkar and Chakrabarti 2011).

Creativity, according to Thangarajathi (2020), is the ability to generate novel and useful ideas and the successful implementation of those ideas. The author added that innovation, originality, and resourcefulness are essential for achievement in the changing world of business. Creativity refers to the uniqueness and suitability of a designer’s creative works and the ability to produce original and successful ideas (Runco and Jaeger 2012; Sternberg and Lubart 1996). A creative idea is broadly considered as an idea that is unique and useful (Mumford 2003) and which is likely to contribute great value to the design process (Fuge, Stroud and Agogino 2013). Creative idea filtering can have a negative impact on the effectiveness of the design process.

These definitions suggest that creativity focuses principally on the ability to generate unusual but useful ideas. This means the idea should be something that had never been seen before in its aesthetic appearance, form or functional details and should also adequately serve the purpose for which it was created. Distinction and functionality are two principal factors that must be considered when a designer wants to be creative ~~[Reference].~~ The definition given by Thangarajathi (2020) is a little different from the other authors in the sense that he considers the successful implementation of ideas as a necessary part of creativity. This indicates that the ideation stage is not the end of creativity in the design process. Creativity is [only] fully achieved when the design ideas transition into functional solutions that are

appreciated by users. It is therefore necessary for every designer to have the production mentality as he engages in ideation to factor details and qualities into the ideas that will result in a successful creative endeavour.

Piaget (1960) delineates creativity as a process of solving a problem by identifying a problem, exploring it and experimenting with the results for thoughtful decision-making. In this definition, the process that leads to the creative outcome is considered important and forms part of the definition. This suggests that some creative processes or approaches can lead to creative outputs. A designer should therefore make a conscious effort to adopt problem-solving processes that will yield creative results. What then are the creative, or the problem-solving approaches? In an attempt to answer this question, Wang (2009) states that creativity can be seen as a form of art that produces *unexpected outcomes* by *unexpected* means. This helps obtain a novel solution to a problem that may be seen as a unique solution.

Unexpected paths, as used by Wang (2009), are explorative approaches in design idea generation where the designer has no specific pattern to guide the process. This approach often leads to *unexpected results* or ideas that are novel. *Unexpected paths* suggest that the designer adopts the concept of a divergent thinking approach. *Purposeful pursuits*, on the other hand, provide the designer with a pattern that guides the ideation process. The designer is limited to operating within a specific path toward the achievement of a specific design objective. This approach is guided by convergent thinking.

Haven researched students' design practices, Hill (1998) discovered that learning was improved and creativity was stimulated when students were given the freedom to solve technical issues by approaching design as an investigation. A design process always requires exploration and is usually considered a dynamic and creative process. Confidence is crucial for a risk-taking design process and this is fostered through exploration as the creative process entails stages of order and disorder.

Studies indicate that creative ideation generally involves a creative process that results in ideas that are original and divergent in nature (Rojas and Tyler 2018; Runco *et al*. 2013). It is worth noting that the idea of Hill (1998) and Wang (2009) shares the same principles with these researchers in the sense that they all consider it as a problem-solving task that requires exploration for the best possible solution.

It is essential to know that creativity is an important skill that helps an individual to develop imaginative expressions that lead to originality and outstanding outcomes. It is not a quality seen in special individuals. This means creativity is not a unique skill for exceptional individuals but a result of a particular education and learning (Craft, 2011). In this regard, Anastasiades (2017) states that the essential conditions for developing creativity in the learning environment are learners' active participation in knowledge construction and different ways of expression. Creativity can therefore be acquired through training.

2.6.2 Skills

Dreyfus and Dreyfus (1986) contend that skill has to be described in terms of the way the 'mental machinery of the individual' works. That is to say, skill rises to its highest level only when a skill is implemented in a semi-automatic way without conscious deliberation or mental representation. Dreyfus and Dreyfus (1986) are proposing things to be considered when defining skill. By using the word, 'mental machinery of the individual', the authors are trying to compare the output of a skilful person with that of a machine. The phrase, 'without conscious deliberation or mental representation' suggests that the agent does not need to pause for a while, thinking of what to do next. It thus stands to reason that they expect a skilful person to execute a given task as quickly, perfectly and consistently as a machine. In brief, an optimum level of performance is expected of an individual for him to be considered as a skilful person working with minimal or no assistance and executing a task without thinking about how to go about it.

Very much related to the definition of Dreyfus and Dreyfus (1986), Knapp (1963) considers ‘skills’ to be the ability acquired to bring about expected results with a high level of assurance and with the minimum outlay of time or energy or both. Here, Knapp considers skill as an acquired ability which is demonstrated by undertaking a given task within a short space of time and with assurance of obtaining the expected result.

Breivik (2016) compares skills and expertise when he states that skill is used to represent expertise that is developed through experience and training, and this includes skills acquired by means of apprenticeship such as crafts and trade, as well as those seen in domains such as arts, professional practices, athletics and games. The author observes that skill is acquired through training and experience and gives some examples of areas in which skill can be acquired but does not touch on the competences to look out for in a skilled individual.

Considering the contributions of these authors, skill can therefore be considered as an acquired ability that emerges through training and experience and which is meant to build [up] an individual to undertake a task within a short space of time in a smooth and consistent manner and with assurance of obtaining an expected (perfect) result. This means there must be a smooth and consistent flow of activities from start to finish, with the person knowing what to do at each given point in time without wasting time when executing a task. Accordingly, a skillful person can be considered as one who has total control over a given domain task and is capable of executing his work perfectly without assistance or delay.

2.6.3 Ability

According to Casakin and Levy (2020), ‘design expertise’ has to do with the ability to exercise some level of competency. Design ability is characterized by particular ways of mind processing and behaviour that designers exhibit when solving design problems. Cross (1995) indicates that everyone

possesses a certain level of design skills, which is a type of mental capacity that humans have. Studies on design in a paper, '*The Nature and Nurture of Design Ability',* Cross (1995) identifies four fundamental components of design abilities a designer must possess. These are the ability to:

a. Rectify unclear issues,
b. Use tactics that concentrate on finding solutions
c. Make use of appositional (coherence), solution-oriented, and abductive reasoning, and
d. Employ modelling and an illustrative, or visual approach

These abilities are usually exhibited during the design process in the manner in which the designers approach problem-solving. According to Cross's (1995) research, design ability is a cognitive capacity that represents the way designers reason and behave while addressing problems. For instance, while the use of tactics that concentrate on finding solutions compels the designer to purposely expand the solution space to have varied idea alternatives, abductive reasoning helps the designer select the most suitable and helpful design solution.

These abilities are very instrumental to successful design ideation. Design students' adoption of these abilities during the ideation process will increase effectiveness which will result in outstanding design solution outcomes. The reviewed literature is helpful as it has directed the researcher's focus to explore, to some extent, the design abilities the participants of this study possess and exhibit during the process of ideation.

2.6.3.1 Synthetic, Analytic and Practical Abilities in Creativity

Creative activities demand the application and balance of three abilities that can all be developed and these are integration, intellectual and application abilities (Sternberg and Williams, 1996).

a. *Integration ability* is what we consider to be creative in general. It is the capacity to come up with original and captivating concepts by combining components or elements from different sources to form a connected whole. It is the ability to organize ideas from heterogeneous sources in a harmonious way to form a novel design.

b. *Intellectual ability* is often regarded as a critical thinking skill. To successfully connect elements of design from different sources and have them assembled in an organized manner, one must adopt an analytical approach. This ability helps the designer to subject the various elements of designs gathered from different sources to detailed examination to enable him to fit them together in an organized manner. The analytical talent is employed by the creative person to weigh the pros and cons of an original concept and examine it.

c. *Application ability* focuses on know-how or the use of ideas and skills to execute a task. It is the capacity to convert concepts from theory to real-world applications and achievements. It is the practical ability that gets the work done. It can externalize that which is abstract in the mind for others to interact with. It requires that the designer acquaints him or herself with the procedure or approach to have a work executed. Practical ability is gained through active engagement in doing things. It is the hands-on experience that brings solutions. Practical ability is opposite to theory which equips the individual with an understanding of fundamental concepts and the know-how about how something works. Practical ability guarantees the performance of work rather than just knowing about how it is done. This is to say that knowledge about a task is different from performing the task.

Anyone who has only integration ability may be able to put elements from different sources together to form an idea but may not be able to subject the work to critical analysis. In much the same way, an individual with intellectual

ability can criticize a work of art and bring constructive suggestions on how to improve it but will not be able to solve the problem at hand. Creativity requires that these three interwoven abilities (integration, intellectual, and application abilities) are jointly put to use to solve a problem. The achievement of design ideation is greatly dependent on the inventiveness and imagination of designers **(**Kim 2020**).**

2.7 Technology as a Tool, Skill and Solution

The word ‘technology’ had never been given a standard definition because of the meanings associated with it (La Shun 2017). Research has indicated that defining the term ‘technology’ has been a challenging task. (Reddy and Zhoa 1990; and Brey 2009). Technology is abstract by its very nature, making it challenging to understand, perceive and assess (Blomstrom and Kokko 1998). Jon (2020) points out that the word ‘technology’ comes from the Greek word ‘techne’, which was originally used to refer to woodworking abilities but later expanded to include specialized knowledge, "know how," and the ability to create things that would not have existed. The word, ‘techne’ is therefore concerned with artificial things. Burgelman *et al.* (1996) considers technology to be the mechanism for developing and providing products and services as well as the theoretical and practical knowledge, abilities and equipment that may be used in their production. The definition of technology encompasses not only the technology integrated into the product but also the knowledge or information on its utilization, implementation, and creation process (Lovell 1998; Bozeman 2000). Lovell (1998) states that technologies can be grouped into two categories: "process technologies," which are related to the method by which problems are resolved, and "product technologies," which are related to the technical and physical components of equipment.

Technology is usually associated with achieving specific outcomes, solving specific problems, doing specific activities with certain abilities, applying knowledge, and making use of resources (Lan and Young 1996). Haven (date) scrutinized several definitions of technology and Wahab *et al.* (2012)

identified two basic components of technology and these are knowledge or technique, and doing things. In support of Wahab *et al*., Levin (1996) posits that technology is not a 'thing' but rather an 'approach'. It is a problem-solving approach made possible by the application of scientific principles. From another perspective, technology is said to have three aspects:

1. material artifacts (things),
2. the use of artifacts to pursue a goal (skills), and
3. the achievement of a goal (result or output).

Technology is the term for the theoretical and practical know-how, abilities, and tools utilized to create goods and services in addition to the infrastructure needed for their creation and delivery (Burgelman *et al.* 1996).

La Shun (2017) states that technology is not what it is thought to be, bearing in mind the origin of the word "technology". The author referred to Volti (2009) who points out that the word "techne" is widely accepted to mean "skill" and "art." The two words interpreting the Greek word "techne" are logically connected and emphasize the fact that skill and art are required for anything to be created. From a secular standpoint, La Shun defines technology as anything created, made, or found with a specific purpose, or something with innate intelligence sufficient to either operate or be utilized to function. According to this concept, technology is made for specific purposes. Technology must be functional for its consumers to really appreciate it.

Technology develops when there is a problem because, in situations of conflict and struggle, people are forced to use their creativity and ingenuity to find solutions. According to Thangarajathi (2020), technology is the process by means of which human life is enhanced by the creation of problem-solving products. Technology is, therefore, any means devised to solve a problem. This is to say that technology solves problems. It also implies that every problem-solving approach can be referred to as technology. Technology enhances creativity. The more we understand the endless possibilities of technology, the more inventive we get (Thangarajathi 2020). This suggests

that the more students engage themselves in the use of digital technology the more creative they will be. Therefore, technology, in the context of this study, is a practical process of skills application or a tool to solve a problem.

2.8 Digital Technology

Like technology, digital technology has been given varied definitions because of its wide scope and the individual author's exposure to it, experience of it, or understanding of it. Adjin-Tettey (2020) defines digital technology as hardware or apparatus that performs tasks (analyze data, produce, and save) by employing a numeric binary code. This means Adjin-Tettey considers digital technology as a tool which is capable of generating, processing and storing data. Devran (2020) defines digital technology as a digital tool, system, device and resource that generates and analyzes data like multimedia, social media, and online gaming. These two definitions are quite ambiguous and are not in sync with technology as a process because they have omitted human activities and influence on digital devices. The definition is projected as if technology operates on its own to achieve results. What Devran and Adjin-Tettey state as the definitions for digital technology are the definitions of digital devices. Ramos *et al.* (2022) consider [digital] technology as a system built around data encoding and transmission techniques. Its primary feature is its ability to solve various problems in a very short space of time. Even though Ramos *et al*. put their definition into two separate sentences, which is not optimal , the principal idea of digital technology as a tool that is meant to solve a problem is evident. However, the definition is still not complete as it lacks the aspect of skills application or human influence on the tool to achieve results. In his attempt to define digital technology related to education, Lindqvist (2019) posits that digital technology includes digital instruments like computers, tablets, and smartphones, as well as programs, apps, and online resources that supplement instruction. The author added that this enables the storing of substantial volumes of papers, media files, and other data in compact devices. Lindqvist's definition can be put into four different categories and

these are 1. software (online resources, programs and applications), 2. hardware (laptops, tablets and mobile phones), 3. skills application (what it is used for) and 4. solutions or results, also referred to as the ideation outcomes (see Figure 2.2). Technology is the combination of these four components (software, hardware, skills application, and solutions). There must be a complete integration of all four categories to term it as digital technology; the omission of one makes the definition incomplete. Lindqvist's definition supports the fact that digital technology is not a tool or a product but the application of skills on a device to solve a problem. The definition is directly linked to Levin's (1996) definition of technology as a problem-solving process.

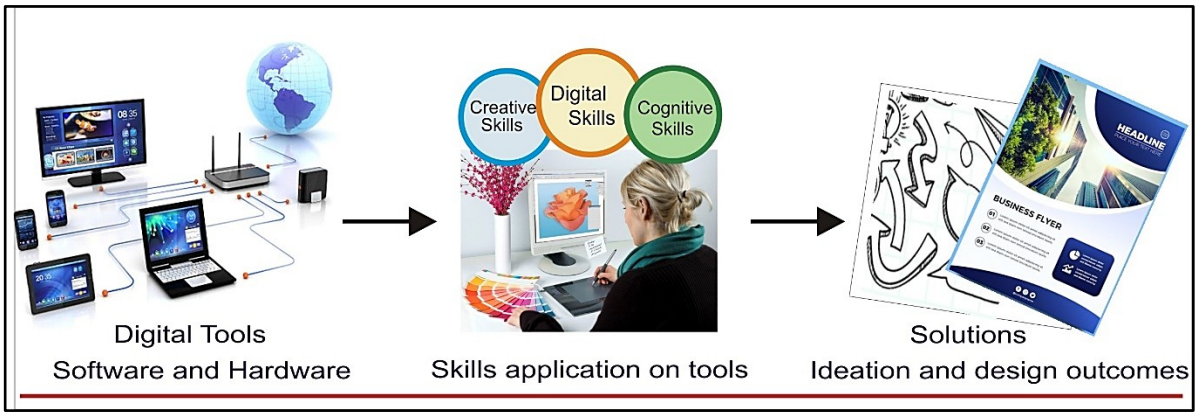

Figure 2.2 The application of skills on digital tools to solve a problem (technology) - *Author's Construct*

Min and Hao (2008) assert that digital technology has led to innovative insights into user experience and design space. This has made a variety of digital design devices available to assist with decision-making and design procedures in the design profession. Radhika (2018) indicates that digital technology serves as a tool to enable people to collaborate in order to accomplish shared goals and objectives, increase productivity, and develop human resource skills, talents, and knowledge.

Min and Hao (2008) posit that with the use of digital technologies, designers can focus more of their time and mental energy on conceptualizing and

solving problems. Digital technology, according to them, does not only reduce the time needed for design projects compared to more conventional methods, but it also provides the following advantages for the design process:

a. makes it easier to suggest fresh, tentative choices;
b. provides more flexibility for changing alternatives and the design process itself;
c. ensures a more accurate depiction of the design result;
d. supports management of processes through sophisticated data storage and retrieval.

Digital technology continuously advances design practice and helps to enhance the design procedure. As a result, digital tools form part of the repertoire of many designers and architects (Min and Hao 2008). Digital technology, according to Hamid and Alshamari (2016), offers the artist the ability to quickly gather shapes, pictures, hues, and material in the computer's memory. Digital technology gives extraordinary freedom [to designers] to create digital graphic forms. Radhika (2018) suggests that task performance becomes easier when digital technology is used and this leads to efficiency that increases productivity. As stated by Min and Hao (2008), the application of digital technology takes different forms and this includes conception, design composition, design representations (two- and three-dimensional drawings. models, and rendering), electronic publishing (reports and brochures), animation (film and video), webpage, multimedia and interactive systems. The digital devices widely used are laptops, computers, tablets, and smartphones (Radhika 2018; and Lindqvist 2019).

In this study, digital technology is broadly used to represent the use of digital devices and design application software with or without the internet to solve a design problem. Digital devices, as mentioned, include but are not limited to computers, laptops, digital camera, stylus, tablets and smartphones and the design software includes but is not limited to CorelDraw and Adobe software such as Photoshop, Illustrator, InDesign, Capture, and Lightroom.

A survey was conducted in Piraeus, Greece by Nikolopoulou (2018) to study the relationship between creativity and digital technology in education. In all, 156 high school students from age fourteen to fifteen were sampled for the study. The report reveals that the majority of participants confirmed that digital technology helped them to be creative. Nikolopoulou observed that digital technology interactivity and its capacity to represent information in a variety of modes supports digital technology's potential to provide a means for trying out ideas, imaginative play, exploration, problem-solving approaches, taking risks, and building connections between ideas. Digital technology plays a significant role in connecting people, projects, information, and resources.

2.9 Digital Ideation Tools in Design

Digital technology has impacted advances in music, video literature, design, and art over the past few decades. The current state of visual communication is revolutionizing due to the constant emergence of new technologies that rapidly alter traditional methods of doing things (Pettersson 2021; Mustaqim 2020).

To examine the ideation tools in professional practice and education, Jonson (2005) conducted a case study involving five design professionals and five second-year undergraduate students. Students who had completed their degrees in architecture (AR), fashion (FA), graphic design (GR), general education (GE), and product design (PR) in no more than two years were sampled for the research. They were tasked to identify conceptual tools and how they were used when they started embarking on design projects within their domains. When students began working on design projects in their respective fields, they were tasked to identify conceptual tools and their applications. The multiple case study related how students and practitioners made use of conceptual tools in daily design activities. It was discovered that verbalization, and not freehand sketching, was the main conceptual tool used for starting design projects. It was, however, discovered that computers were used as ideation tools across design in all the disciplines. According to

Jonson (2005), computer-aided design (CAD) serves as a tool for idea conceptualization in addition to technical drawing. Participants who used CAD for concept development claimed that it enhances rather than restricts designers' creative possibilities by generating new linkages, patterns, and aesthetics. The general view about digital technology with regards to conceptualization is inappropriate as it appears to be founded on the idea that conceptual tools are surface-level rather than deep-level structures.

Pérez and Dorta (2011) conducted a study on design tools assessment for ideation. Pairs of industrial design students worked on Hybrid Ideation Space (HIS) during the conceptual phase of an ad-hoc design project. The digital tools used by the participants were a laser pointer, PC tablet Modbook, iPod, Cintiq and pen tablet Wacom. It was reported that sketching directly on the representation with two laser pointers allowed the participants to move freely and sketch simultaneously on various areas of the representation. The combination of the Wacom [tablet] and the laser pointer allowed the students to sketch while looking at the representation as much as [they did] with the two laser pointers. With the Modbook and iPod, the participants sketched simultaneously and each student started sketching on their own just like with the two laser pointers. This means that knowing about the tools, how to use them, and the appropriate ones to combine during a design task can be of great help in design. Other digital devices used for drawing as stated by Aboalgasm and Ward (2014) include laptops, iPads, and tablets. Digital devices are now part of current technology, and this makes it much simpler to reorganize, choose, add, remove, save, and transfer work (Aboalgasm and Ward 2014). They are of the view that learners should be encouraged to make use of these digital technologies to improve their cognitive and creative skills.

Some researchers, however, contend this kind of technology destroys artistic creativity and some of the reasons given are that it places mechanical processes between the artist and the completed piece; technology produces

an over-sanitized result, and exposes designers to an excessive amount of electronic images that may have a detrimental effect on students' imaginations (Amarakoon 2017; and Dorta 2014), and that ideation should be fluid, abstract, ambiguous, imprecise and devoid of the exactness of digital representations (Dorta 2014).

As stated by Dorta (2014), there are three different kinds of representations during ideation. The first representation is rough physical models and freehand sketches. This is to externalize and visualize the creator's thoughts and to communicate to other designers in a team. It helps designers personally and the team concurrently. In the next ideation stage, designers adopt a second type of representation with images and drawings to better communicate constructively with clients and colleagues about the concepts already designed. The third stage is characterized by comprehensive technical drawings and quick prototype models to communicate the precise and final details needed to construct the item.

According to Dorta (2014), ideation is typically achieved through paper sketches or mock-ups made of flexible materials rather than precise digital representations. The author believes that fluid, abstract, ambiguous, and inaccurate external representations are required for the creator to concretize and view the interior mental images. Dorta further argues that, whether working in synchronous (same-time) collaborative situations or alone during ideation, abstraction and imprecision are essential throughout this stage of the process as ideas keep emerging. The author claims that creating sketches or physical models is a collaborative process in which designers perceive more in these depictions than they are able to capture at the time of creation. This indicates that designers typically omit some of the information they possess about the items they depict. Dorta indicates that while working with incomplete information, designers make spontaneous decisions and presumptions that require revision and can be re=examined later.

In contrast to Dorta's view of freehand sketches for exteriorization of ideas and imprecision during idea development, other researchers support the use of technology in design. They believe that digital tools make design work more convenient with good quality (Wang (2020) and offer the user more choices and variety than traditional methods. Some of them mention that digital tools enhance creativity and artistic expression (Aboalgasm and Ward 2014). Again, it is believed that drawing tools can be manipulated with ease and are capable of linking ideas and concepts in a dynamic manner later (Hods 2008).

It is one thing having a tool and it is another using them. Application of digital tools involves certain skills, especially in the area of design (Seufert *et al.* 2020); however, the efficiency and effectiveness of such technology depend on the manner in which it is handled.

In their study, Veisz *et al.* (2012) reported that there has been a substantial drop in using pencil at the initial stages of the design process among engineering students as they prefer digital tools instead of simple freehand sketches to communicate their ideas. According to the authors, this is not advisable because the use of digital tools at the idea conception stage leads to constrained thinking and design fixation. The term, design fixation, often refers to circumstances in which designers restrict their creative output due to an excessive dependence on elements of previously created designs, or more broadly, an excessive dependence on a particular body of information that is closely related to a problem (Arciszewski and Youmans 2014).

The understanding being put across by Veisz *et al.* (2012) is that the tool used to generate the idea is responsible for the fixation. This is opposed by Arciszewski and Youmans (2014) as they discovered in a study that fixation phenomena, at every given point in time, are caused by one of three classifications: (a) the designer's willful rejection of novel concepts; (b) deliberate barriers to change; or (c) deliberate opposition to novel concepts. This means that a designer can fixate, whether he or she adopts sketching

with pencil or using digital technology if he or she exhibits any one of the three characteristics mentioned.

It is crucial to remember that access to digital technologies does not automatically translate into creativity; rather, it creates opportunities for engagement, involvement, and the active display of creativity, productivity, originality, and value (Kleopatra 2018)**.** What this means is that when a skilful person has access to the right tool, an excellent work will be produced and in much the same way, if a novice gains access to the right tool, he will come out with a sub-standard work simply because of a difference in skills. Generating novel ideas greatly depends on the experience and skills of the designer rather than the tools at hand. As stated by Taegyun (2020), design ideation can be more difficult for inexperienced designers who lack a structured procedure to follow and have limited expertise to draw from. It is not so much the digital device used by a designer that gives the aesthetic quality of a design work but it is much more the skilful artistic expression applied to the digital device that brings out the beauty.

It was established in a study that students can enhance their logical thinking abilities, produce information about different topics, enhance their communication skills, and perform their task effectively by utilizing digital technology (OECD 2016). According to a study by Evans and Aldoy (2016) that investigated how the use of tablet PCs support sketching, it was reported that digital sketching technology significantly improves the development of design ideas.

In his research, Appiah (2014) noted that the education of graphic design has not yet caught up with the application of ICT tools at the different stages of graphic design problem-solving, particularly in concept formulation. Thus, he investigated the ways in which ICT has influenced ideation in graphic design instruction and practice. He discovered that ICT assists in terms of motivating and structuring collaboration, especially with group-based project methods of teaching. His finding supports the claim made by Scoby *et al.*

(2017) that the adoption of technology creates environments that promote student-centered learning and engage them in constructivist classrooms. Again, it is believed that technology increases creativity in students (Anastasiades 2017) and improves their problem-solving skills. This means motivation and collaboration with a group-based project influenced by digital tool integration as discovered by Appiah (2014) must lead to an increase in students' creativity (Anastasiades 2017) and consequently improves students' problem-solving skills (Movchan 2018) in design.

As stated by Appiah (2014: 228), students perceive computers and ICT as accelerating the rate at which graphic design issues may be resolved and enabling designers to use greater creativity in their work. The author adds that a change of this magnitude is crucial in equipping pupils with the necessary abilities to thrive in a technologically advanced economy. He states that designers who can use the appropriate approaches to address today's design challenges are in high demand in the field. Investigating the instructional method of ideation is very important for educational research when the goal is to understand not only ICT knowledge but also how it may be applied to the ideation process (Appiah 2014).

The discoveries and observations emerging from this study are very significant and must be given the necessary attention to improve design outputs that satisfy current technological consumers. Despite the fact that the study looked at how ICT adoption impacts graphic design ideation process instruction, it did not assess the ideation outcomes of students or state the extent to which students use technology in ideation. The author correctly clarified that the study 'did not investigate the influence of ICT on ideation skills' (Appiah 2014: 195).

There is a wealth of existing literature on ideation in the design process in graphic design, architecture and engineering but most often, the focus is always on the skills of design experts and novices; the role of sketches in ideation; CAD impact on ideation; and blending ICT with sketches in idea

development. The utilization of digital technology during the process of ideation in the area of graphic design has not been researched.

It is against these gaps that this study seeks to explore how digital technology can be effectively utilized to enhance design ideation in selected Ghanaian universities to create awareness of the need for digital technology integration into design ideation and develop a conceptual model for effective digital ideation process.

2.10 Paradigms of Thinking in Design Ideation

Design involves quite a number of activities which include planning, researching, gathering, analyzing, synthesizing, organizing and harmonizing all of which require a great deal of thinking. In view of this fact, design thinking is acknowledged as a structured approach to innovative problem-solving that aims to promote creativity (Dell'Era *et al.* 2019; Liedtka, King and Bennett 2013).

2.10.1 Linear thinking

There are two main ways of handling design briefs at the concept development stages according to Dabner *et al.* (2014), and these are linear reasoning and lateral thinking. While the two opposing approaches are important, linear reasoning is focused and has a methodical approach, while lateral thinking is diffused and expansive. Dabner *et al.* (2014) posit that linear reasoning involves a step-by-step systematic approach toward achieving a predetermined concept. Ideas are divided into smaller, workable sections such as scale, type, composition, and colour, and then worked through to the final stage by fitting all the components together. In order to build an idea (brainstorm or sketch) in a graphical manner, challenges can be tackled by delving deeply and comprehensively into each component and identifying relationships and connections that support the notion, and reasonable bounds can be pushed. The authors provide an example of how conceptual development might be compared to taking a stroll in a city. One person might start with a clear destination in mind, and concentrate on

getting there. On the other hand, someone else might merely meander around the streets with no particular direction in mind. Each will offer distinctly varied experiences in a way that is not predictable. If someone is exclusively focused on getting where they are going, they could lose sight of very important items that are not immediately apparent (Dabner *et al.* 2014).

A designer may begin the ideation with a lateral thinking approach by brainstorming as many ideas as possible to produce preliminary concepts before switching to a more linear technique later on. The two approaches of exploring design, according to Dabner *et al*. (2014), are frequently complementary rather than mutually exclusive.

The understanding that Dabner *et al*. (2014) are establishing here is that concepts can be developed in three different ways. Firstly, a designer may approach concept development linearly by working systematically toward the expected solution. Secondly, a designer may develop a concept without having any definite solution in mind and no systematic guide to follow but work his way out through exploration to a solution and thirdly, a designer can combine both the linear approach and the explorative approach to arrive at a solution. Whichever way a designer chooses, he can achieve creative output.

2.10.2 Lateral thinking

According to Liubashenko and Kavytska (2020), ‘lateral’ means sideways. Edward de Bono coined the term "lateral thinking," which literally translates as "thinking sideways" or "thinking beyond existing patterns” to generate new and differentiated multiple methods called deliberate creative thought that he developed from what he saw as the conventional wisdom on creativity and invention (Burgh 2016). According to Bono (1994), lateral thinking is a set of procedures involving methodical and imaginative methods of thinking that consistently result in creative thinking. Lateral thinking is a type of innovative thinking (Fisher 2005) that has the ability to handle information, reorganize

mental processes, and open the door for the development of new ideas that could be required in the future.

The term lateral thinking is used in two senses:

1. Specific: a group of methodical approaches for creating new ideas and altering preconceptions.
2. General: investigating several options and strategies rather than sticking to one (De Bono 1992: 54).

It is understood from the contributions of the authors that lateral thinking is a thinking approach that encourages thought patterns to be restructured to give way to new ideas. No pattern, sequence or order is required when using the lateral thinking approach in the generation of ideas and approaches. It means solving a problem from different and diverse viewpoints. A designer who adopts this approach is likely to obtain unexpected design outcomes. In an academic environment, this kind of thinking demands that students think critically and creatively while solving problems. They require the application of critical thinking skills to find several answers to challenges. A favorable correlation exists between lateral thinking and academic success (Mustofa and Hidayah 2020).

2.10.3 Divergent and convergent thinking

The term “divergent thinking" is defined as "original thought and divergence from the norm” (Bennevall 2016). Bingölbali and Bingölbali (2020) indicate that diverse thinking is mostly linked to innovation, despite the existence of opposing viewpoints. Japardi *et al*. (2018:59) describe divergent thinking as the capacity to break away from dominant ways of thinking and expressing oneself in order to produce original concepts and solutions. The conventional framework for conceptual design processes contains divergence and convergence phases (Mader and Eggink 2014). The divergence phase is characterized by the opening up of the design space, the breadth of which typically depends on certain parameters. In the convergence phase “sources of distraction are shut off”.

The lateral thinking technique allows the designer to shift focus from the obvious pattern to achieve creativity where a blend of expertise and a designer's diverse cultural upbringing could facilitate "unexpected" solution areas. (Mader and Eggink 2014). This indicates, therefore, that the designer’s experience, preferences and risk-taking ability can mould the solution area, while convergent thinking is associated with deriving the single best option

Although convergent thinking is confined to one optimal solution to a problem (Bingölbali and Bingölbali 2020), divergent thinking is associated with using the facts at hand to generate several different responses. Kim (2008) discovered that there exists a far greater correlation with creative accomplishment and divergent thinking test results. There is notably a higher correlation between innovative performance and divergent thinking evaluations. Cropley (2006) believes that divergent thinking is related to the creation of innovative ideas with regards to design thinking, while convergent thinking is linked to the evaluation of the novelty.

This is directly linked to the view of Mader and Eggink (2014) who state that the convergence phase is the process of narrowing the design space until a particular answer is found. Design space reduction is usually a design decision that is influenced by design requirements and available knowledge.

Brophy (2001) explored a number of theories on personality and cognitive qualities in connection to divergent and convergent thinking by looking at participant performance, innovative problem-solving tasks, and attributes. The author discovered that divergent performance has been proven to be much greater than convergent performance. Leikin and Lev (2007) assert that there is a relationship between multiple-solution activities and creativity, and that fluency, flexibility, and novelty are all seen as aspects of creativity. According to the authors, the number of ideas generated is related to fluency, and the speed at which problems are solved, and the transitions

between different solutions are connected to flexibility, and the convention of solutions is an interrelated novelty.

Reflecting on the contributions gleaned from the literature, divergent thinking can be seen as a creative venture that a designer embarks upon in order to differ from design norms. It is a creative risk-taking engagement that may lead to unexpected discoveries because unexpected design paths are taken. It is important to remember, nevertheless, that Shen *et al.* (2018) reported that those who took fewer risks performed better when it came to convergent thinking; however, there was no discernible relationship between taking risks and divergent thinking. According to Leikin and Lev (2007), fluency and flexibility are critical abilities that designers should embrace for successful divergent explorations in their creative endeavours.

Again, the definitions given by the various authors on divergent thinking suggest that it takes the designer to a novel and unexpected path in the design domain. A designer who adopts this approach has to break away from the dominant ways of thinking and expression, find a distinct design path and be open-minded to develop original concepts and solutions.

Equipping design students with this skill will help them develop multiple and alternative design outcomes that promote creativity. Analyzing Cropley's statement regarding divergence and convergence, it is inferred that divergence *generates* novelty while convergence *evaluates* novelty. Understanding and effectively applying these approaches will result in outstanding design output.

This literature informs the researcher about the thinking patterns of designers as they engage in their creative exercises. It is very useful and will assist the researcher during data collection on research question one (1) which reads, 'How are graphic design ideas generated by design students in Ghana?' The researcher will be able to identify designers who adopt linear thinking (dividing ideas into smaller workable sections and following a step-by-step

systematic approach towards achieving a predetermined concept); lateral thinking (restructuring thought patterns to give way to new ideas without following any sequence or order); or divergent thinking (breaking away from conventional ways of thinking and expressing oneself in order to come up with new ideas). This will be achieved by observing the design approach adopted by the designer and examining variations, similarities and design idea connections in the designers' ideation output as they explore design space. During the idea evaluation stage, notes will be taken on how the designer makes use of convergent thinking in the selection of an appropriate design solution. The researcher will be able to appreciate the design activities and outputs of the research participants with a deep sense of understanding and interpretation and thereby give an accurate and scholarly account of their design outcomes.

2.10.4 Creative thinking

Creative thinking entails thoughtful deliberation on options and possibilities as well as coming up with novel ways to combine well-known components. According to Bonsch and Kaiser (2002), creative thinking is the capacity of the individual to bring new ideas to fruition and to transform reality. Three aspects of creative thinking have been highlighted by the writers and these are: 1) intellectual, which is the capacity for idea generation; 2) motivational, which is a readiness to think creatively and express that idea; and 3) emotional, which is the drive to think unconventionally and take risks.

Reviewing 'design creativity', it is obvious that the overall ultimate aim of ideation is to achieve a creative design in response to a brief. Critical analysis of the definitions of creativity reveals that the term is principally linked to keywords such as novel, surprising, original, useful and appropriate. In view of this, the researcher considers the early definition given by Matlin (1998) that the basic principle of creations is an unexpected and unique combination of two or more elements that result into a novel and significant idea, solution, method, explanation, or product to have stood out as the

strong definition of creativity. The words ‘new and unusual’ as used in the definition stand for 'novel' while ‘meaningful concept’ expresses the usefulness and appropriateness of the solution. This means that for an idea to be deemed creative, it should be uncommon and useful.

2.11 Design Thinking

Design thinking, according to Dell'Era *et al.* (2016), is generically scoped, which means that since the creative mental process is not closely associated with any one domain, it can address almost any form of problem in any discipline. Because design thinking requires creativity, abstraction, and experience in information synthesis, it also involves problem-solvers (Dell'Era *et al.* 2019). Maeda (2016) indicates that design thinking has developed from conventional design into an advanced approach that assists individuals in resolving their problems in a more inventive, human-centered, cooperative, iterative, and visual approach. Gekeler (2019) posits that design thinking is collaborative and interdisciplinary. It is the application of original ideas and innovative approaches in the process of solving a design problem. Design thinking provides some helpful tools for thinking in a more inventive and cooperative way about problems in every discipline and social sector. Kelley and Kelley (2013) state that design thinking is a process that uses the skills and mindsets of design experts to identify human problems and develop innovative solutions. Design thinking may be used to identify human needs and develop novel remedies through the use of the designer’s techniques and perspective.

Design thinking as defined by the various authors as a creative problem-solving approach that deals with nearly every sort of problem in any area. It is a multidisciplinary approach which can be effectively applied to solve problems in any field or discipline. This problem-solving approach helps solve problems in a more inventive, human-centred, cooperative, recurrent, and artistic manner. The creative nature of this approach suggests that the approach seeks to find an appropriate and desirable solution to problems. The collaborative nature of design thinking allows room for divergent views

or ideas from the various team members. With a focus on human-centredness, the various ideas from team members are synthesized to eventually lead to creative solutions. In view of this, it is clear that design thinking is a collective and interdisciplinary approach and the primary aim of this approach is to obtain a creative solution.

A study was conducted by Dell'Era *et al.* (2019) to investigate the broad knowledge of the design thinking method taking into account the variables that caused consulting firms to perceive and execute the methods differently. From an empirical point of view, 47 consulting firm case studies that offered advice in a design thinking-based services approach were evaluated in Italy. They included even technology developers, six digital companies, thirteen strategic consultants, and seventeen design firms. Using a variety of primary and secondary sources, in-depth interviews were carried out with 97 individuals. There are four distinct ways to understand the design thinking paradigm, each with its own set of practices. These are as follows:

1. innovation of meaning,
2. creative confidence,
3. sprint execution, and
4. creative problem-solving

The i*nnovation of meaning* approach helps the designer to have a clear focus and direction to identify concepts that fit the novel purpose notwithstanding difficulties that arise due to the multitude of ideas accessed. The c*reative confidence* approach purposely occupies designers with a novel collection of methods, practices and procedures that encourage transformation and innovation. *Creative problem solving* is primarily concerned with encouraging ideas capable of guiding the generation of creative and inventive solutions that can satisfy the needs of users. Finally, s*print execution* is regarded as an improvement of the creative problem-solving strategy that incorporates the effectiveness of the lean/agile strategy (Knapp *et al.* 2016) to help speed up the creation process and lessen the uncertainty of the market. This strategy, according to Dell'Era *et al*., is

suitable in the digital markets where there is a need for continuous updates and renewal of products as feedback from the market is incorporated.

While the innovation of meaning approach is in the direction domain, the creative confidence approach works within the human domain, and the creative problem-solving and sprint execution strategies tackle the solution area (Dell'Era et al 2019). It was observed that the creative problem-solving approach is mostly preferred as 38 out of 47 organizations employ this kind of design thinking; however, the creative confidence and the innovation of meaning strategies are the least preferred (Dell'Era *et al*. 2019).

2.12. People, Place and Process in Design Thinking

According to Gekeler (2019), to ensure effective collaboration for design team members and also to generate satisfactory outcomes within a suitable space of time three core elements are adopted by design thinkers and these are people, place and process.

Gekeler (2019) posits that design thinking is generally people-focused. Whatever a design thinker does is motivated by a desire to better understand the client. The two categories of people in design thinking are the team on the one hand, while the intended client, or target audience is on the other side.

a. The team and its expertise

Design team members should have a varied set of skills and backgrounds and include both genders. A design team may be constituted of engineers, philosophers, medical workers, business experts and teachers of both genders. It is beneficial to appreciate variety on other levels, such as style of working or personality. While members of the team are experts from different fields, they should be able and willing to relate to others to bridge the gap between the disciplines. It is required in design thinking that, in spite of the varying expertise, the team members should assume a neutral position on

purpose to learn something new. They should be open, interested, and empathic toward other individuals and experts in the field.

A design thinker should always bring helpful contributions to a project that could be made by contact or even collaboration with the intended audience, professionals, or other individuals who can bring their viewpoints and thoughts to the project.

b. The target audience and their context

The user is always the focus of design thinking. A design-thinking initiative is always centered on the requirements, desires, goals, and conditions of the people it will eventually serve. The team [must] always ensure that the human being remains the focal point of everything they do. They [must] make an effort to figure out the conditions and context in relation to difficulties and possibilities, as well as the desires and specifications of people (target). They undertake research to gain insight into their target audience and the context in which they operate in order to provide the best solution possible.

For effectiveness, the meeting place for a design team needs to be spacious and comfortable (Gekeler 2019). Small offices, or traditional conference rooms, or banquet halls with heavy furniture will inhibit flexibility and hence will not be an ideal environment for a design team. The ideal set-up should encourage innovation and be adaptable enough to allow the team to rearrange the furniture when needed. The place should offer spaces and flexible mobility that encourage team members to collaborate with each other and be creative. Even changing your environment for a day or two, such as working from a park or a coffee shop, might help you change your viewpoint.

The design process is critical to maintain effective participation and prevent becoming lost in the transparency of searching for a solution. Kelley and Kelley (2013) regard design thinking as a method of identifying the needs of people and developing innovative solutions to solve them. The reason many

companies engage in design thinking is because it fosters innovation. When embarking on design thinking, the team and even the supervisor cannot know exactly what the outcome will be.

At the start of the project, a thorough study is required to fully grasp the challenges and develop compassion for the target audience. Even though the research stage may be a bit confusing, design thinkers usually identify sequences that result in first concepts, models, and, with growing clarity and concentration, progress to a highly definite design.

According to Gekeler (2019), design thinkers and other creative problem solvers usually adopt one of two strategies: a strategy of a flexible approach that accepts observations, insights, and ideas as little and insignificant as they may appear to be as useful (divergent thinking); or a strategy of being more critical and selective to help the team discover patterns in the previously created wealth of data for decision making (convergent thinking). The two techniques differ but they allow the team to move out of the realm of the known and slowly enter into the realm of discovery, or the unknown.

Understanding the ‘people’, consisting of the design team and the target group, the ‘place’, which focuses on the suitability and comfort of the meeting place for team members, and the ‘process’, which considers the approach adopted to solve a design problem are all vital for the success of every design project. The omission of one of these will lead to unsuccessful design engagement.

2.13 Cognition in Creativity

Bayne *et al*. (2019) observed that the word ‘cognition’ does not have a single meaning. According to Bayne *et al*. (2019), the term ‘cognition’ refers to every activity and procedure about the acquiring, preserving, retrieving and processing of information, irrespective of whether these procedures are explicit or unconscious.

Traditional opinions of cognition are generally based on ideas of knowing and thinking, which imply some type of processing. Processing extends beyond brain processes that merely correlate with sensory input. Cognition permits the production of new knowledge by combining information obtained from various sources in different ways (Chittka and Osorio 2007). Engaging in the cognitive approach involves the mental processes of making inquiries about the kind of information an individual (in some way) represents: what it notices, remembers, and may be able to compute with.

Bayne *et al's* (2019) definition of 'cognition' as referring to every activity and procedure about the acquiring, preserving, retrieving, and processing of information, irrespective of whether these procedures are explicit or unconscious is quite similar to Chittka and Osorio's (2007) definition. Chan (2008) considers cognition to be the mental process of changing, decreasing, clarifying, preserving, accessing, and using information. The word 'information' in this regard, is knowledge. According to Chan, organization of knowledge and its integration with reality is cognition, which constitutes intelligence.

Chan's definition of cognition compares to that of Neisser (1976) who considered cognition in humans as all the processes by which the sensory input is changed, reduced, clarified, stored, preserved and used.

While it is clear that these scholars tried to give a general definition that focuses on a series of operations, Chan refers to cognition as a mental process and Neisser considers it as sensory input. The phrase 'sensory input' suggests that what is stored in the human brain, or cognition comes from the external or physical world through sensory experiences of sight, hearing, smell, taste or touch. These experiences are considered to be input because they are encountered in the physical world and are then stored, kept, saved or registered in the brain for future consideration. Neisser indicates that these experiences can be recovered and used. The recovery

and use aspect of the definition expresses the output function of cognition when stored information is retrieved and used to solve a problem.

Again, Neisser's definition spelled out the fact that the sensory input is transformed, reduced and elaborated. Transformation, reduction and elaboration are information-processing activities that go on in the cognitive domain. In effect, Neisser's definition of cognition, unlike the others, covers information input, information processing and information output and is most preferable in the context of this study.

Sharing the same view with Neisser with regard to sensory input, information processing and information output, Chittka and Osorio (2007) state that cognition allows the generation of novel information that is derived combinatorially from data collected on different occasions; this suggests that cognition fosters creativity. That is to say that cognition is actively engaged as the designer expresses an idea on paper or a computer. It means that the physical activity that is perceived by the eye during ideation is influenced by the inputs that were stored in the cognitive domain.

2.13.1 Design Cognition

Numerous studies were conducted to understand the cognitive processes involved in idea development (Finke *et al*. 1992; Marsh *et al*. 1996; Paulus and Yang 2000; Nijstad *et al.* 2002) However, it was discovered that the cognitive processes have inherent complexity and difficulties that pose evaluation challenges. Design as a word, is a verb (process) and a noun (product) (Pettersson 2021). As a process, it involves a series of mental activities generating entities which involve some thinking processes. Cognitive psychology defines *thinking* as a condition of human mental activities (Chan 2015). Design *activities* can therefore be regarded as thinking activities produced by cognitive activities. With this understanding, design as a product could also be considered as the end result of the design cognition [process]. So, whether design is considered as the process or the product, it involves human cognition. Design cognition, according to Hay *et*

al. (2017) is the mental procedures and visuals designing comprises. The term is also used to describe the activities that take place during the design process (Chan 2015).

In his study, Chan (2015) states that the entire problem of context is made up of the challenge framework and the remedy framework. One cognitive activity that designers constantly engage in is checking for problem situations in both the challenge and remedy frameworks in order to accomplish a final solution. By saying this, Chan put the thinking activities in a design process into three stages as follows:

a. Defining [the] problem stage: This is the first step of resolving the problem, in which designers examine the problem's background and seek clarification through questions. According to Chan, the initial problem statement may be significantly expanded and reinterpreted. In certain circumstances, the entire collection of problems may have been specified. At this point, the design brief presented by the clients is transformed into a series of design problems and questions that describe the project situation sufficiently to inform designers about the research actions to take.

b. Creating [the] solution stage: At this stage, many alternative solutions are generated triggered by ‘what-if questions’ that simulate problem situations; responding to the context of the problem encourages designers to take a number of speculative steps to generate solutions.

c. Deciding on and evaluating [the] solution stage: decisions on the solution are made by assessing the issue within the problem framework. To be constantly aware of the problem situation, designers ask questions from time to time. They will simulate the future aspect to identify any disputes or prospective difficulties that may occur in order to determine the best one that fits the solution structure.

All these three stages involve a great deal of mental work referred to as ‘design cognition’. Problem-solving involves thinking and design problem solvers commence thinking the moment they start examining the design brief up to the time they have the solution to present to their clients. As stated by Wang (2009), problem-solving is a cognitive procedure in which the brain looks for or suggests a solution to a specific problem in the form of a set of pathways to achieve some outcomes.

Considering the etymological definition, cognition means ‘thinking’, ‘knowing’, and ‘understanding’. It involves a cognitive process that involves reasoning. This means cognition entails questioning oneself about something. Questions and thoughts that run through the designers’ mind throughout the design processing stages such as: how best to reframe the brief for a better view of design expectations; how to gather history and enough information about the task; gathering the facts about competitors; how to meet the deadline; the number of ideas to develop; what to consider when selecting creative and suitable ideas; what details to add or delete to make an idea perfect, all form part of the cognitive process.

Wang (2009) argues that the mental process of incubation may be explained by the brain's subconscious processes connected to thinking and inference, such as perception, imagination, and inadvertent search. When there is a stalemate, incubation may lead to invention through active subconscious (cognitive) processes. Incubation has been proven to have played a significant role in the creative process.

According to Chan (2015), several cognitive processes are carefully used to calculate a large number of design components. These cognitive strategies include the strategic or methodical use of cognition to address complicated issues. A strategy is neither a straightforward technique nor a system of numbers. It's an approach that helps people create internal processes that carry out higher-level operations (Chan 2015). Cognitive strategies may also be defined as cognitive procedures that assist in the completion of particular

cognitive tasks. They are mental processes that include strategically building a problem framework and a solution framework, which are crucial in leading the problem-solving approach. To maintain a balance between the two, the designer must have confident control over both the problem and solution structures.

With regard to cognition in design, Makri and Warwick (2010) reported on an empirical study of nine architecture students at the postgraduate level as they searched for image resources. After a close observation, they discovered a variety of activities that engaged the human mind and these included:

a. *Finding information,* which they categorized as ’browsing, surveying, monitoring, encountering, accessing, searching, and investigating’.
b. *Assessing information*, categorized as ’choosing, identifying, and extracting’.
c. *Interpreting information*, grouped under the headings of ’visualizing/appropriating, synthesising, and analyzing’.
d. *Using information,* categorized as ’storing and editing’, and
e. *Communicating* categorized as ’sharing, disseminating and consulting’.

The participants' information-seeking activity was documented by the authors, and this included looking at material that was not directly related to the design assignment but would subsequently serve as inspiration for the student. All of these engagements are purely cognitive processes. The brain is actively at work accepting and rejecting information, and determining which information is worth communicating.

As stated by Beaty *et al.* (2018) and Kleinmintz *et al.* (2019), memory functions have been proven to be crucial for creative endeavours. They play a significant role in dual-process theories of innovation, which hold that creative thinking entails both more careful, conscious appraisal and modification of ideas to match task objectives and restrictions, as well as more intuitive recovery and connection of representations from memory.

Whether the designers are aware of this or not, design involves active brain work and this demands that a suitable venue is created for designing, especially in a learning environment.

2.14 Design Ideation Metrics

According to Nelson *et al.* (2009), design's main objective is to provide novel and practical answers to challenges, and a crucial first step in this process towards achieving that is idea generation. Dylla (1991) emphasized the importance of multiple samples in ideation when he stated that there is a relationship between the quality of the finished design and the quantity of design space during concept development. Metrics that are generally adopted for the measure of ideation performance include the entire number of concepts generated, the entire number of design idea categories generated, the originality of concepts, as well as the usefulness of design concepts (Nelson *et al.* 2009).

Different measures have been offered to evaluate the effectiveness of ideation with respect to the characteristics of the design results, including quantity, quality, novelty, diversity, utility, viability and resemblance (Sarkar and Chakrabarti 2011; Shah *et al.* 2003; McAdams and Wood 2002).

2.15 Shah *et al.'s* (2003) Metrics for Assessing the Effectiveness of Ideas

In an attempt to solve the difficulties associated with the cognitive process of evaluating ideation, Shah *et al.* (2002) developed an outcome-based approach. This mainly focused on evaluating the design outcomes of designers during the ideation process. In effect, two ideation measurement approaches were discovered: the cognitive-based approach and the outcome-based approach. Most researchers prefer the outcome-based approach on the premise that the idea-generation techniques are deemed successful if they produce 'good' ideas. The 'goodness' of design concepts is correlated with the effectiveness of the technique (Shah *et al.*, 2002). Shah and Vargas-Hernandez (2003) created outcome-based measures based on two fundamental standards for evaluating the ideation process: 1. To what

extent does the approach broaden the design space? 2. To what extent is the design space explored by the method? The researchers consider design space as the total number of all possible solution options for a specific problem. Shah *et al.* (2002) proposed four separate effectiveness metrics which are novelty, variety, quality, and quantity of designs.

2.15.1 Novelty of ideas

Novelty is defined as 'the extent to which the design is different from usual designs' (Kang *et al*. 2019:280). If novel designs are not workable and practical, they could not be meaningful or relevant to the problem at hand. According to Okudan *et al.* (2006), the degree of originality of an idea is determined by how distinct it is from existing concepts. It has to do with broadening the solution space. Novelty is the degree to which a concept is unexpected or unanticipated in comparison to other ideas (Shah, Smith, and Vargas-Hernández 2003). Novelty measures the extent to which a design idea differs or is surprising in comparison to other concepts—including ideas from others (Shah and Vargas-Hernandez 2003).

To measure novelty, Shah, Smith and Vargas-Hernandez (2003) state that every participant's idea from every technique must be gathered, and important characteristics like control mechanism, and kind of movements observed. Next, all the ways in which each of the characteristics is satisfied must be listed. For instance, a motion might be whirling around, sliding, or revolving. Next, count how many times each solution approach appears across the whole set of concepts. The novelty increases with [a] decreasing count. Shah, Smith and Vargas-Hernandez (2003) point out that the design challenge is first broken down into its essential components and every notion that is formed is examined by first determining the purposes it serves and then explaining, either conceptually or at embodiment-level, how it accomplishes these roles. Each description is assigned a novelty score (Shah, Smith and Vargas-Hernandez 2003). It is feasible to calculate the

overall originality score for any concept by allocating weights to every function and stage.

Depending on the rating system used, novelty may be evaluated on several different levels. Personal novelty is the most basic kind, when someone finds, or comes up with concepts that are unique to them. Using some degree of innovation in the process of coming up with ideas is crucial. Novel designs take up positions that were at first not thought to have existed in the design.

2.15.2 Variety of ideas

Variety may be described as the extent to which one designer's notions differ from those of other designers' (Nelson *et al.* 2009). Shah, Smith and Vargas-Hernandez (2003) explain that variety is a measurement of how much a designer's ideas vary from one to another. Okudan *et al.* (2006) assert that throughout the concept generating procedure, variety is used as a gauge for the investigated solution space. They view the development of concepts that are identical as having limited variety, which could possibly have an impact on other parts of the solution space. They contend that in order to measure variation, concepts must be categorized genealogically depending on the extent to which they fulfill every design role. Ideas are distinguished at the top of the genealogical tree based on the varied physical laws that are applied to fulfil each function. This is the most important level at which discrepancies between concepts may be identified. Working principles are used to distinguish concepts at the second level. Embodiment and detail are used at the third and fourth levels, respectively.

Shah, Smith and Vargas-Hernandez (2003) mention how every function that meets its requirements is examined to quantify variety. A variety ranking is based on the overall set of concepts rather than just one particular concept. Ideas are categorized based on how two thoughts vary from each other.

2.15.3 Quality of ideas

According to Reinig *et al.* (2007), ideation quality is the extent to which an ideation process yields concepts that are useful for achieving a certain objective. In their definition, Shah, Smith and Vargas-Hernandez (2003) state that quality is an evaluation of the viability of a concept and how closely it meets the design requirements. They consider a concept's quality as a distinctive metric that examines the physical characteristic or ratio of ideas created in relation to the artifact's time, weight, and energy performance.

While formal analysis may not be possible at the conceptual stage due to a lack of quantitative data, the quality of an idea can still be accurately evaluated. At the embodiment stage, some ratios and quantitative analyses of desired values of certain qualities can be performed. Appropriateness and quality are closely related concepts. Usefulness and how well the concept complies with design specifications are two indicators of appropriateness.

2.15.4 Quantity of ideas

Quantity is the total number of ideas produced over a predetermined period of time or while going through every phase in a design process. Nelson *et al.* (2009) defined quantity as the sum total of varied concepts developed by a designer. This is to say that two or three similar ideas should be considered as one count because similar ideas mean repetition of ideas and counting of similar ideas will be repeated counts.

The extent to which the ideas vary (variety) in quantity determines the novelty and the quality. The more the quantity and the variety, the more the quality and novelty to be produced. So, therefore, quantity and variety are the effort, or actions (process) that are producing or generating quality and novelty (output), which are the expected solutions or products.

2.16 Criticism of Shah *et al.'s* Metrics of Ideation Effectiveness

The contribution of Shah *et al.* (2003) towards the measurement of effectiveness in ideation has been helpful; however, some of the metrics in

the model have been rejected after they were subjected to critical analysis. Once these criticisms are considered and factored into the measurement, it becomes an excellent tool for the measurement of effectiveness in ideation.

In their study, Nelson *et al*. (2009) argued that there were flaws in the variety metric of Shah *et al.* (2003*).* They identified the first flaw as being the higher the variety of genealogy the lower the overall variety score. According to them, this flaw occurred as a result of double-counting design ideas. They suggested that the double-counting problem is easily fixed by allocating points at nodes where differentiation takes place as opposed to counting the number of branches. Commenting on the second flaw, Nelson *et al.* (2009) argued that variety can only be computed for a collection of several design concepts and not as the typical variation score for each design. Rather than calculating an average for each concept, a non-normalized variety score could be used to evaluate the real design space exploration of the full set of ideas.

2.16.1 Creating a single metric

Nelson *et al.* (2009) are of the view that using three different measures to assess design space exploration is likely to pose challenges when comparing design sets. Regarding the flaw in Shah *et al.*'s (2003) variety measure, Nelson *et al.* proposed a single metric for evaluating the quality of design space exploration during the design idea generation. According to them, measures of the total amount of investigated design space can be conceptualized as variety and quantity metrics, in addition to a non-normalized variety measure. Regarding the novelty measure, the authors argued that it is simply a metric indicating how successfully or poorly the design space was explored during the exploration. Novelty, according to them, evaluates design of space exploration quality that is measured by variety. In view of this, they suggested a metric which combines novelty and diversity to evaluate the amount and quality of design space exploration, and this is provided by:

$$\mathrm{DSQ} = \sum_{j-1}^{m} f_j \overline{n}_j \sum_{k=1}^{4} S_k (b_k - 1)$$

'which is design space exploration quality (DSQ) and $\overline{n}_j$ *is the mean novelty of the design outcomes for every function (Shah et al. 2002). All the functions might use a combination of these measurements. The novelty operates as the factor of scale in the equation, lowering the value of a collection of designs when novelty is limited'* (Nelson *et al*. 2009)*.*

2.16.2 The need for good idea-count

Reinig *et al.* (2007) conducted a study to examine the four metrics that are commonly employed to assess ideation quality which are idea count, sum-of-quality, average quality, and good idea count to examine the advantages and disadvantages of each. They conducted experimental research using three levels of comparison to find the variations in the ideation metrics. They found that the results obtained were based on the quality measures employed in the calculation. Following a thorough investigation, Reinig *et al.* suggested that the only metric that should be utilized for assessing ideation procedures is good idea-count.

An idea's quality may only be evaluated in relation to the particular objectives of the ideation process. This includes feasibility and originality, effectiveness, the significance of a concept in relation to a certain setting and the extent of an idea's influence. Likert scales, semantic differentials, and rubrics that assess a single or multiple quality aspects are commonly used to illustrate quality metrics.

Reinig *et al.* (2007) point out that the three analytical methods established by Diehl and Stroebe (1987) are used by researchers when calculating idea quality and are:

• *sum-of-quality* is determined by adding the quality ratings of each session idea individually.

• *average-quality* is determined by taking the average of the quality ratings for each of the session's unique ideas, and
• *good-idea-count* is determined by only including concepts that reach or surpass a quality threshold and have a certain quality score.

An idea that receives the greatest quality score, whatever other criteria researchers decide to employ in a particular study, is referred to as a 'good idea'. On the other hand, an idea that has the lowest quality score is referred to as a 'bad idea'.

2.16.3 Idea-count

This approach to quality measurement simply takes count of all the concepts produced in support of Osborn's (1963) position that as more ideas are created, there will be an increase in 'good ideas'. Idea count does not call for a quality assessment of each idea. According to Reinig *et al.* (2007) it is less subjective as no score is awarded to any idea and it is less labour-intensive than alternative methods. It is not appropriate to consider every concept to be of the same quality as some may be more useful than others.

This means that if two designers are tasked to generate ideas and designer A generates a total of 10 ideas out of which seven (7) ideas are of high quality and creative, and designer B creates a total of 15 with only two (2) quality ideas, the Idea-Count approach will consider designer B to have performed better than designer A. The focus of the idea-count metric is on the total idea count and not on creativity or quality of ideas which is why Reinig *et al.* (2007) argues that using the idea-count metric is not considered trustworthy because ideation interventions that result in good ideas score less than procedures that produce numerous mediocre ideas.

2.16.4 Sum-of-quality

The idea-count measure rewards good ideas as they are identified and given good scores. The weakness with this measure, however, is that it generates a lot of poor concepts that tend to have higher rewards than initiatives that

led to a lot of good concepts. The sum-of-quality metric shares a bias with the idea-count meter due to the existence of further poor ideas being able to raise the metric's overall score, which indicates greater ideation quality. The metric wrongly leads researchers to conclude that there exists a favorable correlation between the number and quality of ideas, concluding that treatments which generate a large number of poor concepts are better than those that generate a small number of good ideas (Reinig *et al*. 2007).

2.16.5 Average-quality

The results of this metric measure are always dependent on the scores of individual results in the idea set. For instance, if designer A produces 5 ideas in a set with individual scores of 5, 5, 4, 4, 2, the average score will be 4. If designer B produces 10 ideas in a set with individual scores of 5, 5, 5, 5, 3, 2, 2, 1, 1, 1, the average score will be 3. Even though Designer B has generated more creative ideas of higher quality with four 5s, the average score (3) is less than the average score of Designer A (4) who generated only 2 quality ideas (two 5s).

Based on this understanding, Reinig *et al*. (2007) stated that the average quality measure's score declines when further poor concepts are developed, even if the concept collection has a significant number of excellent ideas. It should be noted that treatments with low idea generation with some good ideas in the set may do better on this metric than those with higher idea generation but with a correspondingly greater number of poor ideas.

2.16.6 Good-idea-count

As the words suggest, a good idea count only focuses on selecting good concepts produced by the designer. A threshold is set on an ordinal scale and any idea below the threshold will not be counted. There is no fixed level of setting the threshold; however, it should be set at a good level where the selected idea will be useful enough to add something worthwhile to the objective. The level at which the threshold is set is generally dependent on

the designer and the nature of the project, or the researcher and the phenomenon being studied. The good idea-count metric, according to Reinig *et al.* (2007), is a discontinuous invariant which is useful for evaluating ideation quality hypotheses. The good idea-count assesses the main goal of idea generation, which is to produce as many good ideas as feasible, without depending on doubtful premises.

It was observed that there is an unfavourable association between concept counts and sum-of-quality metrics and the average-quality metric (Reinig *et al.* 2007). A careful analysis revealed that the average-quality metric concluded that a conceptual treatment resulting in a group of concepts which are all poor is better than a treatment that generates the same amount of excellent and poor concepts. In addition, as can be seen in the example under average quality above, treatments that produce fewer concepts overall yet contain some good ones do better on this metric. However, treatments which generate a higher number of good concepts but also a correspondingly higher number of negative concepts receive a lesser rating. These inconsistencies render average-quality measures, like the idea-count and sum-of-quality measures unreliable. The essence of ideation is to generate good ideas and any metric that is not able to reward a high count of good ideas is not worth using.

All the identified errors in the three metrics were considered while constructing the good-idea-count metric. The concept count, sum-of-quality, and average-quality measurements all have biases that are not found in this measurement. The good-idea-count metric is not inflated by the inclusion of poor ideas, so it is not biased in favour of big concept sets regardless of quality. Good ideas are recognized and rewarded unlike idea count and sum of quality. Again, the good-idea-count metric is in contrast to average quality, which is lowered by poor concepts regardless of the quantity of good ideas in the concept set. Assumptions on the correlation between idea number and idea quality are not necessary for good-idea-count.

2.17 Design Space Exploration: Expanding and exploring

Design space can only be fully known when the designer is done with ideation because as the designer works out possible solutions to a design problem, some of them may not meet the design requirements upon further analysis and have to be removed. In this case, there is a reduction of design space as quality measures are applied (Shah and Vargas-Hernandez 2003). Shah and Vargas-Hernandez observed that design space is expanded when a new method of accomplishing something emerges. This is why researchers support the generation of multiple-idea solutions to a problem as this is likely to increase good possible solutions. Increasing design space provides the opportunity to discover superior designs that have existed.

Kang, Jackson and Schulte (2014) define design space exploration (DSE) as the process of identifying and assessing design outcomes when building a system. According to them, the process of examining design options before their execution involves quick prototype development and refinement. As stated by Sas and Dix (2010), the technique of generating and evaluating ideas comprises two phases: abstraction and concretization. While abstraction deals with meditation and comprehension, concretization deals with concepts, objects, or instances. They observed that effective design space exploration leads to a smooth transition from the abstract to the concrete. While examples help to gain a better understanding, they also serve as the basis for the generation or refinement of concrete ideas.

2.17.1 Three Techniques of Design Space Exploration

Sas and Dix (2010) outlined three approaches that can enhance design space exploration and these are the reshaping of bad ideas, critical transitions, and separation and composition of concerns.

a. *Reshaping of bad ideas*

   To Sas and Dix, some ideas that seemed to be bad can turn out to be good if they can be improved upon. The bad idea technique, therefore, focuses on the way ideas that were considered bad become

useful in solving a particular problem. In view of this designers are motivated to develop concepts that are subject to systematic analysis. This approach provokes diverse viewpoints and a more methodical examination of the problem that may result in the generation of a new and unpredictable idea. Sas and Dix (2010) advised that to achieve this, designers should consider three key prompts:

a. Determining and investigating the positive elements of the problematic concept;
b. Altering the situation so that the problematic concept may be improved; and
c. Performing scenarios related to exploring problematic concepts.

Exploration of bad ideas will help designers to gain better understanding of the design space and also reduce their emotional attachment to good ideas. This approach will eliminate idea fixation with designers showing early devotion to previous remedies and a failure to consider other possibilities, thereby resulting in a free flow of ideas knowing that no idea generated is ‘wrong’. The idea is that because the end cannot be predicted, any ideated design stands the chance of being a solution. Ullman *et al.* (1988) noted that skilled inventors spend time in transforming flawed designs instead of tossing them aside in favour of fresh ideas.

b. Critical transitions

According to Dix and Patches (2004), critical transition has to do with recognizing important elements in the design space, like the archetypal instances of each category and the middle samples alongside the groups in which they are situated. This helps identify the transition points where a little alteration transformed a design from one group to another. The critical point at which the example was transitioned to a new category is the attribute (the alteration) that caused the change.

c. *Separation and composition of concerns*

In this approach, constraints and requirements are sequentially factored into each design as the ideas are generated to address them. Following this is the stage at which the relationship and interconnectedness within the various design limitations are handled.

While the concept of Separation and composition of concerns may not be applicable in graphic design, Bad ideas and Critical transitions can be very useful. For instance, a graphic designer may pick a design that is considered a bad one and improve upon it by redesigning it to meet the required qualification standard. This will be added to the possible solutions to increase the design space. Benson (2012) supports the idea of restructuring previous design efforts in order to improve on them which requires design inspiration.

2.18 Design Inspiration

Inspiration is the act of being inspired to act psychologically, especially to do something creative (Benson 2012). Designers find inspiration by examining pre-existing concepts, examining other objects or procedures, analyzing their surroundings, conversing with others, and testing out various concepts. One can get inspiration for design from a variety of places, including people, literary works, movies, flowers, and nature. Designers utilize bits and pieces of these as inspiration for their own creations. Benson states that inspiration sometimes helps to build upon previous efforts by taking clues from what has been done in the past and restructuring it to improve on it. Eastman (2001) states that inspiration comes from stimuli from within as well as from outside. While external inspiration refers to the utilization of knowledge from sources like tangible items and media, internal inspiration encompasses previous knowledge and background. This indicates that a designer who has rich experience and a strong design background is likely to dive inwardly into the cognitive domain and pick out from his previous works some design details that may be useful in response to a brief. This demands some form of deep reflection to mentally scan through the various works, and select and

assemble elements from a number of works that are creatively organized to form a new design. This is what Koestler (1964) refers to when he states that a designer deliberately connects previously unrelated ‘matrices of thought’ in order to produce a creative idea. A matrix of thought refers to an idea in the designer’s mind.

A designer can equally depend on an external environment by observing and synthesizing details from what he sees around him such as images and objects. To throw more light on this, Hofstadter (2001) stated that external sources of inspiration help in establishing connections between different (disjointed) elements and information. The connections drawn from the variety of elements are always referred to as analogies. Analogies, according to the author, are regarded as a cognitive method of knowledge transmission from a particular field (the source) to another (the target). Analogies are powerful tools of cognition and creativity that are capable of connecting the inspirations that are derived from outside factors that inspire the creation of innovative solutions.

Designers sometimes depend on stimuli that serve as actual examples of designs. Typically, in the design process, they serve as outside inspirations (Gonçalves *et al.* 2014) [and in] whatever form they take, vocally or visually, these are things or models of prospective items that may be used to generate concepts and display possible outcomes. Exemplary concepts can also be distinguished by them possessing a tangible counterpart or an explanation of their purpose, composition, and conduct. Real-world examples of naturally existing things like forests and wildlife can stimulate idea formation and encourage analogous transfers (Helms and Goel 2014).

There can also be a blend of internal and external stimuli for a quality design output. This is to say an expert designer may adopt some elements of previous work to come up with a design and blend it with some details inspired by works of others, images or things seen around. However, inexperienced designers are more prone to only rely on external stimuli as

they do not have a design reservoir or any reference of past works from which to draw their inspiration. The quality of their design will vastly depend on the quality and variety of external materials collected and how they are able to draw analogies to arrive at a solution. In view of this, novice designers need to know how to source design inspirational materials for good creative output.

2.18.1 Digital Mood Boards as a Source of Design Inspiration

Designers frequently use mood boards, collages made of text, pictures, and representations of items, to convey and investigate visual concepts (Koch *et al.* 2020: 407). Mood boards, according to Garner and McDonagh-Philp (2001), are sources of motivation for designers working in artistic professions like clothing and design. Freeman *et al*. (2017) posits that mood boards are an effective technique for conveying a complex network of disparate concepts that are challenging to articulate orally. They add that mood boards inspire designers to delve further into their project's subjects and ideas since they are creative and enjoyable to make. They are distinctive paperwork with a unique arrangement of visualizations that make sense in certain design contexts according to Gentes *et al.* (2015) who argue that mood boards build a simple mentality for creators who never had the opportunity to work on a specific project to create a resource for design cues. Mood boards seek to organize users' experiences since they evoke particular emotions (McDonagh and Denton 2005).

Gentes *et al.* (2015) argue that mood boards serve as a repository for characteristics which may be extracted from the depictions. Discrete elements include things like shape, colour, construction, and science (Gentes *et al.* 2015). A mood board is a tool for bringing variability (heterogeneity) into uniformity (homogeneity) (Gentes *et al*. 2015). A mood board may be thought of as organizing materials based on design reasoning from different disciplines (indiscipline). This involves assembling a collection of diverse items that are intentionally arranged within a document to provide

a range of potential interactions. By requesting photos from a variety of sources, individuals may come up with more original ideas for comparison. In view of this Gentes *et al.* (2015) stated that design is an "in-discipline" profession because it selects parts of several kinds to create an assemblage that rigorously works in fields.

In spite of these views about mood boards, Garner and McDonagh-Philp (2001) raised an argument saying there exists no convincing evidence that the communicational goals of mood boards are properly met as users usually typically interpret its representation differently. It is also argued that it is not clear how mood boards serve as inspiration. Cheng *et al.* (2014) point out that mood boards are useless for making design decisions, hard to connect to real-world placement, and impossible to integrate into a project. They also point out that mood boards are tools that are likely to induce fixation during the design process. Compared to other thoughtful and disorganized synthesis processes, they are viewed as time wasters since they are not presented as instantly predictive or actionable (Kolko 2010)**.**

It is understood from the contributions made by these scholars that the essence of a mood board is to produce something creative by gathering inspiration from the images gathered on the board. Mood boards, therefore, act as a repository of attributes and visual elements for the design project. They serve a communication purpose while communicating style goals to clients and other individuals in the design team. As mentioned by Andrés (2012), a mood board acts as a source of visual expression to clients and stakeholders. It helps in collecting designs that have been successful in the past for the purpose of gathering aesthetic cues for future designs. They are collections of images and traits that are gathered from different sources and assembled as unit compositions. They are therefore not analytical instruments as the pictures have lost their context. By disengaement, the depicted object—a mood board—is better understood as an assemblage of qualities that may be applied to a variety of future contexts rather than as a fix for a particular circumstance.

In order to gather knowledge and details for an upcoming endeavour, designers manipulate, organize, prune, and filter data. Mood boards establish cohesion through the use of powerful synthesizing procedures that identify common themes and group them under qualities or themes.

Gentes *et al.* (2015) discovered in a study they conducted that design students felt at ease using and manipulating imagery. The mood board was used as a common design tool among the students and was part of their culture of design practice; however, mood boards were not seen by them as legitimate works that need to be preserved. This is due to the fact that they look too restricted in terms of area and time to be helpful for more design research.

Students had to become familiar with a visual culture that was completely unrelated to the project during their engagement. The study revealed that students used digital tools such as Powerpoint, and Adobe Illustrator to organize the mood boards. A variety of slides, some with annotations, each had a collection of photos for the presentation.

The study points out that students' use of the mood board was to develop their professional skills and at the same time to disorient them either via the application of unusual instruments or techniques, and/or by promoting a very individual approach to an ill-defined problem.

2.18.2 Creating a mood board

To create a mood board, designers engage in an iterative procedure of gathering inspiring images and using them to create a mood board by organizing and choosing them according to design principles (Donald 2017). Mood boards' inherent visual elements stimulate the generation of fresh concepts with a great deal of possibilities for creative problem-solving and inventive discoveries.

When looking for imagery, designers utilize curated inspiration networks like Behance and Pinterest in addition to image search engines like Google. Users may use an image to search related pictures on the internet with Google Reverse Image Search (Koch *et al.* 2020:408). In their attempt to help designers in digital mood board creation, Koch *et al*. introduced the Semantic Collage, which utilizes semantic labels that are extracted from photographs to aid in the search and thinking processes of creators. This is an exploration that starts with a known anchor point that may be an object or association. Step by step, the search is then refined until a desired result is obtained (Teevan *et al.* 2004).

According to Koch *et al.* (2020:408), image-based Google Image Search is of great benefit as computer vision and machine learning have advanced in recent times. Google Image Search uses Google Lens (Patel 2018). By using this search engine, images deemed similar, or semantic images are searched when an image is dragged into the search bar. This is made possible as the neural networks are used by an image recognition system to convert the picture into semantic labels (Google LLC 2020).

Technically speaking, an inquiry method known as content-based image retrieval is used in reverse photo exploration (CBIR). This method of using artificial intelligence to retrieve digital pictures from websites using computational models is often referred to as content-based visual information retrieval (CBVIR). Therefore, in Google's search by image, a search query is formulated using an analogous image to retrieve the information.

Search by photo is easy to use. Simply upload the image you are looking for from your storage device to use this web-based application. It also allows the user todrag and drop to perform image reversed searches.

In order to make search more convenient to users, the search tool also offers users three options which are entering a picture into a URL, uploading a

picture, and using keywords to conduct the search. The necessity of locating the "correct" search phrases is eliminated with image-based search (Koch *et al.* 2020).

In a study, Koch *et al.* (2020) discovered that nine (9) out of the fifteen (15) or at least half of the participants' work was completed using mood boards. The majority, twelve of them, made digital mood boards. The reasons given for creating the mood board were for organizing their feelings and ideas about the work. Mood boards, according to designers, are helpful in exploring a variety of styles and also serve as a means of communicating their ideas. In designing the mood board, according to Koch *et al.,* respondents used tools such as Adobe Illustrator, Sketch / InVision, as well as internet platforms like Milanote, Arena, Pinterest and Behance.

This means a digital mood board was used by the designers as a source of inspiration. Gathering different images from different search engines helps improve creativity. The richness of the mood board in terms of the heterogeneity of images will eliminate design fixation as there will be numerous ideas popping from the board. As put by Vasconcelos *et al.* (2016), external influences can stimulate the creativity and idea creation of designers. A good mood board will therefore engage designers in creating varying ideas leading to innovative ideas. The earlier argument by some researchers that the use of mood boards usually leads to fixation is an indication that the board used by the designers were not rich enough to yield profitable creative ideas. From another perspective, it may be due to the designers' own attitude of hooking onto a particular idea without making efforts to discover more ideas as stated by Arciszewski and Youmans (2014).

Creating a digital mood board is much easier than a hard mood board. The creation of a hard mood board can be very demanding in terms of the amount of time and the process involved.

It is crucial to remember that possession of digital tools does not automatically translate into creativity; rather, it creates opportunities for engagement, involvement, and the proactive display of creativity, uniqueness, purpose, and worth (Nikolopoulou 2018).

2.19 Implications of the Review and the Way Forward

This [literature] review intended to find out about the current practices in graphic design processes, with an emphasis on the use of digital technology during the ideation process. This was to prepare a strong foundation to investigate how digital technology can be effectively utilized to enhance design ideation.

The review exposed current practices in design ideation. Even though much of the literature is not directly based on graphic design, it is very useful and is applicable to graphic design processes. Major design fields covered in the review include graphic design, engineering, architecture, interior and fashion design. The review covered a broad spectrum of design-related subjects which include design brief, stages of the design process, design ideation and its relevance, the role of design cognition in the creative process, the various thinking processes in design (creative thinking, Linear, Lateral, convergence and Divergent Thinking), issues related to design inspiration, general knowledge of technology and digital technologies applicable to graphic design ideation, and many others.

The goal of design ideation, which is the first stage of the design process, is to investigate, produce, and create solutions in response to a brief (Kim 2020). The literature identified two main categories of design practices among professionals and these are: *supporting practices* and *triggers*.

The first classification, "supporting practices, outlines the tasks to be executed by designers in the process of generating ideas. The following five codes are included in this category: (1) material experimentation and

sketching; (2) gathering; (3) verbalizing (noting, mind mapping, evaluation of user); (4) narrowing down; and (5) cooperating. The second classification referred to as “triggers”, consists of four sections that served as catalysts for the ideation process: (1) inspirational sources; (2) outside limitations; (3) main generators; and (4) cognitive images. Following that, the function of triggers and supporting practices was divided into four design strategies: (1) cognitive, (2) materials, (3) word, and (4) visual. This study focuses more on the *supporting activities* than the triggers.

Literature makes it clear that technology is not a ‘thing’; but an approach. It is a problem-solving approach by the application of scientific principles (Levin 1996). It is the term for the theoretical and practical know-how, abilities, and tools utilized to create goods and services in addition to the infrastructure needed for their creation and delivery (Burgelman *et al.* 1996). Skills is an ability developed when knowledge and practice are combined to effectively perform an activity. The use of skills and artefacts to solve a problem defines technology. The artefacts to be used in the case of this study are the digital devices and the skill needed is the digital skill and the expected result is good ideation outcomes. Jones-Kavalier and Flannigan (2008) refer to digital skills as the capacity to carry out duties efficiently in a digital context. The use of digital devices in the design ideation process (the topic being studied) calls for the availability of digital devices and the application of the required digital skills on the devices to solve design problems. In other words, access to digital devices and skilful use of the devices will help in the generation of creative ideas.

The fact remains that students in tertiary institutions are well exposed to digital technologies but the question is how effectively they are using digital technologies during design ideation. The use of digital devices in ideation requires that students are given a substantial amount of skills training in that regard. As posited by Lan and Young (1996), technology is usually associated with achieving specific goals, finding solutions to specific issues, and carrying out specific jobs requiring certain expertise. Jones-Kavalier and

Flannigan (2008) state that digital skill is the capacity to carry out duties efficiently in a digital context. Yes, students may be using digital devices in so many ways but if they are not trained, particularly on how to use these technologies with design software to skilfully generate design ideas, they may not be able to take full advantage of the numerous opportunities for improved ideation outcomes. It is therefore imperative for students to be acquainted with digital technology use in ideation

Some design educators and designers naturally succumb to the philosophies of Dorta (2008) that ideation should be handled by means of the traditional method through sketches on paper (pencil and paper drawing) and the position of McGlashan (2017) who posits that the use of paper sketches for initial idea capture (idea generation) helps in building confidence and encourages an unimpeded flow of ideas. Dorta (2008) argues that to externalize and see internal mental pictures, representations need to be flexible, vague, unclear, and inaccurate and these, according to the author, may not be achieved with digital technology. Meanwhile, a study by Thorsteinsson *et al.* (2010) supports the use of ICT for ideation, stating that students' motivation for the use of ICT in ideation affects their ability to find new ideas. The notion that digital technology does not effectively support ideation is principally because these individuals are not exposed to the use of digital devices in ideation through training. Therefore a paradigm shift from the traditional pencil and paper approach to a contemporary digital approach is needed to improve ideation outcomes and this shift starts from the mind.

The reviewed literature has made it clear that design involves a great deal of thinking. It engages the cognitive domain of the designer, where human cognition is understood to include all of the processes by which sensory information is altered, simplified, developed, preserved, retrieved, and utilized (Neisser 1976). In other words, design cognition is used to describe the mental models and procedures used in design creation (Hay *et al.* 2017). Human cognition also refers to all of the actions that take place during the

design (Chan 2015). A range of design activities that engage human cognition as reported by Makri and Warwick (2010) include:

a. *Finding information,* which they categorized as "browsing, surveying, monitoring, encountering, accessing, searching, and investigating."
b. *Accessing information*, categorized as "choosing, identifying, and extracting."
c. *Interpreting information*, grouped under the headings of "visualizing/appropriating, synthesising, and analyzing."
d. *Using information,* categorized as "storing, editing", and
e. *Communicating,* categorized as "sharing, disseminating and consulting".

All of these engagements are purely cognitive processes as the brain is actively at work accepting and rejecting information, determining which information is worth communicating.

It must be admitted that with this kind of thinking involved, effective design ideation cannot take place just anywhere. There is a need to create a conducive design environment as an individual, as a team or as an institution for an effective ideation process.

Providing an enhanced learning environment that reflects a good integration of technology will offer students a favourable environment to achieve creative and academic goals. Adopting a contemporary approach of digital ideation and creating the needed technology-enhanced environment to support this approach will provide the best atmosphere to encourage the exploration of novel responses to creative issues and will equip students with adequate skills that will be sought after by the technology-gratification clients of the current world. ECLAC, (2021) indicates that production and growth are based on technological advancement. Therefore, advancement and growth in the field of design depend on the integration of new technologies into creative and production processes.

Laing and Masoodian (2015) carried out a qualitative investigation of the function of visual data in graphic design. Fifteen experts from ten distinct firms, all based in New Zealand's North Island, participated in fourteen interviews. The authors classified the role of visual information into themes and these are: 1. personal development (visual materials inform their professional practice); 2. cognitive aid (visual materials that help to execute certain jobs); 3. communication of an idea (use of visual materials to communicate with others during the design process); 4. aesthetic of the client (materials used by clients to help designers know about clients' design taste); 5. aesthetic of the audience (visual information that appeals to the sensitivity of the target audience); and 6. aesthetic of the market (investigating the visual materials and aesthetics of the client's competitors in the market).

While the six themes identified by Laing and Masoodian are important, this study will focus particularly on the first three as they are directly related to the objectives of the study. How the designer gathers the necessary visual materials; how these visual materials are creatively synthesized (organized) to obtain the desired design output, and how the visual materials (graphics) are used to communicate to others are of great interest to this study, particularly, the role played by digital technology in achieving these creative purposes.

2.20 Summary

There is quite a wealth of literature on ideation covering a wide range of disciplines and a substantial amount of study on ideations related to design in general. It was quite difficult researching enough literature, particularly, on graphic design ideation. However, literature on ideation from different design disciplines including engineering, architecture, interior and product designs provided solid support that augmented the scant existing literature in graphic design for this review. This is principally because the ideation processes in these fields are directly applicable to graphic design, although perhaps with a

few adjustments. For instance, while object modelling sometimes forms part of the ideation process in engineering and product design, it is not embraced in graphic design. However, processes related to briefs and reframing of briefs, gathering of visual materials for purposes of design inspiration, idea representation and communication, either through the use of paper and pencil or digital technology, are technically speaking, very instrumental.

Generally speaking, the information obtained in the review of literature related to the study has broadened the researcher's understanding of the topic, giving him a guide on how to approach the research and what to expect in the field. The review also helped the researcher to reframe the research questions appropriately in context, [while] developing a solid conceptual framework for the study, and gaining adequate knowledge on current issues related to digital technology in design ideation, which positioned the researcher to conduct original research and psychologically prepared him for the task ahead.

CHAPTER THREE

CONCEPTUAL FRAMEWORK

Digital Technology in Graphic Design Ideation

3.0 Overview

This study seeks to explore how digital technology can be effectively utilized to enhance graphic design ideation among graphic design students in two selected Ghanaian universities. The previous chapter highlighted that design ideation is the critical phase of the design process which demands creative effort (Casakin and Levy 2020) where creative ideas are generated and evaluated (NCERT 2011 and Kim 2020). The chapter also discusses paradigms of thinking in design which include linear, lateral, divergent and creative thinking and their relevance to design ideation. The reviewed literature makes it clear that applying these kinds of thinking leads to creative output, particularly divergent thinking, which is considered to be the capacity to break free from popular ways of thinking to come up with original ideas. A review was also conducted on design cognition, skills, ability and expertise in art, all of which can be developed through training and experience. It is something that can be taught and learned (Ericsson *et al.* 2007).

This chapter discusses the conceptual foundation that guided the research. First, the concept of a conceptual framework was examined from various literature sources to build a strong foundation of knowledge on which the chapter is based. The chapter delves into issues related to design ideation models and components of ideation which include design briefs and design Inspiration. The chapter also covers digital technology as a tool for idea generation, and Shah's theory of ideation effectiveness. Other areas explored are design cognition, which outlines some mental activities that are carried out during the design process. Digital competence, which covers the essential digital skills and competencies needed for digital content creation and design problem-solving is also discussed. Finally, a conceptual framework was developed based on ideation inputs, ideation processing and ideation output. Ideation inputs include the design brief and inspiration. Idea

processing involves design cognition, digital skills and digital technology application. Lastly, ideation outputs are the results obtained after ideation and include quantity, quality, variety and the novelty of ideas, which are the constructs of Shah *et al.'s* (2003) theory of ideation effectiveness measurement.

A conceptual framework, according to Imenda (2014), is the result of merging several related ideas to give a more thorough explanation and understanding of the subject under research. The conceptual framework arranges the main ideas and concepts from theories, important study results, policy declarations, and the professional expertise that directs the study. These key concepts and findings aid in defining the study's direction and emphasis. They emanate from the results of the literature theories, as well as from investigations of the related topics in literature Shikalepo (2020). The conceptual framework functions as a study guide (Ravitch and Riggan 2016), serving as an ecosystem for integration that enables the researcher to consciously integrate every facet of the investigation. This is accomplished via a procedure that clarifies the relationship, divergence, conflicts, overlaps, and context-shaping of the study environment and the investigation of the phenomena. (Sage 2021).

3.1 Design Ideation Models

Design idea development started several decades ago and as has been mentioned in the review of related literature, design ideation, also known as a creative process, is part of the design process. The concept of ideation is primarily the process of creating ideas through conceptual space exploration and transformation. According to (Warr and O'Neill 2005), models of the creative process are employed to depict the phases involved in the idea-creation process. This section, discusses some of the ideation models.

3.1.1 Wallas's Model of Design Ideation

One of the earliest models was created by Wallas (1926) who proposed a four-phase creative process paradigm known as *Preparation, Incubation, Illumination and Verification*.

- *Preparation*: At this stage the designer is required to acquire knowledge of the design task and have the necessary understanding to produce creative solutions to the problem. This stage can be likened to NCERT's (2011) Design Brief stage. According to Lawson (2005), the stage entails putting in a lot of deliberate effort to find solutions to the situation. Some idea flashes may be presented to the designer as a variety of potential solutions are investigated and the problem is modified.

- *Incubation:* At this stage of ideation, the designer commits the design problem to thought in a reflective manner, trying to figure out the appropriate way to approach the idea generation. During this stage, according to Lubart (2001), thoughts about the issue linger even when the artist is taking a break, unconsciously creating concept pairings that take place during incubation stage. Lubart adds that many of these idea combinations are rejected by the unconscious mind as not viable but sometimes a good idea is found.
- *Illumination:* As a result of the mental activities during the incubation stage, [real] ideas now begin to form in the mind of the designer and the designer begins to externalize them through writing, drawing or modelling, depending on the kind of task at hand.

- *Verification*: At this stage, newly generated ideas are subjected to some form of evaluation to select the most creative one for further development.

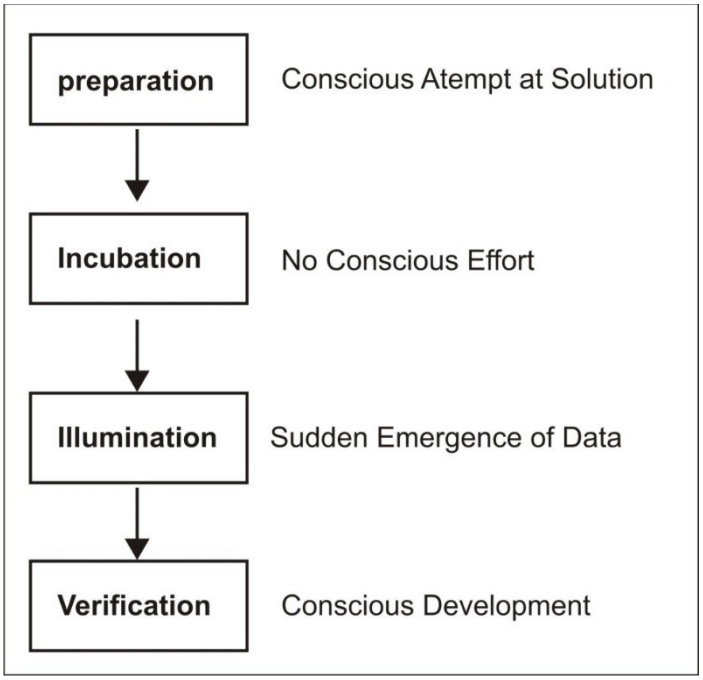

Figure 3.1: Wallas's Model of Design Ideation (1926)

3.1.2 Amabile's Model of Design Ideation

In Amabile's (1983) view there are only two important stages in creative idea processing and these are *Idea Generation* and *Idea Evaluation*. The author disregarded the preparation and the incubation stages in Wallas's (1926) idea model. This means he placed more value on the idea-finding process through creating visual representations that will lead to producing novel ideas. The ideas are then evaluated for appropriateness and novelty, leading to the selection of solutions to the problem. All the other stages such as initial preparations and the idea incubation stage (which involves cognitive processes of idea evocations) that lead to the visual expressions were not of importance to him. He later developed a five-stage model of ideation which included P*roblem and Task Presentation, Preparation, Response Generation, Response Validation* and O*utcome.* Amabile's model is much like that of Wallas's (1926) ideation model, except that he introduces Problem and Task Presentation as the first stage. This stage represents the designer's first contact with a design problem when the design is presented to him with some initial briefings. The intent is to communicate some

information about the task and summarize the amount of work to be done. Problem and Task Presentation is also a way of engaging the designer in understanding the goals and objectives of the task. Wallas prefers to use the terms, Response Generation and Response Validation instead of Idea Generation and Idea Validation because he perceives the generated ideas as responses to the design problem. Amabile's (1983) model has not brought any significant change to the already existing models in the sense that the first stage (Problem and Task Presentation) can be conveniently placed under the second stage (Preparation). This model is basically similar to of Wallas's (1926) model.

3.1.3 Warr and O'Neill's Model of Design Ideation

Warr and O'Neill (2005), on the other hand, organized the ideation process into three stages and these are Problem Preparation, Idea Generation and Idea Evaluation. Problem Preparation refers to the preliminary preparations such as understanding the problem, researching about it and reframing it. Idea generation as already established, is the physical projection of an idea by the designer in the form of writing, drawing or modelling that can communicate the designer's intention to solve the problem. Idea evaluation refers to the selection of quality solutions to the problem based on appropriateness and novelty.

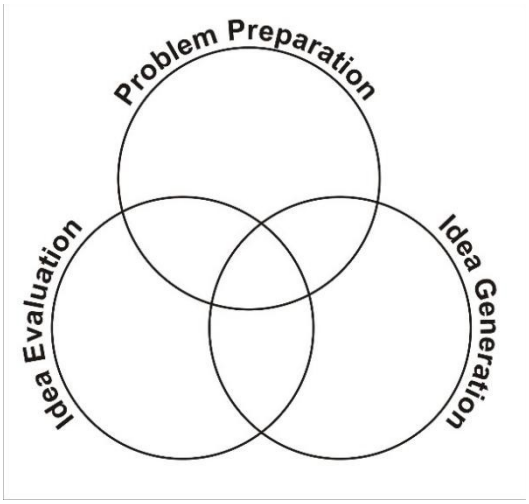

Figure 3.2: Generic Creative Process Model Adapted (Warr and O'Neill 2005)

While the models discussed are often used as creativity support tools, they are criticized on the ground that the illustrations are consistently shown in a static, sequential style that progresses through several phases (Warr and O'Neill 2005). That being the case, several different, more intricate models incorporating sub-processes were created from the fundamental four-process model.

Wallas (1926) pointed out that an individual might go back to the initial stages of the procedure [even] while tackling creative issues. This was supported by Warr and O'Neill (2005) as they claimed that the models illustrate several phases of the entwined and repetitive processes of invention well because they're not meant to be sequential, step-by-step models.

It is observed in the models that the researchers tried to give a more accurate reflection of the ideation procedure within the area of creativity which will help designers in their pursuit of creative solutions. Even though the models vary in the number of stages and the names given to the various stages, one can identify some similarities among them. Apart from Osborn's (1963) creative model which consists of only idea generation and one idea evaluation, the rest of the models have three things in common. They express the need to have design problems, generate design ideas and evaluate the ideas. These are the commonalities that Warr and O'Neill (2005) identified and put together to develop the three-stage model. These three stages are the essential components of the ideation process as they cover the most important aspects of the idea creation process. In view of this, the study adopts the Generic Creative Process Model proposed by Warr and O'Neill (2005) as the standard model that guides data collection and discussions related to design ideation.

It must be mentioned that these models are meant to depict different stages of the entwined and repetitive nature of creativity as opposed to step-by-step linear models (Figure 3.2). The model is descriptive rather than prescriptive.

3.2 Design brief

Whenever someone desires or needs to do something but is unsure of the precise course of action to follow to resolve the predicament, that person [is said to be having] difficulty (Chan 2015). In such a situation, the individual seeks the help of someone he believes can help solve the problem. Likewise, the [design] brief outlines the [end] goal a customer hopes to accomplish by commissioning a designer. The brief is introduced at the start of the design process (Camburn *et al.* 2017) and as a document, it outlines the objectives and intended outcomes of a design project (Kang *et al.* 2019). To shed more light on this, Phillips (2004) states that the brief is basically a project scope description, a document that specifies the project timeline and the required standard of the final output, and facilitates decision-making and project management. The design brief is developed by an individual or a workgroup in consultation with the client.

The brief usually contains the ‘what’, ‘who’, ‘when’ and the ‘where’ of what the client wants but does not know how to achieve it (Georgios *et al.* 2019). This means the designer is provided with all the needed information about the problem in terms of what the constraints and specifications are and what the solution will be used for, whom the design (solution) will benefit; when the design will be needed and where the design will be used without providing any clue on how to get the problem solved. The ‘how to solve the problem’ part is the designer’s responsibility. When he is armed with tools for creative thinking, [appropriate] sources, and personal inspirations, a designer may effectively respond to a brief and produce innovative solutions (Ambrose and Harris 2009). Briefs usually contain information that is either loosely specified in terms of requirements and constraints or is just not given which makes solving design challenges in professional settings the most unclear work [of all] to do (Ball and Christensen 2019). Given that this is the case, designers

must necessarily take some time to think about the main points of the issue at hand. This is termed by Cross (2001) as the ‘problem formulation’. During this stage designers are engaged in information-gathering, assumption-making and problem-scoping. Successful designers allot enough time to effectively gather preliminary data and establish objectives and limitations. The introduction of constraints in this early stage is founded on domain expertise, while other constraints are developed as designers investigate potential solutions while addressing problems (Ullman, Dietterich and Stauffer 1988).

The design brief directs the course of the design process and plays a crucial role in creating innovative concepts (Sosa et al. 2018). Because many clients are inexperienced in preparing design briefs, they are usually ill-defined and difficult to understand. For this reason, design problems from clients are always reframed (redefined) by the designers (Georgios *et al.* 2019; Ambrose and Harris 2009) so they can be well understood, defined and easy to work with. Reframing (or redesigning) the design enables designers to factor in the needs of the customer and rephrase them in a way that will help them come up with a solution. Reframing affects conception, project direction, and how one responds to the design brief (Ambrose and Harris 2009). Research has demonstrated that reframing a brief improves design thinking and creativity (Kang *et al.* 2019). Ambrose and Harris (2009) observed that the design group can dispute, define, and reorient the brief by revising it. This guarantees the clarity of the requirement and ensures that the creative solution fulfils the customer's expectations.

Sometimes, this requires some editing of language or, on a more serious note, a rethinking of the goal of the project to assess if it will benefit the client at all. For example, a client may think he needs more attractive posters for improved patronage but the solution may rather be to improve the product quality. Reframing the brief affects the conception and the direction of the project, and the responsiveness to problem (Kang *et al.* 2019). The inability

of the designer to provide the desired outcomes might be because of an incomplete, unclear, or misinterpreted brief (Ambrose and Harris 2009).

The literature review has given a clear perspective of the importance of the brief in the design procedure. It is the first and the most important stage of the ideation process. It is the brief that actually activates the entire creative process and is a crucial reference point for everyone engaged in the execution of the project, especially the designer. It can be inferred from the literature that the brief is a point of reference in assessing the design output in that the success or failure of the design output can be judged by a critical comparison of the brief (input) and the product (output). It can be seen from the literature that a detailed and comprehensive design brief is a crucial component of the creative design process. The decision-making and problem-solving procedure works better if the client provides more information in the early phases of the design process. Thus, critical attention paid to the required details at this stage pays off at the end of the whole process in terms of output quality. It must also be understood that without a brief, design is of no importance. The question is: if there is no problem what will the designer seek to solve? It is the problem that inspires or triggers the solution process. This is why Marchant (2016) considers a [design] brief to be a problem. He posits that the activity of briefing is stating a design problem that needs to be solved.

This literature is very useful. Even though this study will not be keen on how the briefs are treated by the participants before the commencement of idea generation, the brief will be accessed by the researcher and used as a point of reference for effective design output evaluation. The brief therefore forms the basis for the design judgement, without which the researcher or design assessor will not be able to justify the designs that best solve the brief.

3.3 Design Inspiration

In the 18th century much attention was paid to the unconscious (unintentional) sources of motivation that exists within the individual. This is to say that inspiration was not defined as an outside source of power but instead as a mental force inherent to the individual (Ponsford 1986). This suggests that inspiration is intrinsic and that it is born from within the individual just as interest or passion comes from within. Inspiration, in general, involves motivation in which the individual strives to develop a concept to produce a creative work. Inspiration is essential because it foretells innovation, increases output, and encourages initiatives that are made (Cui 2020). Historically, intellectuals have described inspiration as a supernatural occurrence that is outside the purview of science. In other words, inspiration was perceived to be a supernatural phenomenon beyond the realm of science. According to Bremer (2005:3), Plato defined poetic inspiration as a form of holy insanity, wherein a poet is possessed by the Muse and endowed with a vision of truth and beauty. As stated by Buheji *et al.* (2014), unintentionally, interactions with individuals and the natural world can inspire creativity. While inspiration is largely unconscious, they contend, it can be deliberately sought out to produce exciting experiences by identifying the circumstances that are likely to inspire creativity. A key pre-requisite to achieving this, the authors added, is openness to new thought and possessing optimism, ideals, self-assurance, and psychological mastery. It is important to note that inspiration might not always result in advantageous outcomes (Buheji *et al.* 2014).

3.3.1 Conception of Inspiration

Thrash and Elliot (2003) developed a framework that identifies three essential elements of inspiration and these are evocation, transcendence, and approach motivation.

i. *Evocation* refers to describing the unconsciously passive and receptive method of evoking inspiration. The individual is not personally in charge of the inspiration as it is a response to a

stimulus. Thus, inspiration can be triggered and maintained by a stimulus item, like a person, an idea, or a piece of art. This implies that inspiration is triggered (evoked) instead of deliberately generated by the person.

ii. *Transcendence* refers to a state of knowledge and awakening that gives an individual a high and unlimited desire and expectation to achieve purpose. The individual gains new and better ideas, approaches or dimensions about something that makes him highly optimistic. This idea, or awareness arrives as a flash of enlightenment and is more real and tangible than most intentionally manufactured concepts.

iii. *Approach motivation* refers to the inspiration that drives one to realize their new goal. At this stage, the person is very driven to bring the new idea to reality.

3.3.2 Transmission Model of Inspiration

Inspiration is crucial in the process of making ideas a reality. It is theorized that inspiration drives the transfer of an eliciting item's perceived inherent quality to [become] an outcome object (Thrash, Maruskin, Cassidy, Fryer, and Ryan 2010). The transmission model makes it clear that inspiration is a reaction to original concepts. According to Thrash *et al.* (2014), transmission takes three forms and these are replication, actualization and expression.

a. *Replication* occurs when a new product replicates an existing object's inherent desirable attributes.
b. *Actualization* is achieved by effectively bringing freshly anticipated possibilities to reality or fruition. That is to say, actualization transpires when new possibilities are successfully executed.
c. *Expression* occurs when concepts quickly come to mind after arriving fully developed in the exact sensory modality in which they are to be conveyed.

While *actualization* typically focuses on the final result that can take a form or a shape easily appreciated by the senses, for instance, a piece of music [heard] in the ear or a painting perceived by the eyes, *expression* on the other hand, is an externalization approach that is engaged in, to communicate to others about an idea that is yet to be executed. Without the expression, an idea remains only with the conceiver and it is completely nonexistent to others. *Actualization* has to do with taking actions or goal-oriented steps to achieve purpose. This is always influenced by a personal strong desire or zeal to achieve the results. *Replication*, in essence, expresses the multiplicity or reproduction of an already existing idea or product but with some alterations or modifications that bring improvement to it. *Actualization* is a shuttle between two different ends - the invisible and the visible world. It can also be likened to a dive into the deep blue ocean and appearing ashore with a fish in hand. That is to say that the diver did not come out from the ocean to describe how beautiful and colourful the fish in the deep sea is (this may be termed as expression) but he appears with the tangibility of the existing reality. In another vein, if the diver is unable to catch the fish, for one reason or the other, but he can concretize it either by moulding it with clay or giving a pictorial representation of the fish in the form of a painting, actualization has taken place. That is the evidence of the abstract in concrete form.

3.3.3 Inspiration verses Design Ideation

It is clear from the literature that inspiration is what drives the process of turning concepts into reality. That is from the point of idea evocation to the idea actualization stage where the result or finished product is created. This means that the result is the actualized idea. The big question is, “How can inspiration be linked with design idea generation?” In other words, will it be out of place to discuss inspiration that leads to design ideation and not the actualized idea? The fact remains that evocation comes before ideation which means ideation is a product of evocation. If the abstract concept is birthed by evocation that transcends into ideation which is yet to be

actualized, then inspiration leading to the ideation can be discussed. The existence of design ideas indicates that there is an inspiration that can be addressed.

To this end, this study uses inspiration with regard to design ideation only and not idea actualization or production because the study focuses on the extent to which digital technologies are utilized during the ideation stage of the design procedure. The rest of the design process that leads to idea creation is out of the scope of this study.

3.4 Cognitive Activities that Promote Design-Related Problem-Solving

Design thinking has been researched for years as a "way of thinking," and researchers have tried to define it. According to Chan (2015), studies in the early 1980s revealed that since design constituted the mental process of resolving problems, the thinking of designers was closely related to mental processes. To solve complex design problems and meet the requirements of users, design was viewed as a process that included making decisions and addressing situations (Chan 2015). The author notes that studies began to draw attention to the core cognitive and intellectual abilities of humans.

Tsai *et al.* (2021) conducted a study involving 24 architectural designers to analyze the activity of the brain when they were thinking about environmental visual design. The findings of the study indicated that the prefrontal cortices (PFC) including the left middle frontal gyrus within them helped them develop landscape architectural design through the use of graphic design concepts. It was observed that the designers pondered as they sketched during the architectural design process. The report indicates that by utilizing pen and paper, designers engage in graphic design thinking with confirmation of active PFC during idea production. However, Tsai *et al.* (2021) stated that there was no confirmation of the right PFC activity connected to the initial idea creation stage. In their investigation, no brain area action was seen during this stage. Reflecting on this, the authors stated that it is likely that the

imagined setting did not prompt enough visual design ideas for the mind to register (Tsai *et al.* 2021:11). In contrast to this finding Goel (2014) posits that the right PFC is engaged when planning, visual processing, or logical deduction from an initial idea and draft concepts and that the intangible, imprecise, and conceptual components of performance are enhanced within the right PFC.

However, Tsai *et al.* discovered evidence to support the theory that the left PFC plays a role in the stages of refining as they state that the left middle frontal gyrus, which is a component of the left PFC, was positively correlated with the refinement in graphic design thinking scores. This means the left middle frontal gyrus contributes to the process of thinking in graphic design which is associated with the idea-generating stage of the creative process.

Thinking is described as the phenomenon of human cognitive processes in cognitive psychology. Design activities are therefore thought processes carried out through cognitive processes (Chan 2015). Originally coined by Peter Rowe as the title of his book, the phrase "design thinking" is now widely used (Rowe 1987). After many studies, the phrase "design cognition" came to describe the cognitive activities involved in the process of design.

Design cognition, then, is the term used to describe the mental operations and representations of design which has been a major field of study ever since the beginning of design research (Hay *et al.* 2020). Tsai *et al.* (2021) observed that creative-related industries often utilize design thinking, which is a highly cognitive activity, employed for solving problems. It uses several thinking strategies necessary to recognize, select, and address the issue (Goel 2014; Gero and Milovanovic 2020). According to the authors, design thinking entails thinking as they illustrated how early, vaguely drawn sketches of architectural plans were followed by conceptual changes, analyses, and adjustments of the spatial form that progressively brought the style and accuracy of the building's spatial structure together to address the issue at hand.

In his study, McGlashan (2017) discovered that ideas are generated by playing with materials, reflection and continual refinement of ideas. Reflection and refinement of ideas are cognitive exercises that result in sketching to make changes that fine-tune designs. Abductive thinking is employed at this stage. Peirce (1958) defines abduction as the act of formulating an explanatory hypothesis in response to an observation that has to be explained. Peirce states that the abductive suggestion comes to us like a flash. Kolko (2010) posits that, designers use abductive thinking to develop their ideas through sketching, which helps them conceptualize and spatialize a concept map inside unfinished concepts. According to him, abductive thinking facilitates the development of concepts and the connecting components for the completeness of concepts in designing.

There is much more discussion on design cognition in the review of related literature (chapter two). The literature on cognition helped the researcher to understand the mental processing that goes on in the brain as the designers engage in ideation. These mental processes influence the decisions and actions of the designers and even project the uniqueness of the results. The researcher's discovery of the fact that significant cognitive processes take place as the designer engages in idea development will let him make helpful decisions as he embarks on data collection activities. For instance, it will be understood that when a designer suddenly pauses drawing and begins to gaze sternly into the air with narrowed eyes that some cognitive processing is going on where the designer may be diving deep into his cognition [processes] to capture some details of past works he had produced or seen and may be trying to worj out how these details could be harmoniously incorporated into the current task. Based on the understanding gained from literature on activities that go on in the cognitive domain, the researcher will be advised at this point not to interrupt the designer by asking questions or conveying any facial or bodily expressions that may distort the cognitive process during the ideation process. Again, some actions and inactions of

the designer will be understood, which will go a long way to obtaining quality data.

3.5 Technology as a Tripartite Concept

Technology is usually associated with achieving specific outcomes, solving specific problems, doing specific activities with certain abilities, applying knowledge, and making use of resources (Lan and Young 1996). Technology is not limited to the technology that is integrated into a product; it also implies understanding how to use, apply, and develop it (Bozeman 2000). Mishra and Koehler (2008) distinguish between advanced and standard technologies in educational settings giving examples of *standard* technologies as chalkboards, books, and whiteboards. A*dvanced* technologies, according to the authors, include operating systems, application software (programs), the Internet, web browsers, digital video, and email. Bates (2015) considers technology to encompass all instrumentation used to assist instruction, whether they take the shape of computers, software programs, or printed books.

Bates (2015) gives two definitions of technology claiming that the descriptions include everything from systems that use technology to the fundamental idea of instruments and these are:

i. Technology means devices and equipment that may be utilized to address issues in the actual world.
ii. Technology is the present level of comprehension among humans regarding the combination of resources to create desired goods, resolve issues, meet requirements, or satiate cravings.

A careful look at these two definitions of technology indicates they are divergent because while the first definition focuses on tools and machines as technology, the second one focuses on knowledge, skills (how to combine) and tools (resources) as technology.

Expressing his view about technology in education, Bates (2015) observed that technologies in education are objects or instruments that facilitate instruction. These, according to him, include computers, software applications like learning management systems, printed books and communications networks. Technology frequently consists of a collection of instruments with certain technological connections that allow them to function as a system, like the Internet (Bates 2015).

According to Jon (2020), technology is a means to an end. Short though this definition is, it is embedded with a lot of details. It suggests that technology is a means to solve a problem. In other words, technology has to be a contrivance. For technology to be a contrivance, skill is required because there cannot be creativity without skills application. This is why the statement made by Levin (1996) that technology is not a 'thing' but *is better characterized as an approach* makes a lot of sense. It involves using scientific concepts to address real-world issues. Levin's view about technology is strongly related to the assertion of Burgelman *et al.* (1996) as they posit that Technology is the theoretical and applied knowledge, abilities, and artifacts that are utilized in the creation of products and solutions. In this definition products and services are considered as solutions to problems. It can be deduced from Burgelman *et al.'s* statement that theoretical and practical knowledge itself is not the technology but it is the use (in other words, the application) of it to solve a problem (develop products and services) that makes it a technology. Again, the 'skills' or the 'artefact' is not a technology but the use of it to solve a problem makes it a technology. With this, it can be said that technology has three components 1. A thing (it may be theoretical and practical knowledge, or artefacts), 2. Process (skills or the demonstration/ application of practical knowledge) and 3. Solution or Result (products and services).

It is the existence of problems and the resultant pursuit of solutions that necessitate the development of technology. In other words, where there is no

problem, technology is of no use because technology is invented principally to solve a problem. The use of the tool (artefact or device) to solve a problem is what makes it a technology. The word ‘use’ in ‘The use of tool’ embodies the application of technique, know-how or skills. It suggests that without the ‘use’ (application of technique, know-how or skills) the tool cannot accomplish a task or achieve a goal. The principal idea here is that technology is a problem-solving mechanism. Until the device is used to solve a problem, technology is not achieved.

It is understood therefore that technology is not a thing (artefact, tool or device). Again, technology is not a skill (technique or know-how), neither is it a product (expected end or result). These three components – a thing (artefact, tool or device), skills (technique or know-how) and solution (product, service or expected result) - are very important to give the word ‘technology’ its holistic definitions and it is inappropriate to isolate one out of these three components and term it as a technology. Each of these three things plays an important role in the definition. Therefore, technology, in the context of this study, is a practical process of skills application on a tool to solve a problem.

Based on this understanding of technology, this study examines the three components of technology (tool, skills/process and solution/outcome) involved in digital ideation in graphic design. This suggests that in a digital design environment, it is expected that the designer is knowledgeable about the digital devices and applies the needed skill to the devices to solve design problems. Thus, the various digital tools used by the design students, the digital skills applied and the ideation outcomes are of great interest in this study.

3.6 Digital Skills and Competences

The world has grown increasingly connected through digital technology and digital skills have become essential assets in recent times. Employers place a high value on digital abilities, and an individual's employment prospects are

based on the kind and degree of digital proficiency he possesses (Andrews *et al.* 2018). The word, ‘competence’, according to the Oxford Dictionary, is ‘the ability to do something successfully or efficiently and the word, ‘skill’ is ‘the ability to do something well. The two definitions implicitly mean the effective application of one’s knowledge in the execution of the task. Again, these words mean knowing how to do something and the enablement to do it effectively. Given this, Digital *skills* and Digital *competence* will be used interchangeably to mean the same thing in this study. In the context of this study, however, digital skills /competence refers to an acquired ability to effectively work with digital devices.

Other terms used to define the skills and competence, regarding the utilization of digital technologies, according to Ilomäki et al. (2011) are information literacy, technology skills, ICT skills, digital skills and digital literacy.

Digital literacy is defined as being synonymous with digital skills and competence by Jones-Kavalier and Flannigan (2008) as the capacity of an individual to carry out duties in a digital space and they indicated that the term "digital" refers to information that is largely used by computers and is expressed in a numerical format. In other words, ‘digital’ represents binary codes, usually a series of zeros (0s) and ones (1s) that generate, process and store data in computer language.

The European Commission (2020) indicated that digital competency is the ability to utilize digital tools responsibly, critically, and with confidence for both learning and social interaction. These competencies, according to Vaikutytė-Paškauskė *et al.* (2018), include communications and collaboration, problem-solving, data literacy and information, digital content production (including programming), and safety—which is considered digital well-being.

However, UKDE (2019) has created a framework comprising five digital competencies. These were considered to be essential for life and work for every UK citizen and they are:

1. communication skills,
2. content and information-handling skills,
3. transacting skills,
4. problem-solving skills, and
5. abilities to operate legally and safely online.

Likewise, van Laar *et al.* (2017) identified seven essential digital skills in their research. These are 'technical, information management, communication, collaboration, creativity, critical thinking and problem-solving' as core digital skills (van Laar *et al.* 2017:583).

In a qualitative study conducted by Mwakatumbula and Moshi (2020) with twelve (12) individuals, to investigate the fundamental digital abilities required to engage in the gig transportation labour market, the following six findings were presented as essential digital skills:

i. Technical skill: This is the capacity to complete a task using a smartphone and software (van-Deursen *et al.* 2015).

ii. Information management skill: This is the capacity to get knowledge and use it in decision-making. It is essential in participating and succeeding in the freelance transportation business.

iii. Online communication skill: This competence is required for clear internet communication. This is essential in an increasingly digital environment.

iv. Critical thinking and problem-solving skill: This is the use of ICT tools to solve problems by making well-informed decisions and choices (Lee *et al*. 2016).

v. Online safety skill: This is about cybersecurity proficiency and overall well-being on the internet. Internet users need to be proficient to ensure their security when conducting online business.

vi. E-payment/banking skili: This is having the capacity to supervise and regulate online transactions. For example, to properly track an e-commerce account's transactions, one needs a working knowledge of e-commerce.

3.6.1 Requisite Competencies in the Digital Economy

Markow *et al.* (2018) postulate that in this age of digital commerce, the most important competencies and skills are technological, managerial, interpersonal, and social skills (Markow *et al.* 2018). These skills, according to Mwakatumbula and Moshi (2020), will encourage people's lifelong learning, help them flourish in the digital marketplace, and help them adjust to changing environments and future changes.

i. Technological skills:

According to Markow *et al.* (2018), the most essential competencies under technical skills include data analytics, cloud computing, virtual communication and media skills, security standards, and designing and integrating business technology systems.

ii. Managerial skills:

This covers skills like judgement, intricate problem-solving, negotiation, teamwork, the ability to perform well under pressure, autonomy, leadership, mentoring job rotation, and task guidance.

iii. Interpersonal skills:

Personal skills include emotional intelligence, critical thinking, analytical and logical abilities, networking and communication, leadership, dependability and responsibility, versatility, active

cooperation, self-reliance, and creativity and willingness to learn new things.

iv. *Social skills:*

Social skills include research skills, civic skills, professional ethics, intercultural and linguistic skills, cooperation, the ability to be dedicated, to transfer or gain information, interaction for harmonization of processes, and flexibility in thinking (Sallati *et al.* 2019; Maisiri *et al.* 2019; Jerman *et al.* 2019).

It can be seen that the first three skills of Mwakatumbula and Moshi's (2020) six essential skills were all merged under the 'technical skills' category of digital skills outlined by Markow *et al.* (2018). This makes the 'technical skills' category of Markow *et al.* much broader as it entails other details such as virtual communication and media skills and cloud computing. The fourth of the six digital skills mentioned by Mwakatumbula and Moshi (2020) is critical thinking and problem-solving skills and this is just one of the eleven sub-skills under Markow *et al.*'s Managerial Skills.

Online safety or cybersecurity and e-banking skills are the fifth and sixth digital skills outlined by Mwakatumbula and Moshi (2020). These two skills are not found among the skills mentioned by Markow *et al.* However, the third and the fourth broad categories of skills which are personal skills and social skills respectively embody eighteen different skills, some of which are desire and readiness to acquire new knowledge and skills, active collaboration, autonomy and creativity, critical thinking, teamwork, collaboration for synchronization of processes, and research skills. In all, these are very relevant digital skills needed for effective academic work and on the job market.

As stated by UNESCO (2020), it is necessary to change the educational paradigm and make adjustments to conventional curricula. The issues that will be covered include evaluation based on competency, student-centered

instruction, and virtual and collaborative learning environments. Others include solid professional ethics, application of real-world problems in the classroom, and creative pedagogy. This transformation, according to UNESCO, should be founded on an in-depth study of how information and communication technology (ICT) tools and digital material are used in the classroom. The interest of this study is in line with UNESCO's recommendation for the adoption of ICT tools and digital content to revolutionize educational systems.

Digital skills have become an essential tool in everybody academic disciplines. In this study, skill is referred to as an ability developed when knowledge and practice are combined to effectively perform a task. The study adopts Markow *et al.'s* (2018) categories of digital skills even though it is not everything mentioned under the four categories that are essential for graphic design ideation. Markow *et al.'s* categories of digital skills were preferred over those of Mwakatumbula and Moshi because they include more skills that are relevant in graphic design. Some of these relevant skills are collaboration, autonomy and creativity, critical thinking and teamwork.

3.7 Digital Technologies in Educational Environment

There is an abundance of available digital technologies that can be benefited from both inside and outside of the class (Ng 2015). Regarding the need for technology, Ng suggests that digital technologies support students by increasing their motivation, developing their minds, and providing real-life-like experiences. The author adds that technology provides enabling research, promoting communication and collaboration, promoting higher-order thinking skills and critical thinking, maintaining learning in out-of-school contexts and catering for multimodality. The author indicates that students of all ages possess their own mobile devices and use them for various purposes such as entertainment and academic work. They are digitally literate and they spend a considerable part of their time on social media.

To comprehend how digital advances affect learners' thoughts and views of Higher Education Ferreira *et al.* (2020) conducted a qualitative and quantitative study involving undergraduate students from Portugal and Spain. They stated that everyone associated with the process of learning now uses the internet. They added that digital technology is an invaluable tool for instructional purposes in universities. Throughout this study the authors refer to the Internet and social networks as digital technology. This is so because devices are used on the internet to solve a problem.

In a study conducted in two Australian universities to explore factors influencing how university students use digital technologies, Henderson *et al.* (2015) classified the digital technologies students utilized into two categories namely: 1. official digital technologies and 2. digital technologies for non-official use.

The official digital technology resources include the following:

a. Library website
b. Learning Management System
c. E-books or e-textbooks
d. Library online resources
e. University websites
f. Software related to study area (Henderson *et al.* 2015)

The non-official digital technologies used by students include:

a. Search for papers/journals
b. Internet search engines to find information
c. Online courses and educational contents
d. Social network
e. Audio recordings or videos
f. Web-based citation/bibliography tools
g. Online documents to collaborate with classmates (Henderson *et al.* 2015).

It can be seen in this literature that Henderson *et al.* (2015) others did not make mention of any digital (electronic) device but referred to them as digital technology. This is because these search engines are accessed on digital devices to execute tasks. With regard to some digital practices of students such as recording of lectures, finding external video content to supplement studies, and sharing of videos through websites such as YouTube, the authors report that, 'All of these digital technologies allow learners to visualize concepts and view information differently' (Henderson *et al.* 2015).

Digital technology in education is defined as the teacher's or learner's use of digital tools, including tablets, computers, MP3 players, and smartphones to access online materials like learning platforms and virtual learning environments (VLEs). It also includes digital learning tools such as games, courses, quizzes, and instructional aids to help students advance their knowledge and abilities (ICF 2015). Having reviewed the literature on digital learning resources, ICF outlines the key findings in the assessment framework. The findings indicate that the availability and use of digital educational tools for both official and informal education leads to the following outputs:

a. Students acquire improved competencies and sustained learning.
b. They become more confident to practise and use skills.
c. A greater variety of educational resources are available to them.
d. The capacity to instruct every student successfully increases.
e. It increases the drive and enthusiasm for learning.
f. Students actively participate in their education and skills development.
g. Learners acquire cross-sector employability skills including cooperation and teamwork.

NetSafe (2015) distinguishes between digital devices and digital information by giving some examples. According to the quoted source, digital devices such as smartphones, laptops and cameras can be used to create, edit, communicate, copy or store information digitally while digital information comprises one or more of the following elements:

- *1. text* which includes social media posts, web pages, email
- *2. images* in the form of digital photos uploaded to the internet
- *3. audio* which includes music track, voice recording
- *4. videos* in the form of movie clips taken on a smartphone'. (NetSafe 2015).

In effect, a digital device is a physical hardware object while digital information is the soft data that can be transferred by the digital device.

Even though the above literature is not directly related to graphic design ideation, they are useful digital skills that students need to function effectively in any academic discipline where digital technologies play critical roles. As reported by ICF (2015) students' success is enhanced by using digital learning for formal as well as informal activities at school and at home since it extends their learning period. This is to say that utilizing digital learning resources helps learners to acquire the skills, knowledge and competencies necessary for academic problem-solving. These digital learning resources are problem-solving resources that are accessed on digital equipment as mentioned earlier. This means the equipment together with the resources that are accessed on them form a tool in the hands of the user (student). Access and frequency of use of digital tools among design students will build their capability to organize online resources such as images, design samples and necessary information for quality design output. As stated by Seufert *et al.* (2020), educational technology enhances learning effectiveness and places a deeper emphasis on learners' future job demands. Besides this, it promotes personality development in a digital culture. The continuous use of digital tools leads to improved competencies, sustained learning and general problem-solving outputs. Lan and Young (1996) indicate that Technology is usually associated with achieving specific goals, addressing specific issues, doing specific tasks with specific abilities, applying knowledge, and making the most of resources.

In this study, digital technology is broadly used to represent the use of digital devices and design application software with or without the internet to solve a design problem. Digital devices, as mentioned, include computers, laptops, camera, styluses, tablets and smartphones and the design software include CorelDraw, Adobe Photoshop, Adobe Illustrator and Rhinoceros.

3.8 Digital Technology in Creative Design Processing

Digital design is executed using a drawing tablet and a stylus which acts as a tool such as a brush, blender, or pencil. With the use of styli, pens or fingers, tablets and mobile devices can provide a more accurate and natural way to draw digitally (CCEA 2019). Some designers use digital technology because it has very helpful tools such as blend modes, paint bucket tools, resizing, reshaping, layers, clipping masks and magic rulers that make working with them easy. The argument that the use of digital devices for ideation inhibits creativity is probably because the designers are not using the right tools for their work or do not have the requisite artistic background or digital skills to undertake the design tasks. ‘The application of a computer-aided system has a great advantage’ (Duan 2014: 11028) and this device is operated by the designer. This means it is the designer's ideas that assume an essential purpose in the creative procedure and not the device. This is to say that if the designer has and applies the needed design cognition, aesthetic ability, and creative and digital skills, the design output will surely be outstanding. A designer may be digitally fluent but if he lacks the requisite artistic background, his design efforts will amount to nothing. With regard to artistic background, the designer should be exposed to basic skills and general knowledge in art for effective digital technology application. For instance, the designer must be skilful in drawing (either digitally with tablet and stylus or with paper and pencil), and have excellent knowledge of the elements and principles of design to effectively execute a design task with digital tools. The interesting thing here is that freehand sketching can be done digitally using the stylus as a digital pencil. Digital technology generally

improves the efficiency of design, makes operations simpler, and makes saving and sharing more convenient.

It is the level of artistic input into the digital device that makes the difference. As mentioned in Chapter Two, it is not so much the digital device used by a designer that gives the aesthetic quality to a design work but it is much more the skilful artistic expression applied to the digital device that brings out the beauty. A designer's possession of a digital device does not bring a solution to a design problem. Again, the designer's digital skills acquisition alone is not enough to solve a design problem. It is the possession of the right digital device and the application of design skills on the digital device to solve the problem that brings technological fulfilment. Technology does not equal creativity; it enhances creativity. The more one learns about the abilities of technology, the more creative one becomes (Thangarajathi 2020). This suggests that the more the students immerse themselves in the use of digital devices in problem-solving, the more creative they will be.

Digital technology has shown promise in multiple areas in education (Beggrow, *et al.* 2014; Gierl, Bulut, and Zhang 2018). A review of the literature was conducted by ICF (2015) to investigate how digital technology might benefit educators, parents, and students to improve outcomes to achieve educational ambitions in Scotland. According to the findings, frequent utilization of digital devices not only enhanced literacy; the quality of its application had an impact (ICF 2015). This means students' possession of digital devices alone is not a guarantee of excellence but the effectiveness is in the use of the device. It is therefore necessary for graphic design students to be given the required artistic foundation and the necessary skills with regard to digital technology use for optimum design output.

By taking cognizance of the fact that designers should have basic skills and knowledge in art to be effective digital designers, this study is strategic in the selection of participants, in that only the third and fourth year students of the university are qualified for the research. The premise is that the students had

good artistic exposure at the secondary school level and have been given even more exposure in their first year of university education and will therefore be able to transfer such skills and knowledge into the digital arena for outstanding performance.

3.9 Design Ideation: The Input, the Process and the Output

In the design process, design conceptualization is an essential preliminary stage that seeks to investigate, produce, and create solutions to a problem (Taegyun 2020). Research indicates that the reason conceptual sketching is so challenging is that it calls for producing good quality and aesthetically pleasing drawings in addition to generating a large number of concepts quickly. (Sreekanth and Viswanathan 2019)

Two crucial elements of idea development appear in this statement and these are the generation of a multitude of ideas and high-quality drawings. These two elements have some relation to Shah *et al.'s* (2003) theory of ideation effectiveness measurement. According to this theory, there are four ways to evaluate the success of an ideation process: by evaluating quantity, quality, variety, and novelty.

a. Quantity measures the number of ideas created;
b. Quality indicates the degree to which the generated ideas meet the design brief;
c. Variety represents the number of solution areas explored;
d. Novelty evaluates the number of unexpected solutions ideated in comparison to previous cases.

All four of these aforementioned areas of ideation evaluation are important. Measuring students' idea development by means of these four elements will challenge students to produce good design output that will satisfy today's clientele. Given this, Shah's (2003) measurement of ideation effectiveness is adopted as the theory underpinning this study. Details of Shah *et al.'s* Metrics for Measuring Ideation Effectiveness are discussed in Chapter Two.

Literature reviews were conducted on design ideation processes to examine current practices in the design industry. It was revealed that while paper and pen sketches were being used by some designers, other designers adopted digital devices such as laser pointers, laptops, tablets, Modbook, iPods, Wacom Cintiq iPads and tablets for design ideation (Aboalgasm and Ward 2014; Pérez and Dorta 2011).

Based on the conclusion to the study of Evans and Aldoy (2016) that technology significantly improves the process of coming up with design concepts, and also based on the discovery by Ekströmer and Wever (2019) that there are many opportunities to use Computer-aided design tools for design ideation, a conceptual framework for the study has been generated as seen in Figure 3.3. The theory of Shah *et al*. (2003) which stated that ideation effectiveness can be measured in terms of four ideation principles (quantity, variety, quality and novelty) was also incorporated into the framework.

which foster an atmosphere of fun and innovation, together with

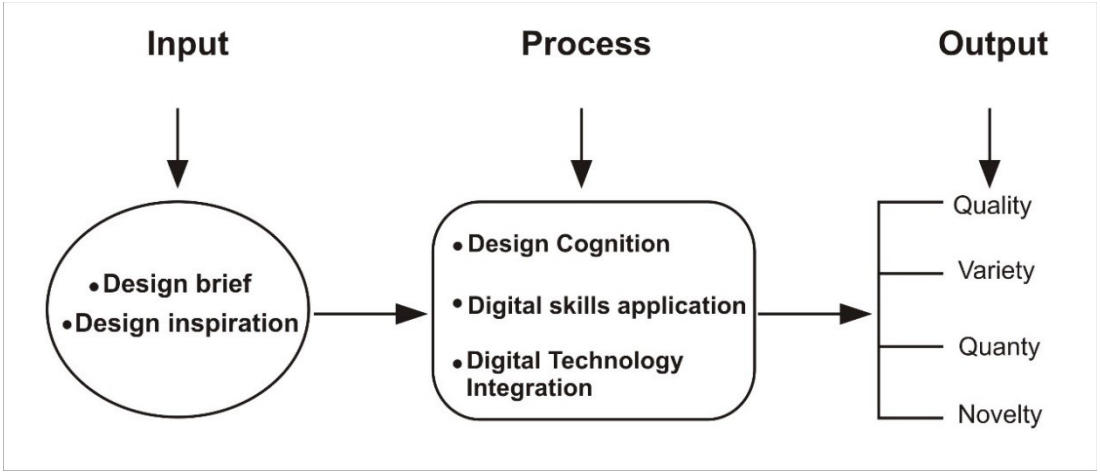

Figure 3.3: Digital ideation framework

3.9.1 Ideation Input

As can be seen in Figure 3.3, the conceptual framework is divided into three parts: the input, process and output. The input is the preparations that go on before the actual creative activities take place. It is the time when the designer gathers more information about the design work through briefing and personal research as discussed earlier in this chapter. Inspiration is very important in creativity, serves a transmission function and promotes productivity (Cui *et al.* 2020). The designer is motivated intrinsically and this becomes externally evident as the designer begins to search for ideas, either in digital or physical sources, to respond creatively to a design problem. Necessary inspirational materials are collected in preparation for creative idea generation. Inspiration, as stated by Cui *et al.* (2020), involves motivation during which the individual strives to come up with a concept or execute a novel and imaginative task.

During the research, an investigation was conducted into how students prepare for idea development. Observations and interviews were conducted to find out about the activities they engaged in before the actual idea creation. Evidence of preparations students make before engaging in idea creation were seen in the form of mind mapping, and images of inspirational materials which were also examined. Because this study is concerned with the digital approach to the ideation process, information was gathered on the digital devices used while researching the design brief and the websites from which images were collected were accessed.

3.9.2 Idea Processing

The design ideation process stage is where the actual design activities take place. Mentally conceived ideas are exteriorized, primarily as a creative response to a brief and also as a means of idea communication. Cognition plays a vital role in searching, organizing, synthesizing, interpreting, evaluating and communicating ideas and information (Makri and Warwick 2010). Digital skills which are essential in today's design activities are of

great importance during idea processing. The ability to use digital devices to creatively express design ideas is expected at this stage.

During the research, data was collected on idea creation processes that the participants engaged in. This included the various tools they used, how they were used and the effects of these tools on ideation outcomes. The digital skills adopted and the software the participants used were also noted. Some of the digital skills required at this stage include the ability to use different kinds of software during design which involves flexibility in applying the appropriate software tools for the harmonious organization of design elements and principles by the use of application tools. Strong digital skills that are likely to provide excellent digital ideation outcomes include students' ability to manipulate design software effectively to acquire the desired shape, and switching between different software to offset the weaknesses of one software with the strengths of another.

Also of great importance at this stage is the application of cognitive approaches that promote effective creative ideation. Design cognition, as discussed in Chapter Two, is the representations and thought processes involved when designing (Hay *et al.* 2017). The phrase classifies the actions that take place during the design procedure (Chan 2015) and the collection of logical techniques used to recognize, select, and eventually solve the issue (Gero and Milovanovic 2020). It is the cognition that influences the actions and decisions that are taken by the designer at each given point in time and this forms a very essential part of the ideation process.

3.9.3 Design Output

Shah *et al.'s* evaluation techniques are frequently employed to comprehend or measure the efficacy of ideas (Venkataraman *et al.* 2017). The four metrics in Shah *et al.'s* (2003) theory are process-based (quantity and variety) and outcome-based (quality and novelty). This is so because a design's novelty and quality are directly influenced by the quantity of varied concepts generated (Laing and Masoodian 2016). Evaluating ideation

effectiveness considering quantity and variation enhances the designers' comprehensive knowledge of design problems and solutions (Venkataraman *et al.* 2017 and Borgianni *et al.* 2018).

The reviewed literature has been instrumental in this study. It motivated the researcher to gather data on the quantity of varied ideas the graphic design students generated and it imparted the quality and novelty of the ideas. Thus, how ideas were generated and selected by the participants was investigated.

Digital technology integration is expected to improve the design ideation process. This means that the process could increase the quantity and variety of designs generated, enhance the quality and improve the novelty of the design. This conceptual framework is based on the philosophy that the effective use of digital devices in ideation should increase good idea counts that will result in creative design outcomes. The more we learn about the abilities of technology, the more creative we become (Thangarajathi 2020). This suggests that the more the students engage themselves in the use of digital technology the more creative they will be. Design instructors will be able to modify how they teach the design process and assist students based on the discussions and documentation of insights in this study.

3.10 Research Setting (Contextual Situation)

The empirical settings for this research are two graphic design departments on two university campuses in Ghana. These are Takoradi Technical University in the Western Region and Kwame Nkrumah University of Science and Technology in the Ashanti region. Each of these universities offers a range of courses at diploma, undergraduate and postgraduate levels with academic and vocational orientations. The two institutions have produced a significant number of graduates from their respective academic departments, some of whom have created their own employment opportunities s while others have been gainfully employed.

Twenty-four students (24) graphic design students and four (4) lecturers from the graphic design departments of the institutions constituted the main participants in respect of the general design practices of graphic design on their respective campuses. This information creates a firm foundation for the empirical study. The lecturers were interviewed and observed during their instructional deliveries in the lecture hall. Students were also interviewed and observed both in the lecture hall and the computer lab during graphic design contact hours.

Given the current climate of technology gratification, it is almost impossible to imagine a student pursuing a course in any Ghanaian university without the support of digital technology. This is a country where the previous government supported students and teachers in the secondary schools with digital devices (laptops) to improve educational standards. The use of digital devices has become so much a norm that students do not even use the dictionary anymore when searching for the meaning of words. They feel it is a waste of time searching for a single word in such a voluminous book. With a single tap on the smartphone, students are guaranteed to find better definitions of words than any dictionary can ever offer.

In an environment like this, technology has become one of the most important tools for academic achievement. Students depend on one digital device or the other for executing coursework during or out of contact hours. With the numerous benefits technologies have to offer, this study seeks to find out how digital technologies affect graphic design students' ideation processes and design outputs.

3.11 Conclusion

This chapter has organized the central concepts, findings [from] other professional ideas and wisdom from literature that provided a guide for this study. The general understanding gained in this chapter helped to outline the

study's primary focus and direction (Shikalepo 2020) and provide the basis for data collection. The understanding of the word ‘technology’ helped the researcher to categorize data collection into three sections, thus, tools, process (skills application) and outcomes. Digital devices and online resources used by the participants formed part of the tools (Ferreira *et al.* 2020; ICF 2015). Digital skills exhibited by student designers, such as searching for design inspiration on various websites, skilful use of tools in design software to obtain the desired results, the use of different software for design purposes, connecting and interacting with different digital devices during the ideation process, and the multimodality of skills exhibited, all fall under ‘process’, or skills application. Outcomes focus on the various design solutions generated by students. It is at the evaluation stage where the theory of Shah *et al.* (2003) plays a very instrumental role in aiding the selection of a creative solution.

The reviews of the various ideation models established the grounds for data collection on the design creative process with full knowledge and understanding Four models were examined, compared and contrasted. Each model outlined activities expected to take place to achieve the creative purpose. After a critical analysis, however, the Generic Creative Process Model developed by Warr and O’Neill (2005) in Figure 3.2 was adapted as a standard ideation model for this study. This model was strategically designed to cover the details of the other three models. The three stages in this model which are 1. problem preparation; 2. idea generation; and 3. idea evaluation provided a concise ground that supports data collection and analysis in this study. The concept derived from this model together with other findings and theories significantly influenced the design of the conceptual framework of this study.

The finding that devices such as styli, pens or fingers, tablets and mobile devices can provide a more accurate and natural way to draw digitally (CCEA 2019) and supporting statements from researchers such as Wang and Wang (2021) and Sanders (2018) who outline the various advantages of

using digital technology provided strong evidence that digital technology integration into design ideation will yield positive results. In all, the chapter has provided useful ideas, theories and information that informed and motivated the structure, the methodology and the design of the study.

CHAPTER FOUR

RESEARCH PHILOSOPHY AND RESEARCH METHODS

4.0 Overview

This chapter discusses in detail the philosophical assumptions (the ontological and epistemological assumptions) that guided the selection of the research methodology adopted for the study. Axiological issues (values and ethics) related to the research paradigm are also addressed. More specifically, the methodological choice, the research method employed for data collection, population and sampling for the study were also clearly outlined. Phenomenology, as an approach for data collection and interpretation and thematic data analysis are also discussed in this chapter. Philosophical and methodological choices were made to answer the following research questions:

i. How do design students in Ghana generate graphic design ideas?
ii. How do digital technologies affect students' ideation process and design ideation output?
iii. What is the perception of graphic design students regarding the use of digital technologies during the ideation stage of the design process?
iv. How can digital technology be effectively used to improve the design ideation process among students?

4.1 Philosophical Assumptions / Research Paradigm

Philosophy explains the way things are with theories that enable one to explain things as they are (Henning, Van Rensburg and Smit 2004). As a field of study, it largely concentrates on reality, knowledge, and existence. It is concerned with perspectives about how the world functions. Saunders (2009) refers to philosophy as a set of presumptions and ideas about how knowledge is created. Research philosophy, as defined by Scotland (2012), is the collection of opinions on the characteristics of the world (the real world) under study. The knowledge (that is, 'what'?) being examined determines which research philosophy should be used in a particular field of study. Research philosophy is crucial as it helps to select which research

design to adopt and the reasons for the choice (Easterby-Smith, Thorpe and Lowe 1999). Assumptions are always made in research and among them are presumptions regarding human knowledge (epistemological assumptions), regarding the reality that was experienced throughout the [word omitted] (ontological assumptions), and the degree to which and the manner in which individual beliefs impact the course of research (axiological assumptions) (Saunders 2009).

Lincoln and Guba (1985) assert that a researcher's presumptions on the best approach to take when conducting an enquiry constitute their paradigm (methodology) together with the description of truth and reality provided by the researcher (ontology) and how the investigator plans to obtain that reality, or truth (epistemology). In other words, it is the method through which the investigator plans to obtain that reality, or truth.

Philosophical assumptions are considered to be concepts that inform what has to be studied, why it should be carried out, and the way the results are to be understood (Bryman 2008). Consequently, the philosophical presumptions of ontology and epistemology influence a researcher's methodological decision (Collis and Hussey 2003). It is clear from this literature that the research paradigm entails more than philosophical assumptions in the sense that while philosophical assumptions are limited only to issues related to the ontology and epistemology of the study, the research paradigm covers the ontological, epistemological and the methodological choices of the study. It must also be admitted that philosophical assumptions (ontological and epistemological choices) always influence the methodological choice(s) of a study. In other words, the philosophical assumptions of researchers on ontology and epistemology determine the methodological choices of the study (Collis and Hussey, 2003)

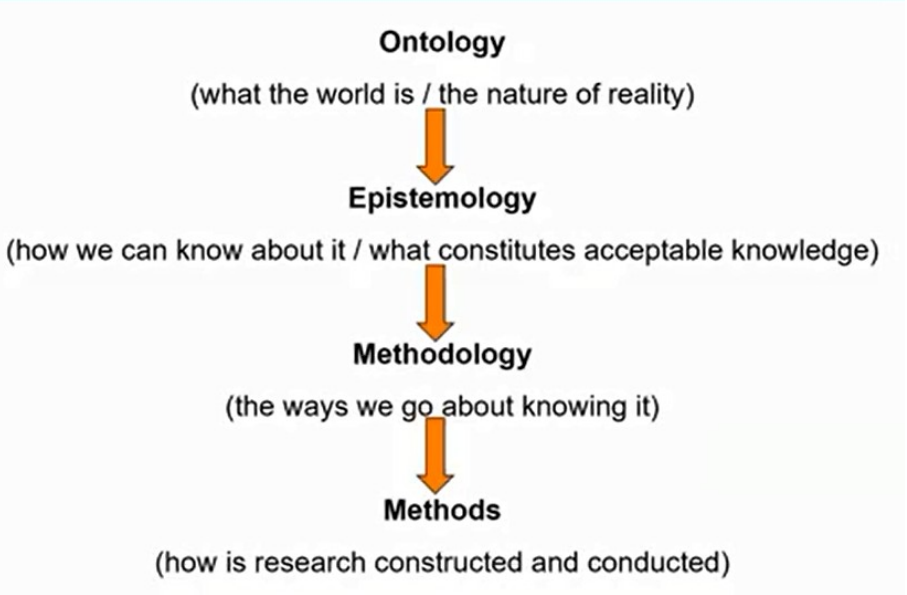

Figure 4.1: Research Paradigm and Methods

4.1.1: Ontology

Concerned with the nature of reality, ontological philosophy describes the distinctions between reality and our experience of it and how they affect everything about humanity (Abidi 2011). Ontology, according to Saunders *et al.* (2007), is the nature of reality, the presumptions made by investigators on how the universe functions, and the adherence to a specific viewpoint. Describing the nature of reality is crucial for ontological presupposition (Creswell 1994). In their submission, Ericsson and Kovalainen (2008) stated that ontology entails concepts regarding the existence and interrelationships of individuals, communities, and the wider universe. These definitions have prepared a good basis from which to view the current research topic being studied under an ontological lens with questions such as 'What is the nature of the digital technology used by design students? How do students use digital devices when designing? How do digital devices affect their design approaches? How do students relate to or interact with digital design tools? and Why would a student prefer to use or not to use digital technology in ideation?

These questions guided the researcher in making philosophical decisions related to the study. Saunders (2009) posits that ontological assumptions shape how a researcher sees and studies research objects. In other words, it influences how a researcher sees the world. Gray (2014) states that there exist two viewpoints of ontology and these are objectivism and subjectivism, or constructionism.

Objectivism

An objectivist's ontology viewpoint maintains that social reality possesses only one objective reality to each studied phenomena regardless of the viewpoint or beliefs of the researcher (Hudson and Ozanne 1988). To an objectivist, the world is external because social reality exists independently of social actors (Carson *et al.* 2001). Objectivists approach epistemology by seeking to understand the social world and its truths. This is made possible by quantifiable, visible facts that lead to conclusions about general social reality.

Subjectivism

From the viewpoint of the subjectivist, truth and meaning emerge from the subject's interactions with the environment rather than being in an outside realm (constructivism) (Gray 2014). Because of this, the constructivists and subjectivists reject objectivism and see reality in society as an expression of human viewpoints (Morgan and Smircich 1980). Thus, subjectivists believe that people should provide meanings to the phenomena around them and have the power to alter the world according to their encounters and viewpoints (Gill *et al.* 2010).

4.1.2 Epistemology

The research into the nature of knowledge, or epistemology, is concerned with what constitutes genuine knowledge (Collis and Hussey 2003). Stated differently, an epistemological problem relates to a query about what constitutes acceptable knowledge within a field of study (Bryman 2008). It is an area of philosophy that examines how to obtain valid knowledge. Burrell

and Morgan (1979) indicate that epistemology addresses presumptions regarding knowledge, including what qualifies as authentic, valid and acceptable information as well as how it can be disseminated to others (Burrell and Morgan 1979). When it comes to epistemological endeavours, phenomenological (interpretive) epistemology and positive (realist) epistemology are two distinct ideas (Bryman 2008). Expressed in other words, Harrison *et al.* (2017) state that research endeavours are influenced by two primary philosophical stances: positivism (quantitative methods) and constructivism/ interpretivism (qualitative methodology). It is critical to differentiate between these two schools of thought (Bhatta 2018)

4.1.3 Positivism

As a paradigm for research, positivism seeks to utilize statistical analysis to solve important real-world problems, discover law-like inferences, and pinpoint precise causal relationships (Kim 2008). As an approach for study, positivism seeks to utilize mathematical evaluation to solve important real-world problems, discover law-like generalizations, and pinpoint precise causal relationships. The positivist likes to operate with an observable social reality and takes up the natural scientist's philosophical position (Remenyi *et al.* 1998).

Because reality is singular it can be accurately and consistently measured using the variables to represent it (Onwuegbuzie 2002). The investigator concentrates on empirical data, establishes causal relationships between variables, develops and evaluates theories using a deductive methodology, and operationalizes ideas to enable quantification and application using quantitative methods (Easterby-Smith *et al.* 2002).

Unlike positivists, phenomenologists maintain that people's experiences of reality in society must be the basis of any attempt to comprehend reality (Gray 2014). Thus, meanings, comprehending what is occurring, and developing theories and models from facts using qualitative methodology are the main points of emphasis (Easterby-Smith *et al.* 2002). To reduce the gap

between themselves and the study, researchers engage with the subjects of their studies (Collis and Hussey 2003).

Constructivism / Interpretivism

Interpretivism holds that an investigator has to understand how individuals differ from those around them in their ability to act as social beings. This emphasizes the differences between studying humans as opposed to items in research. The meaning assigned to a daily social function determines how it is understood. (Saunders 2009). The interpretative paradigm, in the author's opinion, is a philosophical stance that describes how people understand their surroundings. When employing this paradigm, an investigator must comprehend the underlying meanings associated with the phenomena. By gathering the information that is significant to their study participants, interpretivist investigators attempt to account for complexities (Saunders 2009). The aim of interpretative research is creating new, more thorough viewpoints and comprehensions of social contexts and circumstances (Saunders 2009).

Table 4.1: Philosophical Assumption / Research Paradigm (Author's Construct)

	Research Paradigm				
	Philosophical Assumption				
s/n	Ontological Stance	Epistemological Stance	Research Methodology	Method	Research Philosophy adopted
1	Ontologically objective stance	Positivism	Quantitative Approach	Eg. Questionnaire	Philosophically positivist Philosophical positivism
2	Ontologically subjective stance	Constructivism	Qualitative Approach	Eg Interview and Observation	Philosophically constructivist Philosophical constructivism
3	Ontologically objective and subjective stance	Pragmatism	Quant and Qual Approach	Questionnaire and interview	Philosophically pragmatic Philosophical pragmatism

4.1.4 Research Paradigm (Constructivist / Interpretivist)

Typically, social constructivism and interpretivism are mixed in qualitative research methodologies (Mertens 1998). To comprehend the historical and cultural backgrounds of the participants, constructivist researchers frequently examine the processes of interactions between people by concentrating on the particular environments the people live in (Creswell 2009). According to the author, the goal of a constructivist researcher is to comprehend the interpretations that individuals assign to the world around them. As put by Crotty (1998), humans create meaning by interacting with the world they are trying to understand. The constructivist enquirer generates or creates a structure of meaning by induction. According to social constructivism, people interpret their experiences in ways that are personal to them. These interpretations focus on particular, diverse and multifaceted items or things, which prompts the researcher to explore the diversity of [their] viewpoints. (Creswell 2009).

The phenomenon of the digital design ideation being studied is not objective but complex with multiple realities shaped by students' experiences and social contexts. This study therefore assumes the constructivist and interpretivist paradigm on the premise that digital technology used in design ideation among students has to do with design students with varying design experiences, backgrounds and environments based on their interaction with design tools. Individual students have different digital exposures, design approaches, design experiences, varied studio environments (setups) and technology fluency. The varied realities of each design student's level of experience, skills and exposure to digital technology can only be understood and appreciated when hidden facts are communicated and interpreted. By means of this, the subjective interpretations of the various participants can be reconciled and the differences that make the phenomena complex will be exposed. Constructivism permits the investigator and study participants to engage in a flexible manner (Bhatta 2018) which leads to openness and richness of data.

4.2 Research Methodology

If it is believed that nature exists (ontology) and there is a belief about how one might discover knowledge about the existence of nature (epistemology) then there must be a way or procedure to help obtain knowledge about the existence of nature (methodology). The methodology comprises a collection of approaches informed by presuppositions regarding ontology, which deals with the reality state of the "thing" under investigation, and epistemology, which deals with its "know-ability." (Schwartz-Shea and Yanow 2012).

The beliefs a researcher adopts about the nature of society (ontology) influence their perceptions of the nature of knowledge within that society. (epistemology) and this consequently determines the researcher's choice of ways to discover this knowledge (methodology). A methodology is an action plan that uses a strategic set of rules in an organized manner to help researchers undertake scientific study. A methodology is a plan of action to obtain the facts. There are three categories of research methodological approaches and these are use-mixed, qualitative, and quantitative methodologies (Creswell 2008 and Cohen *et al.* 2007).

Using the numerical rows in Figure 4.1, the current study is best described in row number 2 which outlines the fact that the research is ontologically subjective and epistemologically constructivist. As a result of this epistemological stance, the research methodology is qualitative and the methods of data collection adopted are interview and observation.

4.2.1 Qualitative Research

Aspers and Corte (2019) consider qualitative studies as a method of conducting social science studies that entails meeting people in their own habitat and conversing with them in their own language and according to their own terms. Qualitative research, according to Teherani *et al.* (2015) is naturalistic in the sense that it looks at various social groups' daily lives as they occur in their natural environments. Qualitative research is intended to give the researcher a way to comprehend phenomena through interaction or

observation of study participants (Denzin and Lincoln 2008) and this justifies the qualitative approach adopted in this study. Qualitative approaches are highly advantageous since they may yield detailed accounts of individuals' mental processes and concentrate on the causes behind a phenomenon's occurrence (Creswell 2003). Thus, the objective of the qualitative inquiry method is to comprehend a social or human problem from several angles (Denzin and Lincoln 2000).

Using a variety of interrelated interpretative techniques, qualitative researchers always strive to get a deeper comprehension of the subject at hand (Denzin and Lincoln 2008). According to Bhatta (2018), *e*mploying a qualitative technique instead of a quantitative one, which is more regimented and direct, enables an iterative and flexible process. The exploratory verbs "explore" and "describe" are used by the qualitative researcher to start the enquiry, along with terms like "how" or "what" (Creswell 2009). An exploration-based, flexible, data-driven, and context-sensitive approach is typical of qualitative research (Mason 2002). This is inductive and entails the process of creating a comprehensive and intricate picture of the phenomena of concern. Additionally, it is thought that "qualitative paradigms are inclusive and can include objectives that are interpretive, exploratory, explanatory, or descriptive (Harrison *et al.* 2017). For a comprehensive knowledge of the phenomena, qualitative case study research is helpful (Bhatta 2018).

It is clear from the literature that qualitative research is wide-ranging and focuses on providing exceptional interpretations of events through investigation in natural environments. In view of the complex nature of digital technology use among design students in Ghanaian universities, the study is ontologically subjective. A qualitative methodology was adopted for this research because it is in line with the aim of the study to explore in-depth the effectiveness of digital technology utilization in the graphic design ideation process in the students' work environment with the intention of providing detailed descriptions, explanations, and interpretations of the data gathered.

4.3 Research Design

The general framework or blueprint of the study effort is referred to as the research design (PEDIAA 2017). Research design is the procedure employed in research initiatives for collecting, assessing, analyzing, and presenting data (Creswell 2007). It is the overall method for drawing the required linkages between the conceptual research issues and appropriate (and achievable) empirical study. Put another way, the study design specifies the procedure for gathering and analyzing the relevant data and how this data will be utilized to respond to the question being investigated (Gray 2014). For the conclusions of the investigation to effectively address the study concerns, the study design is regarded as the conceptual blueprint that acts as an organized framework that demonstrates the links between the questions to be answered, the data to be gathered, and the techniques for data analysis (Yin 2011). Influenced by underlying philosophical assumptions, research design describes the plan or strategy that specifies the respondents of the study, data gathering techniques and the data analysis to be adopted (Nieuwenhuis 2007b).

These definitions, from different authors, have given a clear view of what research design is about. Except for the second definition given by Creswell (2007), which regards research as a procedure, the rest of the authors considered research design as a plan. Even though these authors used different words such as blueprint, strategy, framework and structure, they are all referring to the word ‘plan’. The purpose of the plan, as seen in the definitions, is to harmoniously organize the various components of the research such as the research questions, data collection, data analysis, data interpreting and data reporting for the sole purpose of addressing the research problem. Research relies heavily on data and how it is treated and managed. As noted by Nieuwenhuis (2007), the research plan is influenced by philosophical assumptions. This is to say that the ontological and epistemological decisions made by the researcher determine the types of research questions to ask, the kind of data to collect, and how the data is

analyzed, interpreted and reported. With all these units or components in mind, (Schwartz-Shea and Yanow 2012) expressed their views about research designs when they stated simply that ‘How will you carry out the research to answer the research question?’ is a question that research designs aim to solve.

According to (PEDIAA 2017), a research design comprises the following: semi-experimental (field experiment, quasi-experiment), experimental (experiments), descriptive (case study, survey, naturalistic observation), correlational (case-control research, observational study), review (literature review, systematic review,), and meta-analytic (meta-analysis) element. This study adopts the case study as a design purposely to obtain in-depth knowledge of the phenomenon.

4.3.1 Case Study

The use of case study research as a legitimate research tool to examine complicated phenomena in real-world contexts has grown in prominence (Harrison *et al.* 2017) and due to its extensive use across various fields, it is growing in popularity (Bartlett and Vavrus 2017), especially in social sciences (Crowe *et al.* 2011). One theoretical issue with case study research, however, is that Its authors have given it a variety of definitions *(Harrison et al.* 2017; Yazan 2015). Yin, a case study researcher, acknowledges that defining the word "case study" is quite challenging (Yin 2014). However, he defined it as in-depth investigation of a phenomenon entangled in the specific environment with the use of multiple sources of data, while Flyvbjerg (2011) observed that the case study's primary strengths are its within-case variance, richness, wholeness, and comprehensive detail. Dooley (2002) emphasized that case study research aims to comprehend complex phenomena. A case study is a type of enquiry where the researcher analyzes a case, usually a procedure, action, event, or program [concerning] a person or a group of persons, in-depth. Cases are constrained by their scope and activity, and investigators use a variety of data collection

strategies to collect extensive data over a lengthy period (Stake 1995; Yin 2012).

The various definitions postulated by these authors are distinct in meaning but share some common features. It is evident that a case study principally, focuses on a deep study of a phenomenon seeking to unearth the 'why' behind the 'what' and the 'how' details of the 'what'. That is to ask, 'W*hat* is the nature of reality? and further probe by asking 'Why is reality the way it is?' or 'What are the contributing factors leading to this reality?' and 'How did reality turn out to be what it is?' The more complex a case is, the more questions the researcher poses for clarifications. The statement made by Denscombe (2007) that a case study tends to be 'wholistic' rather than deal with 'isolated factors' (Denscombe 2007) means that a case study researcher has to dig deep until there is nothing more to find out about the case being studied. This means the case study approach, by its nature, deals with a case in its entirety, or as a whole, thereby discovering the various components or aspects that contribute to and affect one another in a phenomenon. It also means that the case study seeks to investigate, in detail, existing interactions, connections and relationships among components of a phenomenon and how these components influence one another to understand and appreciate the intricacy of the phenomenon in its social context. The quantum of tasks and the processes involved in the wholistic discovery of a phenomenon explains why a case study in research concentrates on just a few participants.

By this it is understood that the case study is not designed to untangle (solve) what is entangled (a problem) but rather to understand the seriousness of the entanglement and, only if possible, assist by proposing possible ways of disentangling the entanglement. This can be achieved by adopting the inductive approach to case study.

A case study is considered most appropriate for this research because as stated by Yazan (2015), a qualitative case study is informed through the

epistemology of constructivism. This approach is used more for qualitative research (Gummesson 2014) since it involves thoroughly researching complicated issues (Crowe *et al.* 2011). A case study is adopted in this current study to explore how digital technology can be effectively utilized to enhance design ideation in graphic design in selected Ghanaian universities because the study aims to obtain comprehensive knowledge and interpretation of the phenomenon. This involves an in-depth analysis of participants' activities as they engage in digital technology use during the ideation. There is a keen interest in available digital devices, how they are used in processing ideas and the ideation output achieved. A case study is the right approach for the interpretation of design phenomena in each of the universities as separate cases and appreciates the context within which the different phenomena occur. A case study offers the researcher the opportunity to utilize multiple sources of information (Creswell 2007) in order to unearth more truth and rich information for better interpretation of [in this case] digital technology use in design ideation. The sources of information (data) adopted in this study are observation and interview. It is believed that the weakness of observation is taken care of by the strength of interview and vice versa. As the idea of qualitative research is to examine a complex social phenomenon, the use of case study research and its relevance for the qualitative study is more prominent (Bhatta 2018). It is an empirical investigation that aims to thoroughly examine in a setting representative of actual life.

The capacity of case study research to address 'how' and 'why' kinds of enquiries is one of its key advantages (Baxter and Jack 2008) and this is relevant to qualitative research (Bhatta 2018). Again, there exists conformity between case study and inductive study in the sense that they share common characteristics of in-depth study of the setting in which phenomena occur. As stated by Saunders 2009, research employing an inductive method of reasoning is probably going to focus especially on the environment in which these kinds of incidents occur (Saunders 2009).

4.3.2 Hermeneutical Phenomenology as a Philosophy and Methodology

As was stated earlier, this qualitative case study seeks to explore how digital technology can be effectively utilized to enhance design ideation in selected Ghanaian universities. The study also intends to create awareness on the need for digital technology integration into design ideation and develop a model for effective digital ideation process. Due to the exploratory nature of this research data collection and analysis were primarily guided by a phenomenological perspective and thematic analysis with a particular focus on the meaning-making of contextual issues.

Phenomenology is the investigation of occurrences in order to get a greater knowledge of human nature (Husserl 1962). According to (Qutoshi 2018):

> *'…A*s a philosophy and an investigative technique, phenomenology is not restricted to a way of knowing; instead, it is an intellectual process of interpretation and meaning-making that is employed to comprehend the intentional lived reality of humans. As a philosophy, phenomenology offers researchers a theoretical framework for comprehending occurrences at the level of subjective reality. This theoretical framework, also known as the theory of subjective reality, is crucial for comprehending the subject, or actor concerning a certain phenomenon in his or her life.' (Qutoshi 2018: 215).

Through the purposeful study of life experiences, phenomenological investigations produce results that open minds, enhance perspectives on phenomena, and clarify the position of the investigators. Nonetheless, subjectivity and individual comprehension in viewing and interpreting information from the viewpoint of the research participant have been particularly emphasized in phenomenological investigations (Qutoshi 2018). Comprising philology and methodology, phenomenology is a component of the interpretivist / constructivist paradigm (Qutoshi 2018).

4.3.3 Phenomenological Reduction

Phenomenological reduction holds the view that there is an experience in which we can arrive at the world with no prior information or assumptions; it is an experience of amazement (Cogan 2006). According to the author, the technique known as phenomenological reduction describes and suggests how to intentionally maintain the force of amazement that awakens us, enabling conceptual cognition to be executed by deliberate evaluation and introducing the "knowing" of amazement into our daily lives. In other words, phenomenological reduction is properly understood as a regimen created to change a philosopher into a phenomenologist by achieving a certain understanding of the universe.

The understanding gained from the statements of Cogan (2006) is that phenomenological reduction can simply be considered as making a determined effort as a researcher to reduce personal opinions, presumptions and preconceived notions about the world (phenomena) to nothing, or non-existence and facing the research as a new world devoid of biases and other influences to discover the phenomenon with an open mind.

Phenomenological analysis is predicated on conversations and introspection on direct sensory awareness and observation of the problem being studied (Alfornon 2019). The ability to tackle a project devoid of forming preconceptions, explanations, or models of concepts, serves as the foundation of the strategy. Based on the phenomenological perspective of the Philosophy of Science, phenomenological analysis is a general term for a variety of analysis techniques. These orientations placed a strong emphasis on perceptions, experiences, and physical feelings. Phenomenological analysis can be used alongside other analytical techniques. The researcher can investigate experiences and sensory perceptions of the phenomena under study through phenomenological research, and they can also build understandings based on these experiences and perceptions (Alfornon 2019).

Having been exposed to technology and design processes over the period of their study, the design students in the selected Ghanaian universities have a wealth of design experiences related to digital ideation to be unearthed. This study has adopted hermeneutical phenomenology, or an interpretive approach, to construct interpretive descriptions of the digital design ideation experiences of students. This approach is to help describe design students' experiences and examine the experiential commonalities through the researcher's reflections on these experiences. Students' experiences refer to the descriptions of their design experiences during ideation, including quantity, variety, novelty design output when using digital devices, the type of software they used and their views about the available tools for digital design. The study focuses on the effects of digital devices on design ideation, the participants' perceptions and how they described their inner thoughts and experiences about all of this.

The study of phenomenology is not the study of individuals but rather how a phenomenon manifests in the life world as it is lived and as experienced. The unit of analysis in phenomenology is therefore the phenomenon and not the individual. Designers were expected to narrate their lived experiences with regard to the use of digital devices.

4.3.4 Exploratory Research

Exploratory qualitative research is utilized to investigate when the variables and theoretical underpinnings of a topic are unknown (Creswell 2009). When there is insufficient information available on a phenomenon or problem that is not fully defined, investigative study is done (Saunders *et al.* 2007). The primary goal of the exploratory technique is to address novel issues with little or no prior research. It delves into the study problem at various points; it makes no attempt to provide comprehensive responses to the study's queries.

Design idea development has been thoroughly studied by scholars over the years in a variety of disciplines, including architecture, engineering, graphic design, product design, interior design, and fashion [Reference]. In spite of this, very little research has been done on the use of digital technology in graphic design ideation. As a result of this, not much literature exists in this area, hence the need to conduct this exploratory study. The researcher seeks to interact with participants to develop a comprehension according to findings. The exploratory method shares common principles with qualitative study. With a constructivist / interpretivism philosophical stance, the study is congruent (in harmony) with the case study approach adopted [Reference].

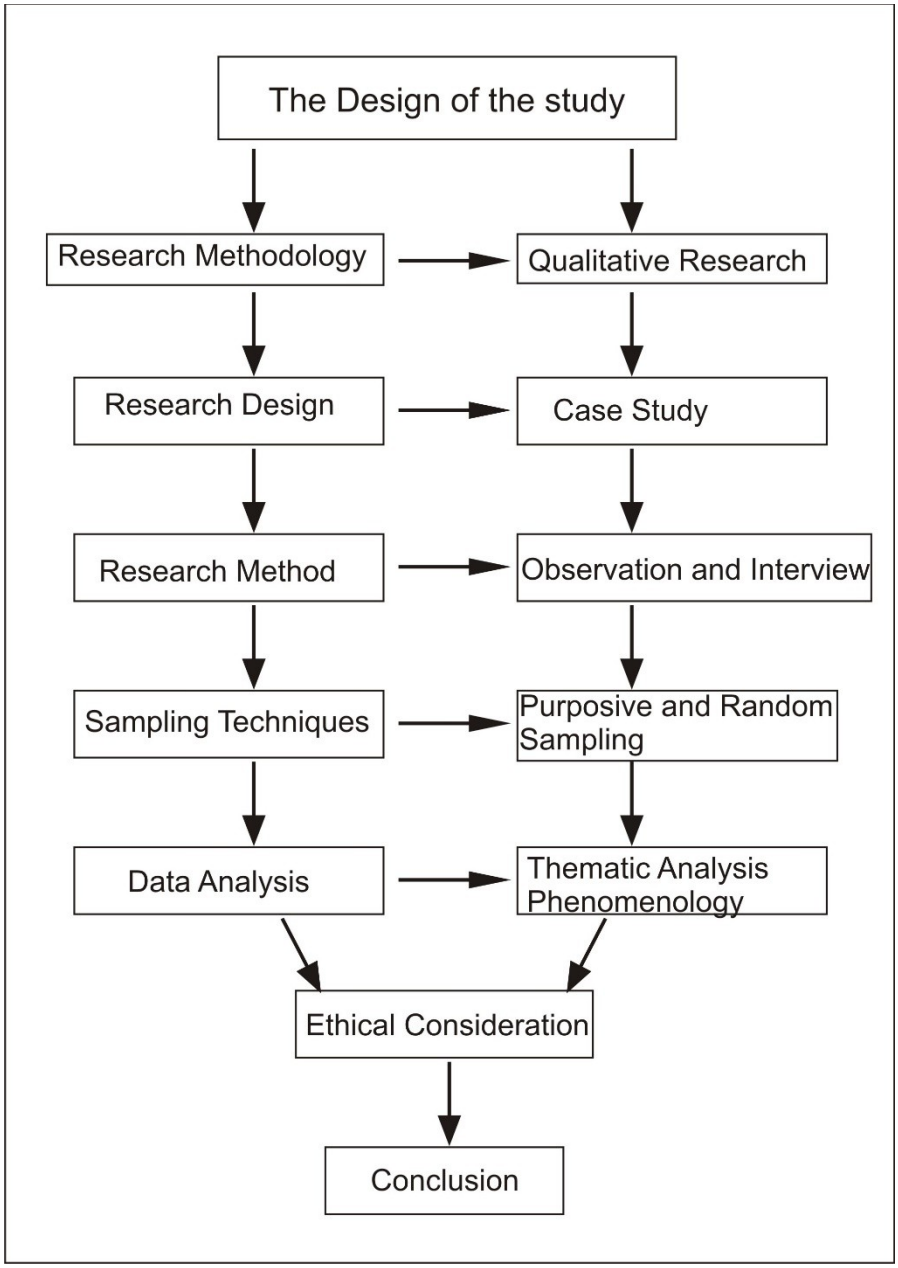

Figure 4.1: Research Design (Author's construct)

4.4 Population

Asiamah *et al.* (2017) assert that in a qualitative study, the population represents the broadest possible set of participants. Banerjee and Chaudhury (2010) describe it as an entire community about which specific information has to be obtained. Each member of the general population must have a common interest (Creswell 2003) and it is the common interest that qualifies the individuals as population members (Asiamah, Mensah and Oteng-Abayie 2017). The authors claim that because the population as a

whole is always made up of individuals whose participation in the study goes against the purpose of the investigation, it is inherently crude. With regard to this study, however, the general population covers all graphic design students in Ghana.

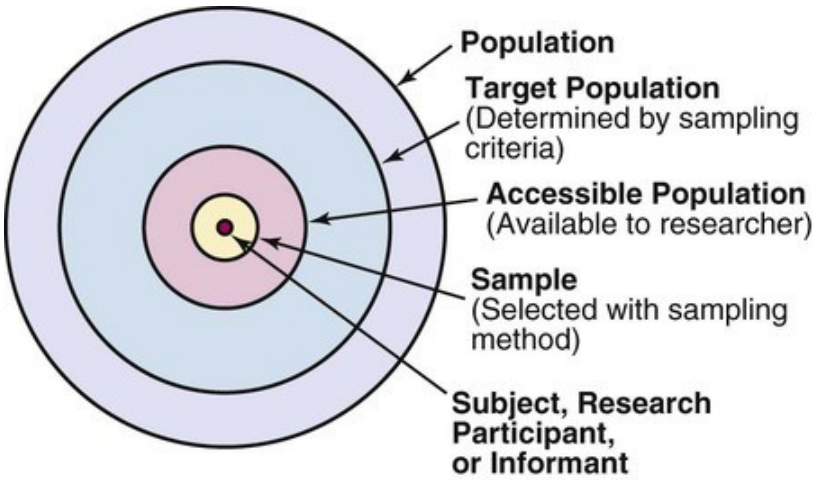

Figure 4.2: A diagrammatic Representation of the relationship between Population, Target Population, Accessible Population, Sample and Participant.

4.4.1 Target Population

The refined general population that lacks any trait that might contradict a study premise, context, or purpose is the target population (Asiamah, Mensah and Oteng-Abayie 2017). A collection of people or participants who have particular characteristics that are relevant and interesting forms the target population (Bartlett et al. 2001; Creswell 2003). It is known as the population of interest that the study aims to investigate (Majid 2018). Based on this understanding, the target population for this study is graphic design students in the Ghanaian universities. 4.5.2 Accessible population

The accessible population is reached once all members of the target population who will not or may not participate, or cannot be reached during the research period are removed (Bartlett *et al.* 2001). The accessible population is the graphic design students at Kwame Nkrumah University of

Science and Technology and the graphic design students at Takoradi Technical University.

4.4.2 Sample (Participants)

A sample is characterized as a subset of a population chosen for the purpose of study from a larger population (Salkind 2010). Very much related to this definition, Salant and Dillman (2004) state that it is a group of people chosen for a survey from a wider community. To achieve the goal of sampling of ensuring that the results of the sample accurately reflect the target population, a statistically representative sample from the population of interest is taken. A research study's sample needs to be sufficiently significant (Majid and Ennis 2018), enabling the researchers to be certain that the results of the study cannot be explained by chance differences in the target population. Every study should have an ideal sample size since a sample that is too small cannot provide a suitable reflection of the population (Salkind 2010) and an excessively high sample size is also inappropriate (Sekaran 2013). The sample sizes are chosen at 0.05 and 0.80, respectively (Altman and Bland 1995) and this is greatly dependent upon the study issue, technique, quantity of participants, and specialty (Majid and Ennis 2018).

The study is constructivist in nature with focus on the context in which graphic design ideation takes place. For this kind of study, a smaller sample size is deemed more acceptable than a larger one in the deductive method (Saunders 2009). Qualitative investigators select comparatively tiny subsets from a wide study population, all of whom are part of sufficiently qualified groups (Asiamah *et al.* 2017).

The sample for this study is drawn from the third and fourth-year graphic design students in a Traditional University, and from the second and third students in a Technical University and the sample size for the study is 28 participants in all. This is made up of twelve (12) students and 2 lecturers from each of the two universities.

The Graphic Design programme of study entails three (3) years of study in the Technical University for the award of Higher National Diploma, and four (4) years of study in the Traditional University for the award of Bachelor Degree. The second (2nd) and third (3rd) year students were selected in the Technical University, while third (3rd) and fourth (4th) year students were selected in the Traditional University for the study because they may have been more exposed to the use of technology and were more likely to adopt digital technology in the ideation process.

Table 4.2: Sample Selection Approach

TECHNICAL UNIVERSITY PARTICIPANT SELECTION			
	Lecturer participants		Number of lecturers per university
	Graphic Design lecturers		2
Student Participants			
Year of participant	Class Distribution of Participants	Number of participants per class	Number of students per university
2nd year	Two (2) first class students	6	12
	Two (2) second class upper		
	Two (2) second class lower		
3rd year	Two (2) first class students	6	
	Two (2) second class upper		
	Two (2) second class lower		
TRADITIONAL UNIVERSITY PARTICIPANT SELECTION			
	Lecturer participants		Number of lecturers per university
	Graphic Design lecturers		2
Student Participants			
Year of participant	Class Distribution of Participants	Number of participants per class	Number of students per university
3rd year	Two (2) first class students	6	12
	Two (2) second class upper		
	Two (2) second class lower		
4th year	Two (2) first class students	6	
	Two (2) second class upper		
	Two (2) second class lower		
Total Number of participants (students and lecturers)			**28**

4.4.3 Sampling Technique

i. Purposive Sampling

In purposive sampling, sometimes referred to as judgemental sampling, an researcher makes a conscious effort to choose those who can consciously contribute to knowledge of the study's main phenomena and research problem (Creswell 2007). According to Andrade (2021), purposive samples provide several benefits. For instance, they exclusively research the population that is of particular interest, which homogenizes the sample. Subjects who run the risk of experiencing severe adverse effects are excluded. Purposive l sampling is employed when the researcher is already familiar with the sample population and the purpose of the sample, ensuring that the representatives have the necessary data (Fraenkel *et al.* 2012). Again, purposive sampling is used since it aids in choosing the most suitable and effective participants to strengthen the validity of the research results. Purposive sampling is the selection of the best productive sample to provide answers to the study objectives.

It is clear from the literature that selecting the most appropriate sample is crucial to maximizing the credibility of study results, as the qualitative researcher takes a relatively small sample from a large study population. Because of the specific data needed on design ideation in this study, purposive sampling was conducted to select only lecturers who taught ideation related courses like Graphic Application, Advertising Design and Computer Graphics. They have the needed information and have formed the most appropriate participants. Again, because of the ‘class’ categories of students needed for data collection as indicated in Table 4.2, purposive sampling was adopted for the selection of the three class categories. With the help of lecturers, teaching assistants and course representatives, participants were purposively grouped based on the three categories specified - that is first class, second-class upper, and second-class lower students.

ii. Random Sampling

Simple random sampling, according to Saksena (2020), is the most basic kind of probability sampling, where the probabilities of each potential sample are the same. With an equal chance of selection for each unit during every draw, the sample is selected unit by unit in this manner. In another expression, Cohen *et al.* (2007) state that in simple random sampling, the likelihood that a person will be chosen does not change based on who else gets chosen from the population.

Random sampling was adopted to select six participants from each of the three categories of classes. The selected students were scheduled for one-on-one interviews with the researcher on an agreed day, and at an agreed place and time after informing them on the study being conducted and having them sign the consent form. Because all the sampled participants could not be interviewed on the same day, data was collected from the 15th of February to the 24th day of May, 2023.

4.4.4 Recruitment and Approach of Participants

Participants recruited for the study were fully informed about the research through letters of information and consent that were given to them by the researcher. It is only those participants who submitted signed information and consent forms who qualified to be part of the study and were scheduled for an interview at an agreed time and venue.

A non-threatening environment was preferred for the interview. The participant was allowed to choose a venue he or she was comfortable with. A lecture hall or design studio on campus could be considered provided there is no distraction.

Before the interview commenced, the individuals involved were briefly taken through some important details of the study including the duration of the interview; the study's purpose; as well as a guarantee of confidentiality and privacy. The participants were reminded that they were not under any obligation and therefore the participants had the right to discontinue the

study at any point if they were not comfortable with it. With the participants' consent, the interviews were recorded so that the researcher could capture all the details of the information.

4.4.5 Inclusion and Exclusion Criteria

Andrade (2021) notes that the more inclusion and exclusion criteria that are defined, each for an essential reason, the more purposeful the sample becomes. According to Stanley (2007), the inclusion and exclusion criteria of the study sample define those who are eligible for consideration and those who are not. The inclusion criteria consist of a standard, objective, consistent, and dependable way to identify the research population. According to Stanley (2007), the circumstances that prohibit the enlisted population from partaking in the study are included in the exclusion criteria. A requirement that cases must meet in order to be included in the research should be outlined in the inclusion criteria. For instance, research on domestic abuse could stipulate that women who were victims of partner abuse and reported it to the police should be the subjects (Luborsky and Rubinstein 1995). The characteristics that exclude a case from the research must be specified in the exclusion criteria. Consider research on exercise where it is required that subjects must be non-smokers. When combined, these standards create a perimeter around the sample area.

Inclusion Criteria for the selection of universities for the study

i. The study is focused only on the public universities in Ghana because they are well established, produce the greater number of graduates in the country, and are recognized.
ii. Only Ghanaian public universities that offer graphic design courses were considered for the study.

Exclusion Criteria for the selection of universities for the study

i. Private universities are excluded in this study.

ii. Ghanaian universities that do not offer graphic design courses were not considered for the study.

Ghanaian public universities are categorized into two groups, namely, Universities (usually referred to as traditional universities) and Technical Universities. There are four (4) traditional universities and ten (10) technical universities in Ghana. Two (2) of the traditional universities (University of Education–Winneba, and Kwame Nkrumah University of Science and Technology) offer Graphic Design programmes while three (3) of the Technical Universities (Ho technical University, Takoradi Technical University, and Koforidua Technical University) offer Graphic Design. This is to say that five (5) public universities in Ghana are offering graphic design courses. Out of the five (5) universities offering graphic design courses, two (2) were selected for the study.

In order to have a balanced view of graphic design ideation practices among design students in Ghana, one (1) university was sampled from each category of universities. The two (2) selected universities for the study were Kwame Nkrumah University of Science and technology, and Takoradi Technical University. These universities were purposively selected because they produce the highest number of graduates in their respective categories and findings from them will be highly representative of graphic design ideation practices among Ghanaian university students.

Inclusion Criteria for the selection of participants for the study

i. Only graphic design students in the second (2nd), third (3rd) and fourth (4th) years were considered for the studies as they may have been more exposed to the use of technology and were likely to adopt digital technology in the ideation process.
ii. Only students with 1st class (80%-100%), 2nd class upper (70%-79%) and 2nd class lower (60%-69%) [passes] were eligible for the study as they were likely to be using digital devices for graphic design idea development.

Exclusion Criteria for the selection of participants for the study

i. The first (1st) year students of the selected universities were excluded from the study because they were at the introductory stage of their studies and may not have the requisite design ideation skills and the appropriate technology grounding to respond to the research questions.

ii. Students with a pass of (50%-59%) and those with a Fail (below 50%) were not selected for the study as they may not have given reliable answers to the question or exhibit the average competencies required to be eligible for the study.

In all, a total of 28 respondents were used as the sample for the study. This consisted of 24 students (12 from each of the two universities); and a total of 4 lectures (2 from each university).

Random sampling was adopted for the selection of 3rd and 4th year students. With help from teaching assistants, participants in three (3) categories namely, 1st class (80%-100), 2nd class upper (70%-79%), and 2nd class lower (60%-69%) were selected.

4.5 Research method

Research methodologies are the procedures that a researcher suggests for gathering, analyzing, and interpreting data for a study. With a focus on interpretivism, the study adopts Crotty's (1998) approach to data collection. Crotty mentioned that a researcher can adopt a phenomenologist, hermeneuticist or symbolic interactionist approach for data collection. According to Crotty (1998)r, a phenomenologist studies existence, and concentrates on the lived experience of participants; it is [about] the participant's memory of facts and interpretation of their experiences. Since meaning is something that arises from interactions between people, the symbolic interactionist views meaning as something that arises from social interaction, like teamwork, meetings, and conversations, whereas the hermeneuticist typically focuses on the study of cultural artifacts like texts, symbols, stories, and images. Based on the objectives of the study to

investigate how graphic design students generate design ideas, and the effect of digital technology use on design ideation process and output, this study adopted a phenomenologist approach with interviews and observation as tools for data collection.

Data Collection Techniques

The collection of data was intended to capture how students use digital devices during ideation and the quality of the ideation outcome. Simply put, the data collection focused on the tools used, the process, the product (ideation outcome) and students' perception of using digital technology during the design ideation process. Data was collected through interviews and observation.

4.5.1 Direct Observation

Due to the fact that ideation flourishes in opportunistic environments as opposed to organizational ones, direct observation was carried out without interfering with the flow of concepts during the design process. This helped in capturing quality and realistic data. It has been said that observation is a poor technique for recording nonverbal and mental processes since design conception takes place outside of the studio as well. In view of this, interviews were conducted as a complement to this approach to improve the authenticity of the outcomes.

Observation covers three major areas of ideation and these are preparation (research), the idea creative process, and the idea evaluation stages. To capture every important detail with regard to the research question, an observational protocol was developed as seen in Table 4.3.

Table 4.3: Observational protocol and tools (Author's construct, 2023)

Idea Creation and evaluation	**Observational Protocol (Activities to observe)**	**Observational tools**	**Reasons**
Preparation stage	The researcher observed to find out: a. how students research on the design brief. b. if the students use digital portfolios c. how students collected inspirational materials d. if the students use physical or digital theme boards. e. if students engage in brainstorming	Field notes Photograph	To take note of digital devices used by designers, sources of design inspiration, and the websites they visited while browsing for inspiration.
During idea creation	The researcher observed to find out if the students: a. use at least one electronic device when developing design ideas. b. are proficient in the use of at least one drawing software. c. have access to a personal computer d. some students depend on their friend's computer to work. e. have internet access for browsing any time they want f. use only electronic devices for idea development or in combination with pencil sketches. g. use multiple electronic devices when developing an idea h. effectively students utilize digital devices in search of multimodal sources of inspiration for creative ideas.	Field notes Photograph	To identify digital devices used by designers, the software they used during ideation, their digital fluency and how all of these affect ideation outcomes.

Ideation evaluation	The researcher takes note of a. Good idea counts b. Variety c. Novelty of design d. Selection made by the designer	Field notes Photograph	To record graphic designers' evaluation approach.

4.5.2 The interview

Comments and questions that were documented during the observation formed part of the interview. The participants' thoughts during ideation, their 'reflection on certain actions taken and their source of inspiration were discussed at the end of the conceptualizing period in individual interviews.

Open-ended, semi-structured questions were used throughout the interviews (see Appendix 3). Even though the questions were predetermined, it was observed that rigid adherence to the order of the questions could affect the smooth and natural flow of interaction which would not allow the interviewees to present their information in an orderly and comfortable manner. Given this, an interviewee may be answering question one according to the interview guide but the next appropriate question to ask to maintain a good flow of interaction, may be question seven. In order not to miss a question, the researcher had to tick every question asked. A semi-structured interviewing method implies that the investigator is not going strictly according to the order of questions and words of the interview guide. This created the flexibility of asking follow-up questions if need be.

Each interview was audio-taped and transcribed. Some questions asked during the interview session included: Which digital devices do you use for graphic design work? How does the use of electronic devices affect the quality of idea development? Which teaching facilities do you think are needed to improve digital ideation? and What are some useful websites from which great design ideas can be generated? Nevertheless, the interviews diverged from the pre-planned questions, validating the statement that case

study interviews seem to be guided discussions rather than systematic investigations (Yin 2003:89).

The constructivist researcher's objective is to rely on the participants' perspectives on the subject under study. The purpose of asking broad, generic questions is to allow the participants to interpret a given scenario for themselves. Better understanding comes from asking open-ended questions (Creswell 2009). The researcher pays close attention to whatever the subjects have to say and observes what they do in their life settings (Creswell 2009). Open-ended questions are frequently utilized by qualitative investigators to allow participants to express their opinions. This methodological approach seeks to comprehend the environment, or background of the participants by visiting the location and personally acquiring the needed data. As stated by Creswell (2009), studying a situation in-depth, considering its historical, geographical, and social settings, is essential for researchers to comprehend what is occurring or how realities are being perceived.

Given this, data were collected to cover students' past design experiences through interviews, to understand why they approached the ideation process the way they do. Delving into the socio-cultural contexts, the study examined the digital social life of the students to see how it affected the culture of design ideation. Data was collected on environmental influences affecting design ideation.

Table 4.4: Research questions with corresponding data gathering tool (Author's construct, 2023)

	Research Questions	Data gathering instrument(s)
1.	How do design students in Ghana generate graphic design ideas?	Observation Interview guide
2.	How do digital technologies affect students' ideation processes and design ideation output?	Observation Interview guide
3.	What is the perception of graphic design students regarding the use of digital technologies during the ideation stage of the design process?	Interview guide
4.	How can digital technology be effectively used to improve the design ideation process among students?	Literature Review Interview guide

4.6 Data Analysis

To clarify the outcomes to other people, investigators interpret the data they have gathered using a process known as qualitative data analysis (Williamson, Given and Scifleet 2018). It is a process that principally has to do with detection and which involves describing, classifying, analyzing, speculating, clarifying, examining, and charting (Ritchie and Spencer 2002) interview transcripts and notes systematically. Data analysis is the investigator's endeavour to accurately and reliably describe the data gathered. It is the presenting of research results in a way that leaves no room for doubt. Lofland *et al.* (2006) listed the four characteristics that make up qualitative data analysis.

a. An analysis procedure that leans more toward induction than deduction produces the outcomes or discoveries.
b. The investigators generally serve as the main analytical agents.
c. Qualitative analysis is an extremely participatory process between the investigator and the data due to its inductive and agent-driven nature.
d. As a result, the procedure requires a lot of labour and time.

4.6.1 Thematic Analysis

To purposely uncover hidden trends and inferences effectively, the qualitative dataset is collected, transcribed, organized and analyzed utilizing thematic analysis. Thematic analysis is the method of locating themes or patterns in qualitative analysis (Maguire and Delahunt 2017). It's a strategy for meticulously identifying, categorizing, and setting relevant patterns (themes) within a dataset in context (Braun and Clarke 2012) who add that the purpose of thematic analysis is to assist researchers make sense of shared or communal experiences and meanings by focusing on meaning within a dataset. According to the authors, rather than bolstering meanings and experiences in a single piece of data, the thematic analysis focuses on identifying similarities between how a topic is spoken or written about and making sense of those connections. Braun and Clarke (2006) observed that the variable nature of theme analysis enables the investigator to use many approaches to focus on the data. The researcher might describe the evident meanings in the information or look for underlying themes or the ideas beneath the facts, or concentrate on evaluating meaning throughout the whole dataset. They can also investigate a specific component of a phenomenon in detail.

4.6.2: Flexibility of Thematic Analysis and Choice Making

One strength of thematic analysis is that it is a strategy for carrying out qualitative research as well as a technique for data processing. The method, according to Braun and Clarke (2012), offers a means of distancing qualitative research from these more general discussions and opening up its findings to more people. The flexibility of thematic analysis renders it useful and easy to conduct in different ways. It can be used in three main approaches and these are essentialist against constructionist theoretical stances, critical versus experience-based orientations to data, and comparing deductive and inductive approaches. It is suitable for multi-methods research where many who are involved are not trained researchers.

The inductive data coding approach is considered to be a ‘bottom-up’ approach, which is influenced by the content of the data. That is to say, the investigator's analysis typically does not take the shape of semantic data content; instead, the themes and codes are derived primarily from the ideas and thoughts that the investigator applies to the data. Because the study is inductive in nature, and includes questions for exploratory investigation, and data-gathering techniques, thematic analysis is deemed acceptable for this particular investigation. The study illustrates an inductive form of thematic analysis with in-depth reasoning especially focused on the environment in which the phenomenon occurs (Saunders 2009:147). In this study, design students’ (participants') design experiences served as the basis for data coding, where the analytical lens does not entirely supersede their narrative. Some findings from the literature reviewed on technology, design process and inspiration and Shah *et al.*’s (2003) theory of design effectiveness also helped in understanding and meaning-making.

Thematic analysis offers fundamental abilities that are applicable to a wide range of different types of analysis (Braun and Clarke 2006:78). As stated by Javadi and Zarea (2016), thematic analysis can be approached in a variety of ways but for effective analysis, this study focuses on Braun and Clarke's (2006) six-step process for doing theme analysis and these are:

a. Data familiarization,
b. Initial code generation,
c. Theme search,
d. Theme review,
e. Theme definition and naming, and
f. Report production.

This provides a simple and practical framework for theme analysis. Finding significant themes or patterns in the data and applying these themes to the study's questions are hallmarks of thematic analysis, according to Maguire and Delahunt (2017), and a strong theme analysis explains and makes meaning out of the information (Clarke and Braun, 2013). Data from

unstructured observation and interviews are frequently analyzed using thematic analysis and category coding by qualitative researchers, such as ethnographers (Williamson, Given and Scifleet 2018). Researchers adopting thematic analysis must control their personal beliefs and notions.

4.7.1 Validity

Validity pertains to the suitability, significance, and efficacy of the deductions that an investigator draws (Fraenkel and Wallen 2003:169). Hollweck (2015) states that a high-quality case study depends on a valid research process. This involves quality control methods used in collecting and interpreting the data to make it credible. As stated by Babbie and Mouton (2001), validity centres on how well an empirical measure captures the true significance of the idea being studied. To establish the quality of the case study, Yin (2009) outlined four tests to adopt, and they are “internal validity”, “external validity”, “construct validity”, and “reliability” (Yin 2009: 40).

i. Internal validity

Regarding internal validity, Yin (2009) believes that the greatest concern is the issue of causal relationships that will make the researcher conclude with inference. Since this qualitative research does not seek to draw inferences, internal validity was established by reporting issues ‘just as’ presented by respondents and ‘just as’ as observed devoid of all biases.

ii. External validity

External validity is how well the findings apply to different and related phenomena and achieve the same results. It is also referred to as ‘transferability’ by Guba (1981) who states that there is the need to collect "thick" descriptive information and provide an exhaustive account of the situation so that assessments of its compatibility with other situations may be made. In qualitative research, according to Maxwell (2012), there should be a good connection between the components of the study plan which include the goals, the conceptual

framework, the issues, the settings, the theory, the research questions, the methods and the techniques to generate and analyze data. For purposes of external validity (transferability), these research elements are well organized and aligned with an adequate and detailed description of each. To this effect, a full description of all contextual factors impinging on the inquiry is documented in an appendix to the study.

iii. Construct validity

The researcher must ensure that a given problem's construction agrees with other issues' constructions of the same underlying issue to show construct validity (Cohen *et al.* 2007:138). This may be done by comparing the investigator's creation to a large body of scholarship that explains the significance of a certain construct and its parts, or by correlating the results with other measurements of the problem.

Given this, the study is supported with sufficient related literature to unearth needed facts. Again, two sources of evidence for the data collection (observation and interviews) are used. Observation is used not only as a means to capture relevant data, but also to corroborate data that were collected during interviews with participants. Multiple responses were collected on similar questions to give credence to issues that were captured during observation.

The procedures for data collection were methodical and thorough to capture important details. With these combined efforts, construct validity was established for the study.

4.7.2 Reliability

Reliability determines how consistent the data are in the research: both outside and inside. The term "internal consistency" describes how plausible the data are. This is provided without typical kinds of human dishonesty while

external consistency is attained by confirming or cross-checking findings with various disparate sources of evidence.

To achieve reliability during the interview, a sound recorder was used to record, and notes were used to document important points. Notes, pictures and voice recordings were taken during interviews and observations with permission from the participants. All this was done is to cross-check data collected for reliability.

4.7.3 Ethical Consideration

Ethics are usually understood to deal with opinions of what is positive or negative, appropriate or inappropriate, or right or wrong Ethics are social rules that define what behaviour is acceptable and undesirable (Shah 2011). Thus, research ethics is a subfield of practical ethics with established norms and regulations that specify how investigators are to behave (Akaranga and Makau 2016). Every researcher has a duty to avoid every form of threat and harm to the participant by observing professional research ethics (Creswell 2013)

To comply with the ethical codes of the study, gatekeeper permission letters were distributed to the heads of departments, explaining the study and its aim preceding the data collection and a thorough explanation of the study objectives was given to the respondents before data collection. Permission had to be secured from the central administration of each study institution, particularly from the office of the registrar, to conduct research in the institution and again, permission was secured at the department level from the office of the heads of department, in each of the institutions where data was collected, to gain access to the students and lecturers. This allowed the researcher to study the activities of graphic design students and connect with them and their design environments for rich data gathering. Because of the need for ethical compliance of the study, the whole exercise of data collection was guided by a sense of security and the participants, including

the lecturers, were willingly involved and displayed understanding and openness. They were very cooperative and gave their utmost support and made valuable contributions.

It was made clear to the respondents that the data to be collected would pose no physical, psychological, legal or social harm to any participant. It was made known to respondents that anyone who wished to opt out at any stage would be permitted to do so, since participation was voluntary.

Participants were made to understand that no incentives would be offered, as the research was academic in nature and also because such a gesture can negatively affect the quality of data.

The anonymity and privacy of respondents was assured concerning the study and was strictly adhered to with all seriousness. It was explained to respondents that the study report would not require their identities and if it became necessary to use names at all, they would be replaced with pseudonyms, whereas those of lecturers would be captured by means of numbers, all done to protect the respondents' privacy and identity.

During data interviews, questions did not address anything related to participants' personal lives. Interview sessions with students and lecturers were strictly related to the research topic and lasted between 15 and 20 minutes on average.

With consent from the Durban University of Technology, the researcher will, based on the preferences of individual respondents, provide those participants who specifically requested feedback on the study's findings after it has been accepted and presented to the institution.

4.7.4 Data storage information

(Storage of all electronic and hard copies including audio recordings)

Electronic data are stored on external devices and are password protected. They are regularly backed up to avoid and protect against loss. Data collected in hard copy are securely put under lock. After the study, the collected data will be retained for five years before they are finally disposed of by formatting the devices on which they are (in the case of electronic copies) and by burning them in the case of hard copies.

4.7.5 Ensuring Trustworthiness

To ensure the trustworthiness of the study, qualitative data are subjected to the four criteria as outlined by Guba (1981) and these are 1. Credibility 2. Transferability 3. Dependability and 4. Confirmability).

i. Credibility

The study is subjected to peer debriefing. This is the input and feedback of other people by seeking the views of professionals, peers and other scholars. Constructive criticisms raised during the debriefing are incorporated into the study. For better research outcomes, approaches and perspectives may be redirected as a result of **p**eer debriefing.

There was prolonged involvement with research participants to increase the level of trust between the subjects and the investigator. Over time, the participants may become accustomed to the presence of the researcher and may exhibit their natural traits which perhaps were hidden or controlled earlier.

Interviews and observations were used so that the weakness of one instrument was catered for by the strength of the other. The prolonged use of these instruments helped in controlling researcher biases which led to a collection of factual data that was representative of the participants, or the phenomenon being studied.

Referential materials are to be kept. All research diaries, audio recordings, and coding books are kept.

Member verification is the process of examining the veracity of findings. It is sometimes referred to as responder validation. The final phases of analysis will be given back to the participants, who will be requested to provide feedback on whether the findings aligned with what they contributed for the purpose of accurate data reporting. In addition, participants will have the chance to add further remarks at any time.

ii. Transferability

The concept of transferability refers to how effectively the results of qualitative research may be used in other circumstances or contexts. To support transferability, the research offers enough details about the investigation's setting so that anybody else with a similar interest will have a foundation of knowledge that is suitable for the court. The study provides statements that are descriptive and interpretative of the context. That is, remarks that are pertinent to the situation are recorded to establish a strong foundation for transferability.

For purposes of transferability, Guba (1981) states that there is the need to collect “thick" descriptive information and provide an exhaustive account of the situation so that assessments of its compatibility with other situations may be made. Here, the researcher provided a robust and thorough report on the experiences during data gathering. To this effect, a full description of all contextual factors impinging on the inquiry is documented in an appendix of the study.

iii. *Dependability*

An "audit trail" was established to enable the external auditor to review the methods by which data was collected and analyzed. All research diaries and audio recordings will be made available to ensure a dependable audit.

iv. *Confirmability*

According to Guba (1981), adopting triangulation, reflexivity and confirmability [in the] audit leads to confirmability. In this respect, interviews and observations were adopted for the study so that the weakness of one would be offset by the strength of another.

Reflexivity is examining one's own opinions, beliefs, and behaviours while conducting studies and how they could have impacted the findings. It entails challenging oneself to examine one's own presumptions. It demands honesty and an understanding that the investigator is a participant in the study (Finlay 1998). The adoption of phenomenology as an approach for in-depth study and the adherence to the theory of phenomenological reduction has controlled researcher biases and preconceived notions. The researcher examined his personal beliefs, previous experiences, opinions and preconceived notions regarding the study. He ensured that none of these affected how data was collected, analyzed, presented and reported. This helped to eliminate researcher bias and subjectivity that helped improve the trustworthiness of the study, Again, all documentation needed for confirmability audit will be readily provided if need be.

4.7.6 Summary

The study is ontologically subjective and epistemologically constructivist. This epistemological stance has oriented the research for qualitative methodology. The methods of data collection adopted are interviews and observation. A case study design was adopted so as to have a thorough comprehension of the phenomena of graphic design ideation in the selected universities. In sync with this approach phenomenology and thematic analysis were adopted to guide data collection and analysis. The chapter covers such areas as the study population, the sample and sampling techniques, the recruitment of participants, data generation, trustworthiness, and ethical considerations.

CHAPTER FIVE

PRESENTATION, ANALYSIS AND INTERPRETATION OF FINDINGS

5.0 Overview

In the previous chapter, the philosophical assumptions of the study were discussed. It was clearly spelt out that the study is ontologically subjective and epistemologically constructivist. With this epistemological stance, qualitative methodology was adopted for the research. This study therefore assumes the constructivist and interpretivist paradigm because digital technology use in design ideation among students has to do with students with varying design experiences, backgrounds, design environments and levels of interaction with digital design tools. Individual students have different digital exposures, design approaches, design experiences, varied studio environments (setups) and technology fluency.

The research method employed for data collection, population and sampling for the study were also clearly outlined. The chapter also discussed case study as a research design and focused on phenomenology as an approach that guided the data collection. Thematic data analysis, which provided a structure for the presentation and analysis of findings, was also discussed. A case study design was considered most suitable for this study and the reasons for this choice were discussed in the chapter. Finally, the study population, sample and sampling techniques, the participants' recruitment, ethical considerations, data storage information and trustworthiness were also covered.

This chapter presents and analyses the findings related to the effectiveness of digital technology utilization in the graphic design ideation process among Ghanaian students. Data was generated through face-to-face interviews and observations. The structured interview and observation were adopted to elicit data from 24 students and four (4) lecturers in two universities in two regions in Ghana. These participants were purposively sampled.

Phenomenology and a case study approach were used as tools to interrogate the interactions among students to gain adequate knowledge about the effectiveness of digital technology utilization in the ideation process for effective design idea creation.

This study seeks to explore how digital technology can be effectively utilized to enhance graphic design ideation among graphic design students in two selected Ghanaian universities. The study also seeks to create awareness of the need for digital technology integration into graphic design ideation and to develop a model for effective digital ideation.

The following research questions served as a guide for the study to accomplish this purpose:

i. How do design students in Ghana generate graphic design ideas?
ii. How do digital technologies affect students' ideation process and design ideation output?
iii. What is the perception of graphic design students regarding digital technology utilization in the ideation phase of the design process?
iv. How can digital technology be effectively used to improve the design ideation process among students?

Observations and interviews were conducted in two universities to purposely discover the realities of digital technology usage among students during design ideation and these findings are presented in this chapter. For clarity and systematic organization, the findings are presented sequentially based on the research questions.

Data form

The data collected are in the form of audio recordings, field notes and photographs.

Table 5.1 The form of data collected

Data Form	Description
Audio recordings	The audio recordings were transcribed by the researcher himself. It was time-consuming but it was worth it. In order to maintain the conversational flavour of interaction with the participants, the transcription was verbatim; however, any word or construction that the researcher felt the reader would not understand was explained during the analysis. For instance, a student said, 'Because my machine is plague and play it has to be connected to electricity any time I work. This sentence was explained as 'Because my laptop battery is weak, it has to be connected to electricity any time I work.' Again, any information given by a respondent that was completely immaterial to the interview question and which is not relevant to any of the research questions was excluded during analysis.
Field notes	Notes were made principally on things that were observed and any other information the researcher deemed important to note.
Photographs	Photographs were taken of students' ideation works in their sketchbooks and on their computer screens and also of classroom and computer lab environments.

5.1 Analytical Approach (Thematic and Phenomenological Analyses)

Thematic analysis was combined with a phenomenological data analysis approach and clarities of these two approaches are seen as the discussion unfolds. The research analysis was guided by phenomenological reductions as discussed in the previous chapter. The first major reduction was 'epoche',

which is the process of letting go of all preconceptions, biases, beliefs, theories, and principles. The suspension of this natural attitude is necessary to take a impartial look at phenomenon to discover essences and to report issues as they really are. With thematic analysis as a major tool for analysis, all the data collected were put under various themes and sub-themes using the research questions, the structured interview guide and the observational guide questions. That is to say, the research questions were converted into themes and some of the questions in the interview and observational guides were converted into sub-themes. For instance, research question 1 says, 'How are graphic design ideas generated by design students in Ghana?' and the major theme generated from it is 'Graphic Design Ideas Generation among Students'. A question in the observation guide which says, 'Which electronic devices do students use during idea development?' was converted to a sub-theme which reads, 'Students' Use of Electronic Devices during Design Ideas Development.' With this approach every question and sub-question was covered in the discussion.

The six thematic steps as outlined by Braun and Clarke (2006) were followed in this analysis and this starts with 'familiarity with the data.' The researcher at this point transcribed audio recordings and documented observation records so that they could be analyzed. The researcher read these written documents over and over in order to familiarize himself with the entire dataset. The reading was actively, analytically and critically done (Braun and Clarke 2012). Notes were taken and personal comments were made about some of the data. Some portions of data were highlighted to be given attention later. These annotations were very important as the researcher began to identify issues that were relevant to the research question, familiarize himself with data and prepare for better analysis. From a phenomenologist's point of view, the researcher began to explore the 'noema,' 'noesis,' and 'essence' of the data. This can also be referred to as 'the what, the how and the why' of the data. It is stating *what* the experience or the situation was as it was observed or narrated by the participant, finding

out *how* the experience was perceived or understood by the participant and *why* the participant perceived the experience in that way.

Even though the study was conducted in two separate universities, the discussion of findings was integrated across all participants and data sources because the responses were quite similar. However, in instances where there are differences in the data, these are clearly spelt out.

The four research questions in this study are presented in two different chapters because of the content the questions address. Research questions one, two and three constitute a chapter, while research question four forms another chapter.

The first three research questions were combined because they were associated with how graphic design ideas are generated, the tools used and students' perceptions of these tools. Even though they are combined, each question was analyzed separately. Research question four focuses on the intervention approach that seeks to improve design ideation leading to the introduction of the digital ideation model. A conclusion which draws together the key findings related to how students generate design ideas concludes the chapter.

5.2 Graphic Design Idea Generation among Students

The discussions in this section are guided by research question one: How do design students in Ghana generate graphic design ideas? The objective of this section is to find out what characterizes the ideation process of graphic design students from design briefing to idea selection. It is also to discover whether students depend on the traditional approach of pencil sketches or use digital devices during ideation. The data collected to answer this question were generated through interviews and observation.

5.2.1 Research on Design Brief

It was observed that the design briefs that students usually worked on were given to them by their lecturers. Upon receiving the brief (see Appendix 15), just like every designer does, they tried to understand it. Depending on the brief, they began to engage potential consumers they thought could provide answers to certain questions. This included visiting people in the shops, market places or offices. They also conducted research on the brief by browsing on the internet. In response to a question regarding research, one of the participants said:

> "*We go out to collect information before we design. It is like you doing a newspaper, you have to go out for the information."* (Participant 2a)

Literature points out clearly that research is very important in the early stages of ideation in order to gather relevant information regarding the design task. According to NCERT (2011), the designer conducts research about similar projects for more information and all existing solutions through the use of the internet or library. The designer's goal at this stage is to acquaint himself with the strengths and the weaknesses of the existing designs to develop or come up with a better design solution. Undoubtedly, embarking on research helps design students to gather information about the target audience and acquaint themselves with the requirements of the audience and this increases the designer's understanding of the project. It acts as an integral part of design ideation for effective problem-solving.

5.2.2 Brainstorming

Brainstorming is one strong problem-solving approach identified among students across the two universities. This problem-solving approach is usually used when they have a group project to execute. The brainstorming session is characterized by a round-table discussion and a free flow of ideas from every student. The researcher observed students in this discussion session twice with an average duration of two hours. While the researcher observed some of the groups from a distance (a few metres away), on a few

occasions he took a seat close to the students' discussion table and had the chance to listen in to the discussion as he observed. It was quite amazing how orderly this session was organized by the students. They usually had a leader who facilitated the discussions and a secretary to record information.

As stated by Mindmanager (2019), there is no judgement of whether idea is right or wrong when brainstorming. The exercise was conducted among the students without any form of criticism from any team member. It was observed that students were engaged with their smartphones every once in a while, browsing for information related to the discussion. In some instances, the team leader posed a question and gave the team members a few minutes (seven to ten minutes' break, depending on the task) for the team members to browse the internet for information on their smartphones and it was amazing the kind of ideas that emanated from the discussion when they resumed. It was observed that students made optimum use of smartphones as far as their design tasks were concerned.

Eager to hear from students regarding these brainstorming sessions, the researcher asked during face-to-face interviews why it is important and this is what the students had to say:

> *"We are able to get ideas from each person."* (Participant KN 2b)

> *"You have to know how to work with people. And working with groups, you can achieve greater things."* (Participant 3e)

> "… *Sometimes the assignment is not even clear but when a group member explains, we all understand it."* (Participant KN 2a)

In a separate interview with one of the lecturers, he said:

> *"… another technique that has to do with ideation has to do with brainstorming session. Having them in groups and then encouraging them to share ideas is also a technique that the individual is supposed to have with the confidence that he will listen to other people's ideas to improve his or her idea."* (KN Lecture 1)

From these responses it is clear that brainstorming is a necessary tool in design ideation as the session provides team members with the opportunity to produce a multitude of varying ideas and get a deeper comprehension of design projects that lead to creative solutions. The session provided the basis for a lateral thinking approach to problem-solving where team members were encouraged to think beyond existing patterns to generate creative ideas (Liubashenko and Kavytska 2020). This is what MindManager (2019) refers to as 'out-of-the-box' innovations. That is, thinking outside the usual pattern that leads to the generation of novel ideas.

Brainstorming is a team-based problem-solving approach and according to MindManager (2019) it:

a. Gives individuals the freedom to think without worrying about being judged.
b. Facilitates quick development of multiple concepts by teams, which may then be combined and polished to provide the best possible outcome.
c. Enables groups to come to decisions by agreement, resulting in a more comprehensive and knowledgeable course of action.
d. Encourages team members to share ideas with one other even when there isn't a formal meeting.
e. Presents many viewpoints and makes room for unconventional developments.
f. Works well for fostering teamwork. Because no one individual is responsible for the outcome, a complete team effort is possible.

5.2.3 Mind Mapping

A significant number of students mentioned mind mapping as an initial approach to idea development. In a response to the question, 'Which will you advise designers to use for ideation, pencil sketches or digital devices?' an interviewee replied:

> *'They should mind map, have everything on paper so that when they go behind the machine they know what they are coming to do'.* (Participant 3e)

The participants considered mind mapping as an integral part of design ideation and admitted that it helped them in generating ideas. It enables the externalization of concepts as an organized network composed of written and visual depictions of ideas that radiate outward from a central issue (Elmeshai 2021).

Liedtka and Ogilvie (2018) state that mind mapping is a tool for visualizing relationships between thoughts and a central concept. When mind mapping, the creator develops, visualizes, organizes, and categorizes ideas to identify patterns that provide essential design guidelines. It allows themes and patterns to emerge. The process helps students to better understand the design brief and helps them increase their design space during ideation. Mind maps are considered to be a great way to organize thoughts more productively (Figure 5.1).

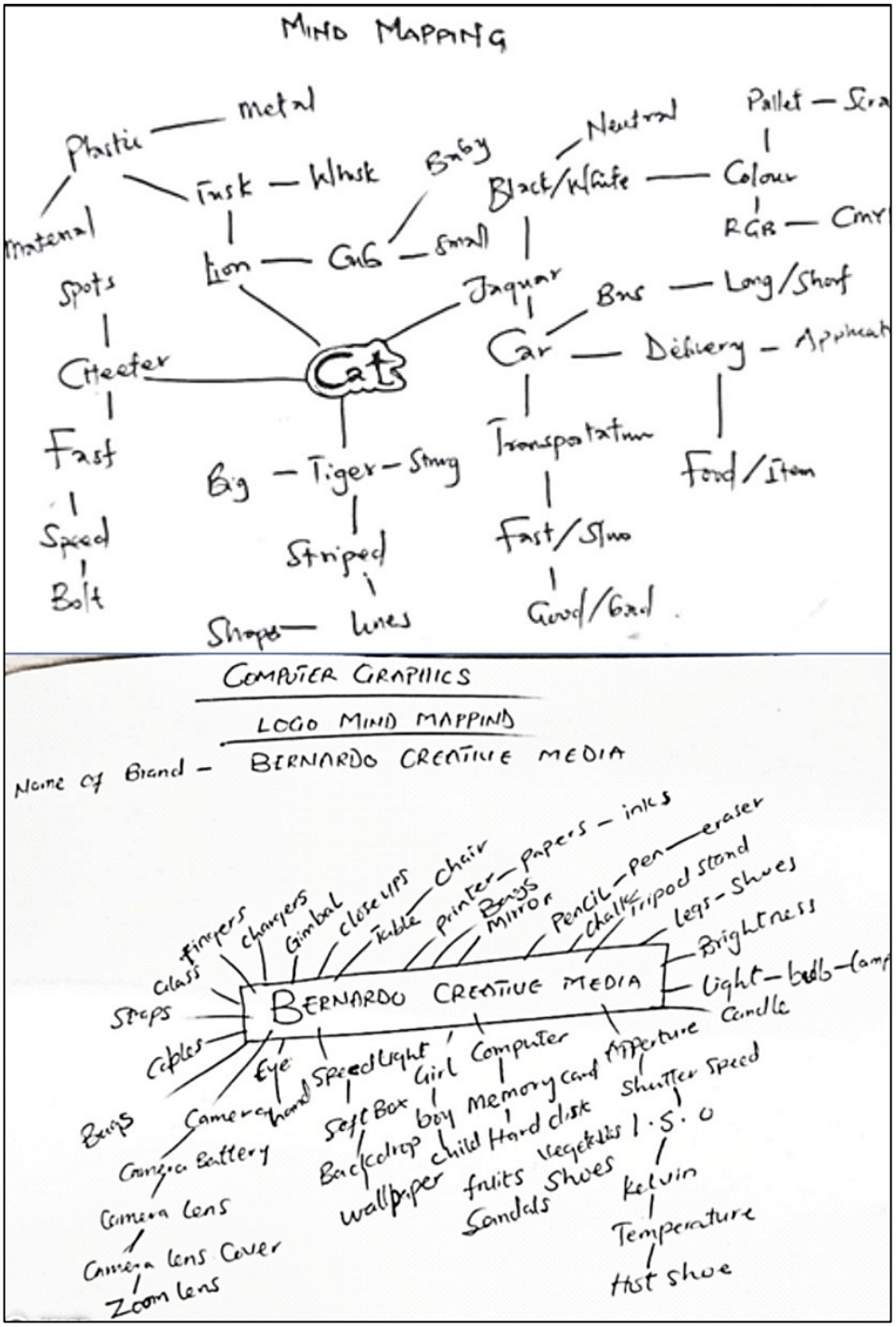

Figure 5.1 Two examples of mind mapping by students

As can be seen in Figure 5.1, there are central themes that appear in the centre of each mind mapping [exercise]. Connected to the themes are various ideas related to the tasks to execute. These elements are then analyzed and synthesized into idea creation. Erdem (2017) states that mind

maps are useful for remembering information, enhancing creativity, addressing problems, maintaining attention, and structuring ideas.

5.2.4 Internet as a necessary technology in graphic design ideation

Graphic design students in both universities depended heavily on the internet during the design ideation process. Students connected various digital devices to the internet for design works. Enninful and Boakye-Amponsah (2022) state that technology is an essential component of the Graphic Design curriculum in the twenty-first century. The internet is known to be the most significant information and communication technology that has changed the standard of information globally (Yebowaah 2018). According to Enninful and Boakye-Amponsah (2022), Technology has helped designers become more skilled and productive, which has had a favourable impact on the design business. Reporting on research conducted on 'The Effect of Internet Use on Academic Success and Face-to-face Conversation', Ellore *et al.* (2014) confirmed that most students have internet access on their mobile phones. The finding of this current study corroborates with the finding of Ellore *et al.*

When the participants were asked whether they used Wi-Fi (internet) for their design ideation they responded in the affirmative. The responses revealed that every single participant uses the internet during design ideation. Some responses regarding the use of the internet include:

> "*Yes, for research and inspiration*". (Participant KN 2a)
>
> *"It helps a lot because you kind of know what is already there, what people have and what people haven't done by researching."* (Participant KN 4a)
>
> *"Yes, if I am doing a logo for myself like OS that is to combine O and S for a design, I will go online and go and*

search how to combine O and S to form a design." (Participant 2a)

Responses from these three respondents indicate that designers use the internet for two main purposes and these are *research* and *inspiration* as stated by Participant KN 2a. These two stages of ideation are very important because they have a great influence on the design output. The research stage helps the designer to have a good understanding of the task at hand (the brief) and gathering design inspiration provides solid ground for the flow of creative ideas during ideation. As stated in the literature, the initial design problem is formulated by the designer at this stage and the designer conducts research on similar projects for more information and all existing solutions (NCERT 2011). This, the author confirms, is done through the internet or library. Interestingly, none of the respondents ever mentioned visiting the library for purposes of research and the reason is obvious. The internet provides quick access to information anywhere, any time and it is the most convenient. As indicated by ECLAC. (2021), information may be stored in the cloud and is accessible at all times, from any device, regardless of location across the globe, thanks to online database systems. When responding to an interview question on the benefits of using the internet for ideation, one student said:

> *"Benefits of using the internet during ideation is if I am supposed to work on say, 'e-commerce' I will simply type e-commerce and add logos to it and you will be surprised the results that will come out with. So hardly do I take my pen to go through this ideation process. You sit back and look at ten 'e- commerce' logos designed by somebody and it exposes you to what you wouldn't have known". (*Participant 3c)

In other words, this respondent is trying to establish the fact that ideas are readily available on the internet to access and because of this, he hardly sketches with a pen. Digital images must be utilized sensibly, keeping in

mind copyright laws and ethic usage guidelines (MSUB 2022). The majority of providers include usage guidelines for images. It is crucial that you thoroughly study this material and follow every set of instructions. Cruz (2021) states that it is only the owner of [the material who has] the exclusive right to copy, share, and provide licenses for a picture that is protected by copyright. You must obtain permission before using another person's intellectual work for profit. This means that using a copyrighted image without permission is illegal and has legal implications. Besides this, a designer is not expected to copy images without editing them. The images are meant to be sources of inspiration for the generation of new ideas. Copyright violation is not only unethical with legal consequences but also demonstrates a complete lack of creativity. A designer is so called because of the creative ingenuity embedded in him and this has to be expressed to exhibit the distinctive qualities of the designer.

Aside from the search for information by entering keywords, the internet also offers the designer another flexible approach of using images in sourcing for inspiration that makes it preferable to books and magazines in the library. As discussed earlier in the literature, images are translated into meaningful labels using the Mage Recognition technique with neural networks. This helps a designer search for similar images in a few seconds by dragging the image into the *Google Image Search* bar (Google LLC. 2020). As a way of collaborating this, Zhang (2021) states that through the Internet, the designer gains access to more visual communication designs that improve design research. Internet technology has become very important and has changed people's daily lives. In their submission, Al-Qudah and Al-Shari (2020) point out that the online resources significantly increase the productivity and expertise of graphic designers. This confirms Afif’s (2016) statement that the accessibility of contemporary technology facilitates communication, information access, and skill and job enhancement.

It is good to take inspiration from the considerable volumes of resources available on the internet but there has been an overdependence on digital

sources of ideas leaving the other sources unexplored. Participants did not explore sources such as physical materials, artworks, print materials, natural phenomena and daily occurrences, as outlined in literature (Laing and Masoodian 2015; Tarja-Kaarina and Pirita 2014). These sources still offer unique design ideas that need to be explored. The combination of diverse sources could work wonders in design idea exploration.

5.2.5 The use of Pencil Sketches and Digital Illustrations in Ideation

Some students admitted that they use electronic devices in combination with pencil sketches during ideation. When asked why they liked combining the two, they stated that they were more comfortable with that approach because it was much easier that way. During an interview a Participant 3d said:

> *"Me for example, when I am designing, I have to sketch first with pencil or pen, then I transfer it to the PC. I scan it using my phone and transfer it to the PC, then I sketch it and work on it."*

Pencil/pen and paper ideation

Most of the students in the two universities use sketchpads for design ideation; however, they do not usually use the sketchpad in the lecture hall because they are not engaged in design idea development during contact hours. The lecture hall is not conducive for effective idea development, primarily because of the large number of students, the noisy nature of the environment and the seating arrangement. The students usually availed themselves for lectures, for instructions and to be given design briefs to work on. Given this situation, the researcher could not observe students during design idea development as planned. The students were, however, requested to bring their sketchpads with them to lectures and this gave the researcher the opportunity to examine their ideation works.

Figure 5.2 The researcher looking at students' design ideation sketches at KNUST

It was observed that the students used pencil and pen as their major drawing tools for sketching. The pencils ranged from HB to 6b while the pens were usually black or blue writing pens. From the literature, McGlashan (2017) states that the use of paper sketches for initial ideas capture (idea generation) helps in building confidence and encourages a good flow of ideas. These sketches were later illustrated digitally and presented for evaluation and selection. This was done by the lecturer or by peer critiquing.

5.3 Evaluation of Students' Generated Ideas with Shah *et al.*'s Metrics for Measuring Ideation Effectiveness

Students' ideation outcomes were evaluated with Shah *et al's*. (2003) metrics for measuring ideation effectiveness with a focus on quantity, variety and novelty. As already discussed in the literature, this theory focuses on evaluating the design idea outcomes of designers during the ideation process. This outcome-based metrics [for measuring ideation effectiveness] uses two fundamental standards for evaluating the ideation process: 1. To what extent does the approach broaden the design space? 2. To what extent is the design space explored by the method? Design space is the total

number (count) of all possible solution options for a specific problem. The four separate effectiveness metrics which were proposed by Shah and his colleagues are, novelty, variety, quantity, and quality of designs.

Novelty is how far the idea diverges from standard designs (Kang *et al.* 2019) and is a metric for how unique a concept is, in comparison to other concepts (Okudan *et al.* 2006). Shah and Vargas-Hernandez (2003) indicate that *variety* measures the extent to which the design concepts differ from other concepts. In other words, it is the degree of difference in each of the concepts generated by a designer (Nelson *et al.* 2009). In their definition, Shah and Vargas-Hernandez (2003) state that a metric of *quality* gauges an idea's viability and the degree of adherence to design requirements. That is the extent to which an ideation process yields concepts that advance a goal. (Reinig *et al.* 2007).

Quantity is the total number of distinct ideas produced by a designer (Nelson *et al.* 2009). This is to say that two or three similar ideas should be considered as one count because similar ideas mean repetition of ideas and counting similar ideas will be repeated counts. This means if the concept is not different from already generated ideas, it is not worth counting.

With this theory in mind, the researcher began to evaluate the effectiveness of ideas generated by students. It is not the intention of this study to look at sketches from their, expressive, interpretive or skilfulness in rendition point of view but rather to examine the quality of concepts developed by the designer in terms of how varied a unit of idea is from the other, and the total count of good ideas developed, and to identify novelty in the design work in order to see how digital technology could be used to improve the outcome. For purposes of clarity and better understanding, some of the best ideation works of four participants from the two universities were selected and discussed.

5.3.1 Evaluation of Ideation Effectiveness 1

Participant 3a in Figure 5.3 worked on a design for a hair care product. The brief (see Appendix 15, question 1) required that the participant design a logo for a fictional company using mind mapping as an ideation process. She used ‘S’ and ‘B’ as symbols ~~nitials~~ in the logo design. After some mind mapping, and brainstorming she finally came up with some ideas. Figure 5.4 shows details of the ideas she sketched.

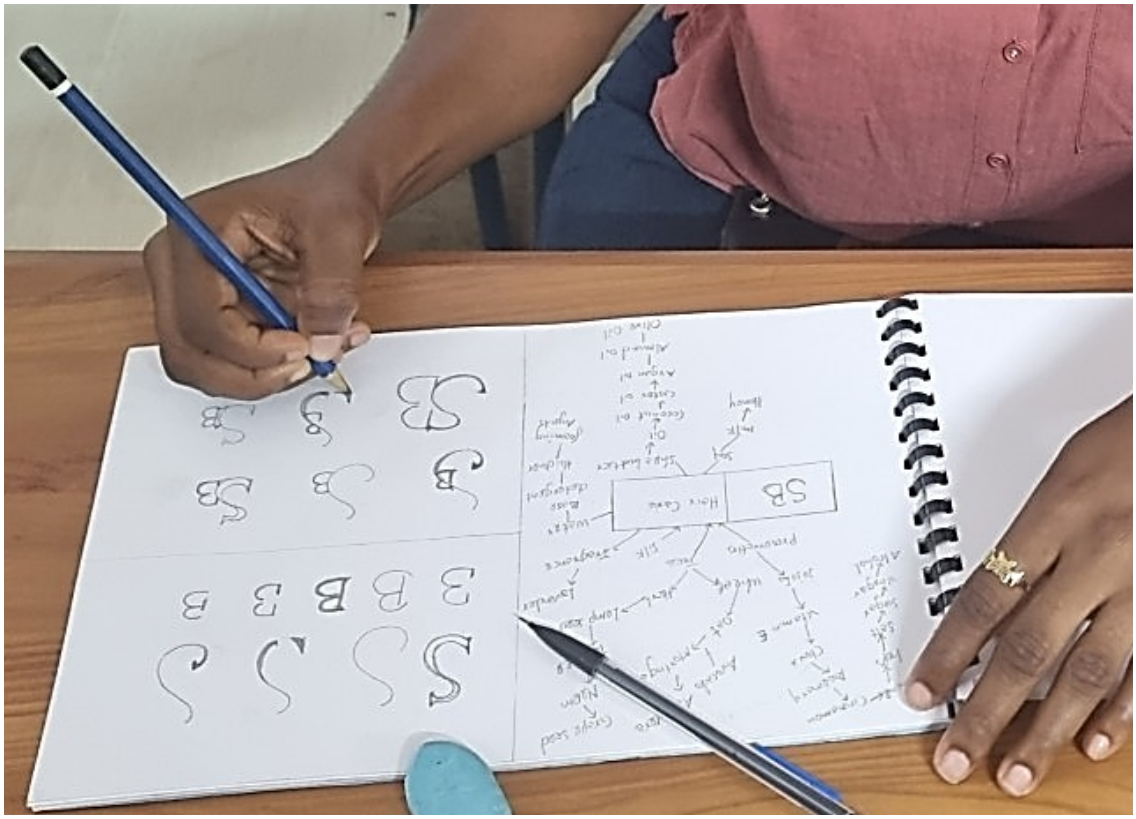

Figure 5.3 A technical university student detailing her ideation sketches

It can be observed that there is a strong emphasis on the ‘S’ symbol throughout the designs which nearly resulted in similarity but some variety was introduced by the different positioning of the letter ‘B’ and the introduction of the ‘oil-drop-like’ symbol at some parts of the letter ‘S'. The ideas can therefore be counted as varied.

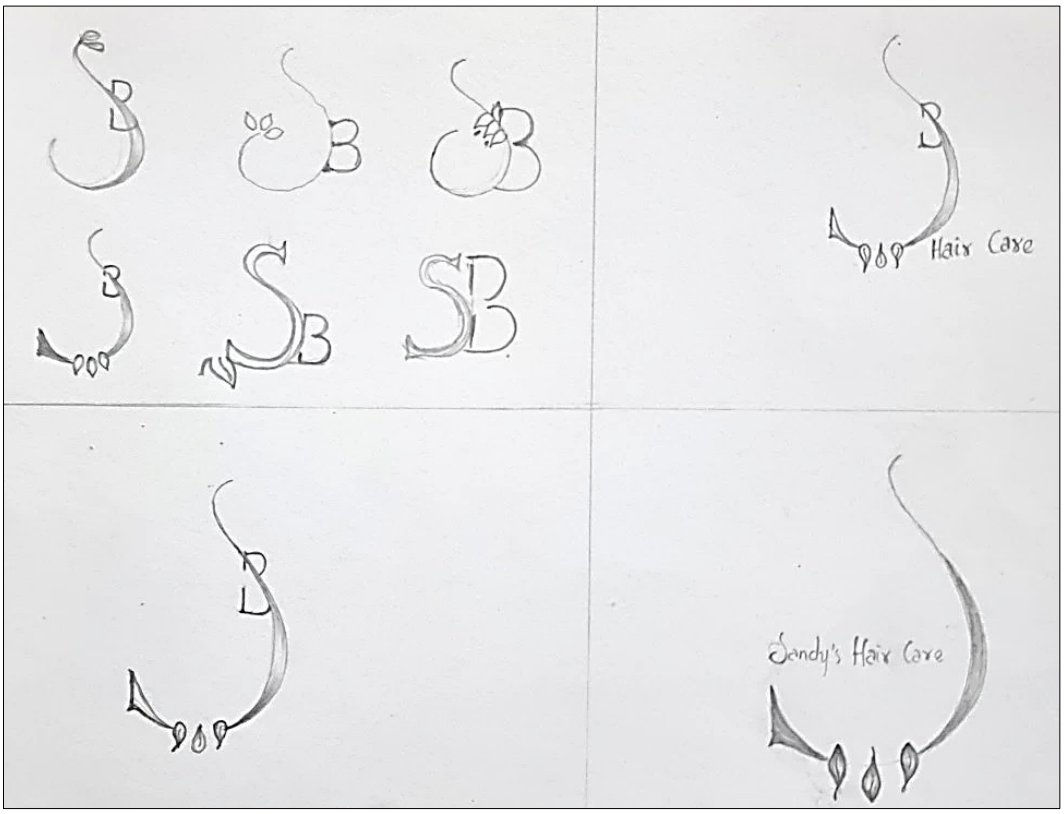

Figure 5.4 Ideas generated with letters S and B as a corporate identity for a company dealing in hair products

Participant 3a did not achieve novelty because she did not explore divergent or unusual paths. In view of this, the designer did not discover any unexpected outcomes which are usually called novel ideas. Japardi *et al.* (2018) describe divergent thinking as the capacity to break away from popular ways of thinking and speaking to come up with original concepts and answers. Unexpected paths, according to Wang (2009), are explorative approaches in design idea generation where the designer has no specific pattern to guide the process. In the case of the designer of the ideas in Figure 5.4 there is some kind of pattern, that is, the maintaining of ‘S’ and ‘B’ in the design. However, the restriction imposed on the designer to only use these two letters may limit the exploration of unexpected paths to some extent.

Based on the evaluation of the ideas produced in Figure 5.4, the valid ideas generated are eight in quantity; the ideas are considered to be varied because each of them is different from the other; they are of good quality as each of them meets the design specifications and for this reason any one of them could be selected to represent the solution. The designer's ability to reshape letter, 'S' into a hair strand demonstrates some level of creativity and uniqueness; however, more ideas could be explored to come up with more creative ideas.

5.3.2 Evaluation of Ideation Effectiveness 2

Figure 5.5 shows the ideation outcomes of Participant Kn 3 who was tasked to generate ideas suitable for a videography company (see Appendix 15, question 2). His work page is covered in many pencil designs some of which are bold and others faint but each pencil stroke means something to the designer. The ideas are not organized in thumbnail square boxes in horizontal and vertical order but can clearly be seen. It can be seen that the upper part of the worksheet Figure 5.6 shows some kind of scribbling of ideas that are juxtaposed with drawings in faint pencil impressions. This was the starting point in the idea creation and the designer was probably preparing himself cognitively for the task ahead.

Even though the pencil workings in that section of the worksheet are not clear or pronounced enough to be analyzed, they form a necessary part of the whole process as they prepared the way for good momentum. There is clear evidence of the visual thinking process in these sketches which began with light pencil marks that were gradually improved into well-defined sketches with pronounced pencil marks. It was seen in the reviewed literature that design involves human cognition and the conclusion that can be drawn after analyzing and synthesizing various studies (Chittka and Osorio 2007; Chan 2015; Pettersson 2021) in chapter two, is that design activities can be regarded as thinking activities executed by cognitive operations. With this understanding design as a product could also be

considered as a product of the design thinking operated by cognition. Designers' cognitive expressions on paper may look abstract and incomprehensible to viewers but behind every single stroke lies a reservoir of details that perhaps can only be understood by the designer.

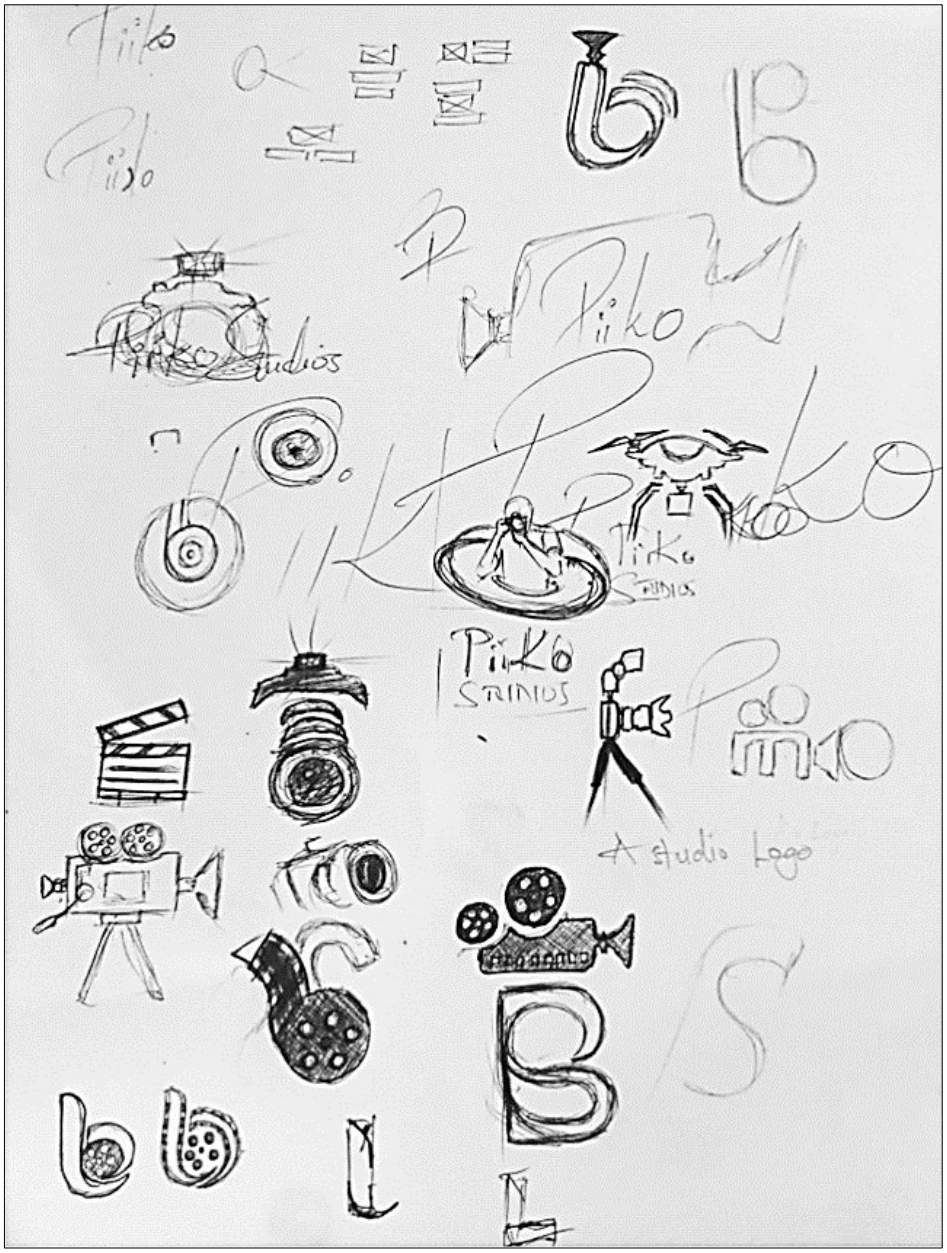

Figure 5.6 The ideation outcomes of the design student

Looking at the pencil works from the top and moving down to midway on the worksheet in Figure 5.6, the ideas become clear and distinct. The quality of ideas produced is not of great importance at this stage. As stated by Rikke

and Teo (2020), the goal of ideation is to produce a number of concepts that can be refined and reduced to the best, most useful, or most creative ones that lead to improved design solutions and products, and in support of this, Asana (2022) states that the more ideas you have, the better the chances that one will be worthy of execution. It can be seen in Figure 5.6 that the designer produced a number of ideas on the given brief. Images of video-making equipment and words were combined in the ideas generated. The designer successfully captured his ideas in varied forms with each design different from the other. The ideas are impressive but one stands out and is considered to be the most novel one. This idea depicts the internal structure of the video camera with two video tape wheels exposed and the studio name, Piiko Studio, was creatively put together in an abbreviation.

Even though the position of the camera and the studio abbreviation is not the best, the concept is novel. To organize this unit of design in an outstanding form, the designer had to make a series of drawings, alternating the positions of the images and the texts, for the best possible output. These drawings can be executed with pencil and paper but it would be much easier and more fun with the opportunity to increase design space exploration using digital technology. According to ECLAC (2021), the use of digital technology has expanded globally and developed dramatically. Easy access to and use of continuously improving technology has completely transformed how things are done in today's world. Technological advancement has significantly increased the influence of global networks by combining it with a shift in the business models of the leading digital technology corporations (ECLAC 2021).

5.3.3 Ideation Effectiveness Evaluation 3

Participant KN 2a in the Traditional University was required to design a brand logo for a company that offers cloud storage services (see Appendix 15, question 3). To start with, Participant KN 2a gathered different digital images from different websites and organized them into a digital mood board. As

stated by Diana (2018), a mood board is an assortment of visuals, hues, and typefaces that precisely capture the essence of a project. It can comprise a wide range of elements, including photographs, drawings, cut paper, colour schemes, textures, text, and anything else that aids a designer in determining the project's path.

The mood board serves as a source of design inspiration for the designer. Diana (2018) further indicates that the mood board, which is also referred to as a physical or digital collage of ideas, helps the designer to polish his concepts and see how different components work together. It awakens the creative buds of the designer. The mood board is a helpful visual tool that facilitates the designer's presentation and effective communication of his concept. By means of this, the designer is able to project his abstract concepts in a visual form for others to understand. In other words, it helps the designer to more effectively convey a project or concept to others (see Figure 5.7).

Figure 5.7 Digital mood board for design inspiration

As already discussed in the literature, there are two forms of mood boards: the physical and the digital mood board. In Figure 5.7 storage devices of different kinds, network cables, images of the clouds and document folders formed part of the mood board. Soliciting images from heterogeneous sources allows the designer to generate more creative ideas out of analogies and metaphors. In connection with this, Gentes *et al.* (2015) describe a mood board as an exercise that brings homogeneity out of heterogeneity. Designers frequently use mood board samples of objects, collages made up of text, mood boards, and pictures to convey and investigate visual concepts (Koch *et al.* 2020). This initial preparation made by the designer had a marked influence on the ideas developed as elements of the images in the mood board can be seen in the ideas generated.

Using the images on the mood board, pencil and paper sketches of ideas were generated as seen in Figure 5.8. Participant KN 2a generated twelve varied ideas. The sketches were scanned and transferred to the laptop to be traced in vector software for further development.

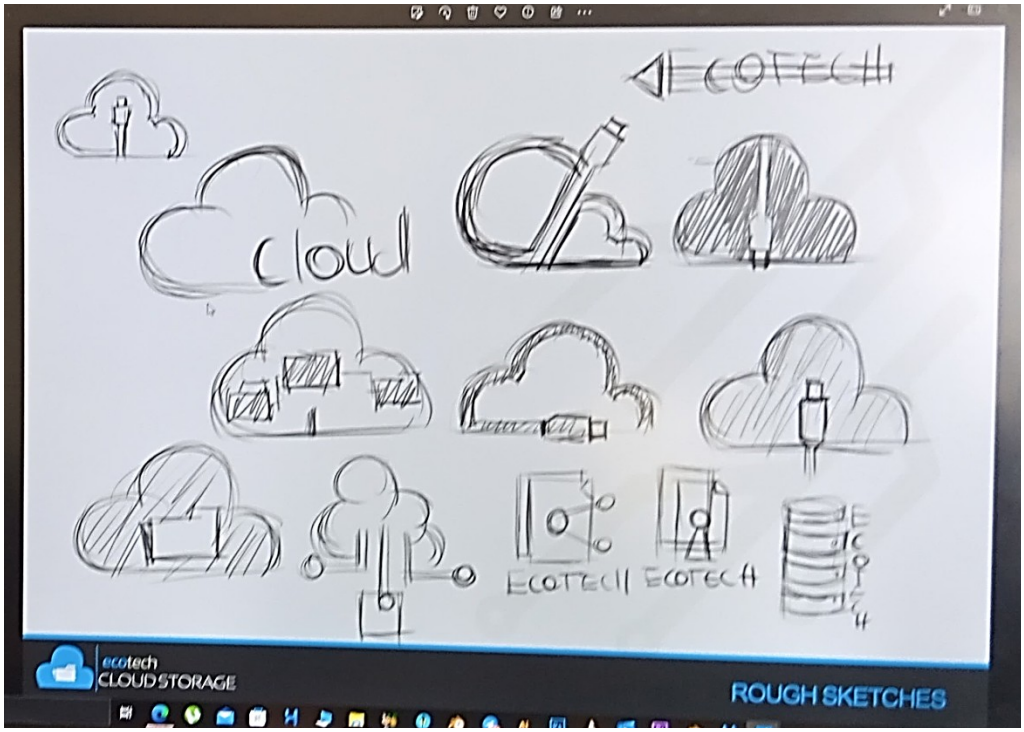

Figure 5.8 Sketches transferred to the laptop

Twelve design sketches were produced. Each of them varied from the others. Out of the twelve ideas generated, one was selected for fine-tuning. This was a simplified cloud with an icon of a folder. The idea here is that files which usually contain data are organized in the folders. Seeing folders in the cloud therefore means working and saving documents in the cloud, or more precisely, cloud computing.

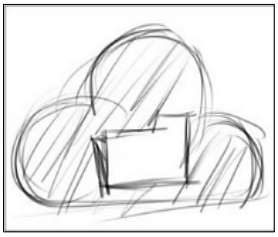

Figure 5.9 The selected idea from the ideas generated

i. Digital Illustration

The selected idea was further worked on in vector software by finetuning it. Fine-tuning a drawing is improving it by way of adjusting the various elements to the right proportions. Details of every element are considered and this could be an addition of a new element or the removal of an already existing one just to ensure their balance. While doing this the designer must ensure he does not lose the sense of the focal point. Empty or negative spaces are adjusted to create balance in and around the design area. Distance between shapes or elements is examined. Where there is some form of disconnect in the elements, they can be arranged closer to bring about connections. It is important to look at the overall colour balance and make sure that the balance is consistent and the colours make sense. The colour blue used by the design makes sense because the design is related to the cloud. Inspiration for the colour is drawn from the mood board. The size of the folder and font are also good. In all, the elements are well organized with good balance.

Having achieved the main shapes and sizes of the elements of the design, varied colour tests were made to see what the outcome would look like.

From these one was selected to represent the final design. The pencil work was finally transformed into a digital image as seen in Figure 5.10.

Figure 5.10 Variation of colour tests

Figure 5.11 Final design

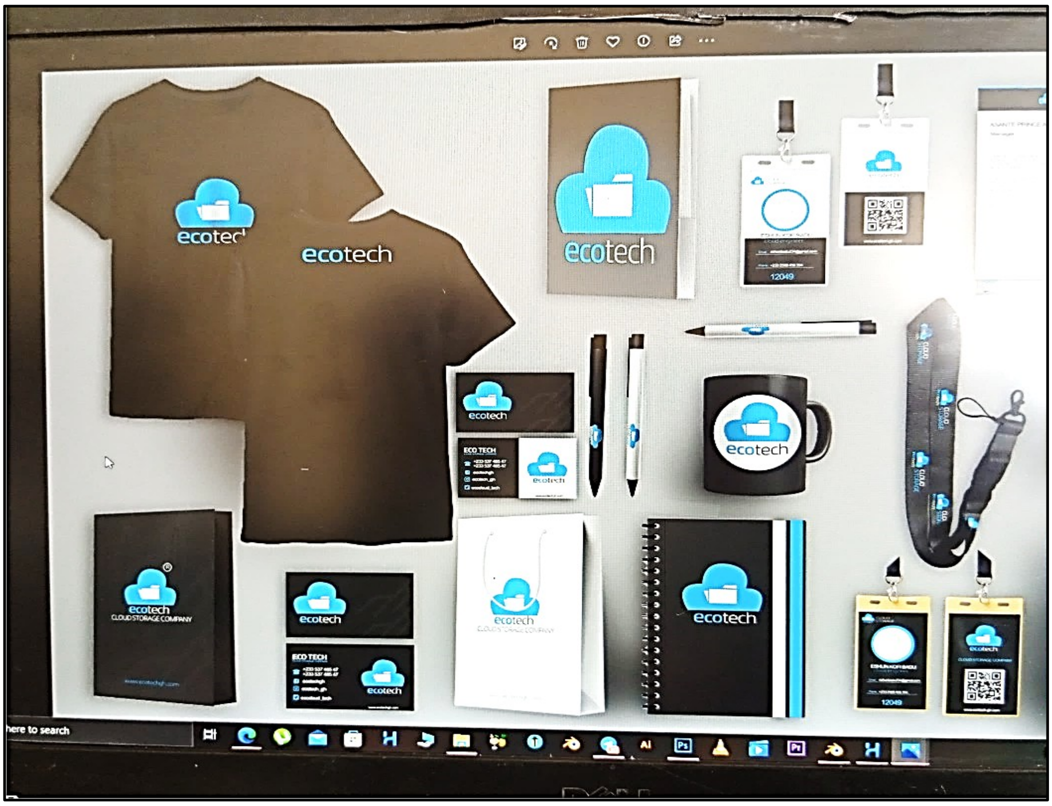

Figure 5.12 Application of final designs on articles

5.3.4 Ideation Effectiveness Evaluation 4

Responding to a design brief which had to do with a design for a group of four young men who came together to provide creative graphic design solutions (see Appendix 15, question 4), Participant KN 2b started with a series of sketches predominantly composed of shapes and texts. The shapes include triangles and squares that were creatively arranged to form designs. The text, D M E N was formulated using the initials of the four members of the group. Also seen in the worksheet are rough sketches of a male's head and a dumbbell. Participant KN 2b generated a good quantity of ideas, each of which varied from the other.

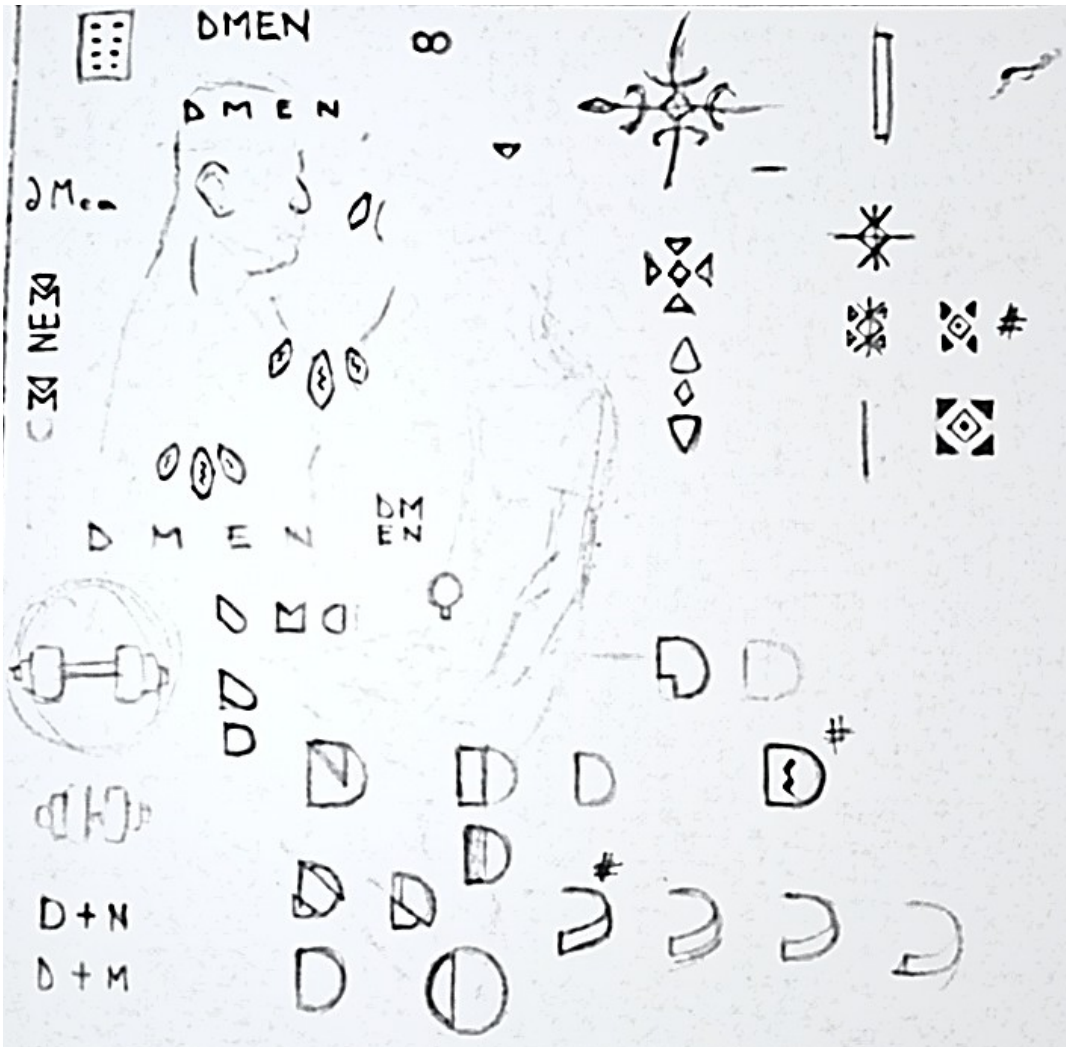

Figure 5.13 A student's pencil-generated ideas

The designer selected some of the ideas generated in the pencil sketches for further fine-tuning onn the computer as seen in Figure 5.13. The triangle and square designs have been given some more editing by increasing the thickness of the outline, removing and adding colour fills and rounding of corners. Further varied ideas were digitally generated with the combination texts and in effect, six final ideas were generated from which a selection had to be made. The digitally illustrated ideas, as seen in Figure 5.14, have shown clarity, sharpness and precision in appearance.

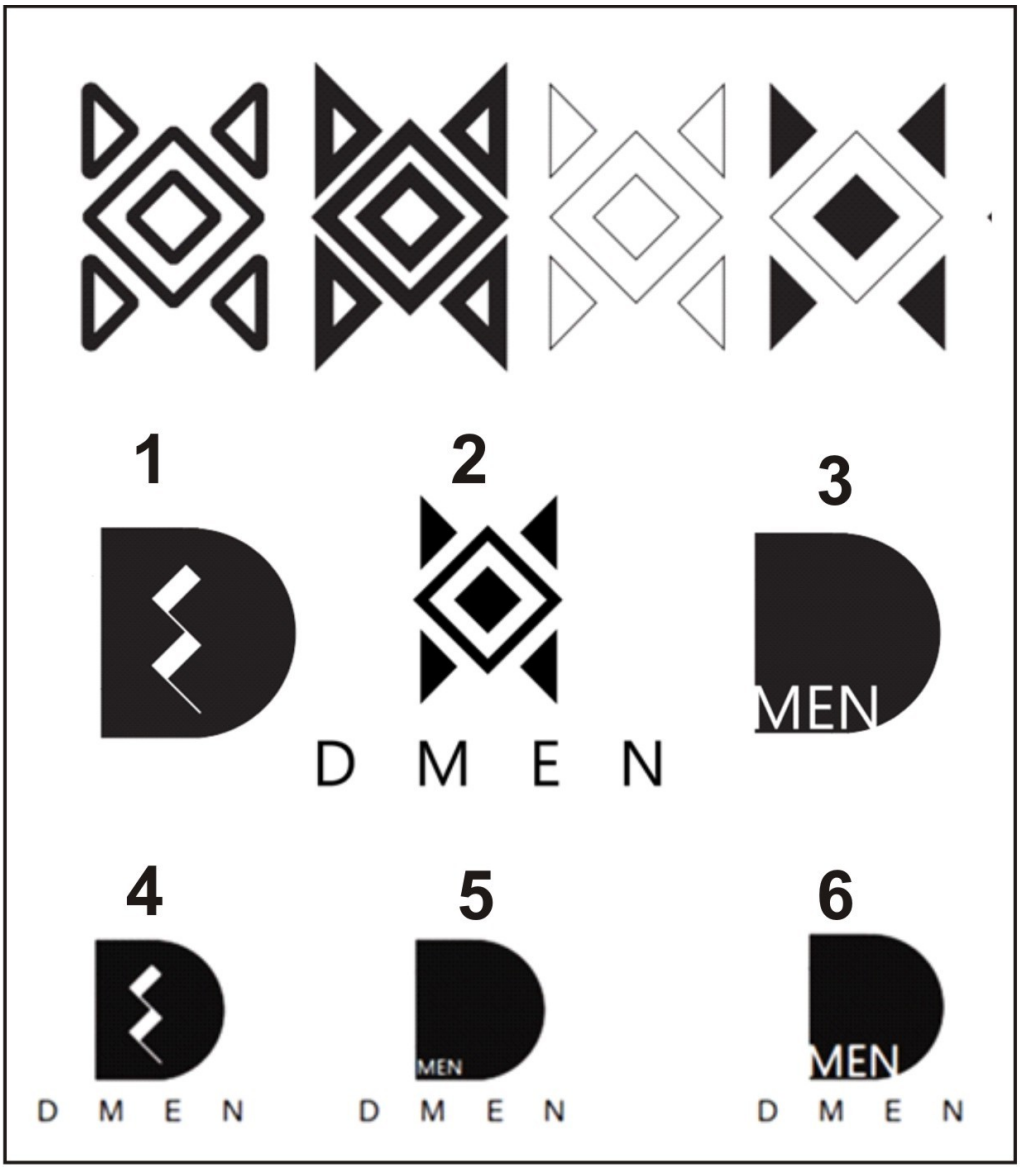

Figure 5.14 Digitally Illustrated Ideas

Designs number 3, 5 and 6 are quite similar but have minor differences. Design number 2 slightly differs from number 6 because of the text, D M E M written under it. Design numbers 5 and 6 are, technically speaking, similar. Every detail is the same in the two designs except that the size of the word, MEN written in the filled D shape is reduced. In actual idea count, one of these should have been taken out. Design 5 is not worth counting. It should have been deleted because the word MEN written in the filled D is too small to be read. The idea is varied but it lacks usefulness or creativity and does not meet the quality requirements to be worth counting. Clearly, there was some level of fixation at this point. This is probably because the Participant KN 2b limited himself by selecting only a few pencil sketches for development. There were some other ideas on the pencil worksheet that could have been explored.

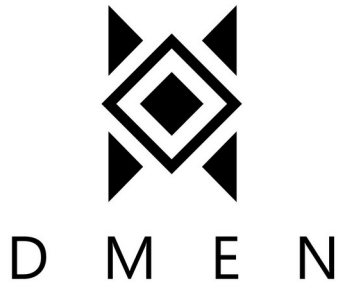

Figure 5.15 The final Selected Idea

The selected design is novel because Participant KN 2b was able to harmonize a contrast of black and white colour and a contrast of square and rectangle into a unit block of design. Besides that, there is a display of balance as the harmonized shapes are resting on M and E while D and N create some sort of broad base support at both ends. It can also be noticed that Participant KN 2b made good use of repetition in a manner that brings out the aesthetics in the design. The ability to organize different elements of design by skilful utilization of design principles to achieve aesthetics in the design makes the idea a novel one. Design number 2 was therefore selected as the final design out of the six ideas generated.

According to design students, today's clients do not accept pencil-and-paper generated ideas. They always prefer the digitally generated ideas. Some of the participants commented:

> *With customers I have met so far, there hasn't been any that has asked for pencil work. Actually, they all asked for at least three designs (ideas) then they select one from it. The logo, as I said already, I start with pencil and I create three to five logos (ideas) then capture it to the client to choose one from it then I start designing it.* (Participant 3a)

> *Honestly, the customer's interest, really, is the finished work. The finished work is what they are interested in. They come with a problem and they need a solution. They don't want information on the process* (Participant 3c).

> *Today's customers I work with, they want to see the final product. Some people do not like the process. They think it is stressful. They give the briefing and expect you to give them the work. If they find a fault, they tell you that I have a fault here. So, you have to go back and make corrections.* (Participant 3e)

This means the clients are usually not interested in the design processes that led to the solution. The pencil sketches done by a designer are for his own use and usually this represents the thinking process of the designer. In view of this, the designers select some of the pencil sketches, scan them and transfer them to the computer to make them digitally presentable for the clients.

5.4 General Observations about Participants' Ideation Processes

5.4.1 Inspiration

Students usually went online for design inspiration during [the] ideation [process]. None of the students worked without inspiration. They visited different websites to source images related to the tasks they were given. This is supported by Passionate (2023) who encouraged designers to get online tools for graphic design inspiration by exploring different design works, logos and illustrations. The author advised that designers should experiment with the materials they gathered online to come up with their own designs. Some of the participants admitted that they took photographs of images in the environment as inspirational sources. This was usually done with smartphones and digital cameras. However, very few of the students used a digital camera for this purpose.

5.4.2 Pencil Sketches

Most of the students did pencil sketches before they transferred the idea to the computer for further development. Twenty-two (22) participants said they like doing pencil sketches because it is more flexible for design ideation, helps them develop creative ideas, and organizes ideas for further development. Two (2) of the participants, on the other hand, said they do not like doing pencil sketches. One of them said he felt too lazy to take up a pencil and the other said he was not a fan of using a pencil to design**.** One of the participants said:

> *"Our lecturers actually ask us to acquire sketch pads to do our ideation inside. We do our preliminary sketches inside it. Later on, we transfer it onto the phone. We actually do everything with sketch pads. If it is approved, then we go to the software and design. At the end of the day, we use both the pencil and the digital [methods]."* (Participant 2b).

Idea selection among students (Selection of final idea)

It was observed that there are three levels of idea selection among students and these are:

i. *Designers' idea selections from pencil sketches.*

In response to a brief, participants developed a number of pencil sketches. They looked through the ideas and selected those they thought were good for presentation. There is no clear guarantee that the few pencil sketches the designer selected for digital illustration actually represent the creative ideas.

ii. *Selection by lecturer, peer critiquing or by client*

The designer's own selected ideas, which are usually in pencil sketches, are brought to the lecture or studio and presented to the lecturer who goes through the ideas and selects one for the student to finetune. On the other hand, peer critique can be conducted during lecture or studio [time] which leads to the selection of the appropriate design for finetuning. Goalbook (2023) indicates that peer critique involves learners providing helpful and critiqued comments to each other on their own work or other students' works while the instructor directs the critique group or takes part in it as a member. During the study, it was observed that students' works were projected on a screen one after the other to the entire class and peers were allowed to comment about what they noticed, things they liked about the work, and corrections to be done to improve the work. Peer critique helps students gain knowledge and ideas from each other by reviewing each other's work (Goalbook 2023).

iii. *Selection of ideas by the client*

Some of the students admitted that they work for clients. In this case, the brief comes from the client and not the lecturer and because of this, sketches are not presented for peer critiquing or for the lecturer to select. Some of the pencil sketches are selected and

illustrated on the computer because the clients are not interested in pencil works. The number of ideas generated using the computer software are relatively smaller in comparison to those generated in pencil sketches. The digitally illustrated ideas are then presented to the client who then selects one to be developed further. The question is, are the few ideas selected and illustrated digitally, the most creative ones among the pencil sketches done by the designer?

In Figure 5.16, which is a portion of Figure 5.13, the idea that was selected and illustrated on the computer by the designer is the one circled. Taking a closer look at the rest of the ideas on this fraction of the worksheet, one will agree that the designer's choice may not necessarily represent the best idea.

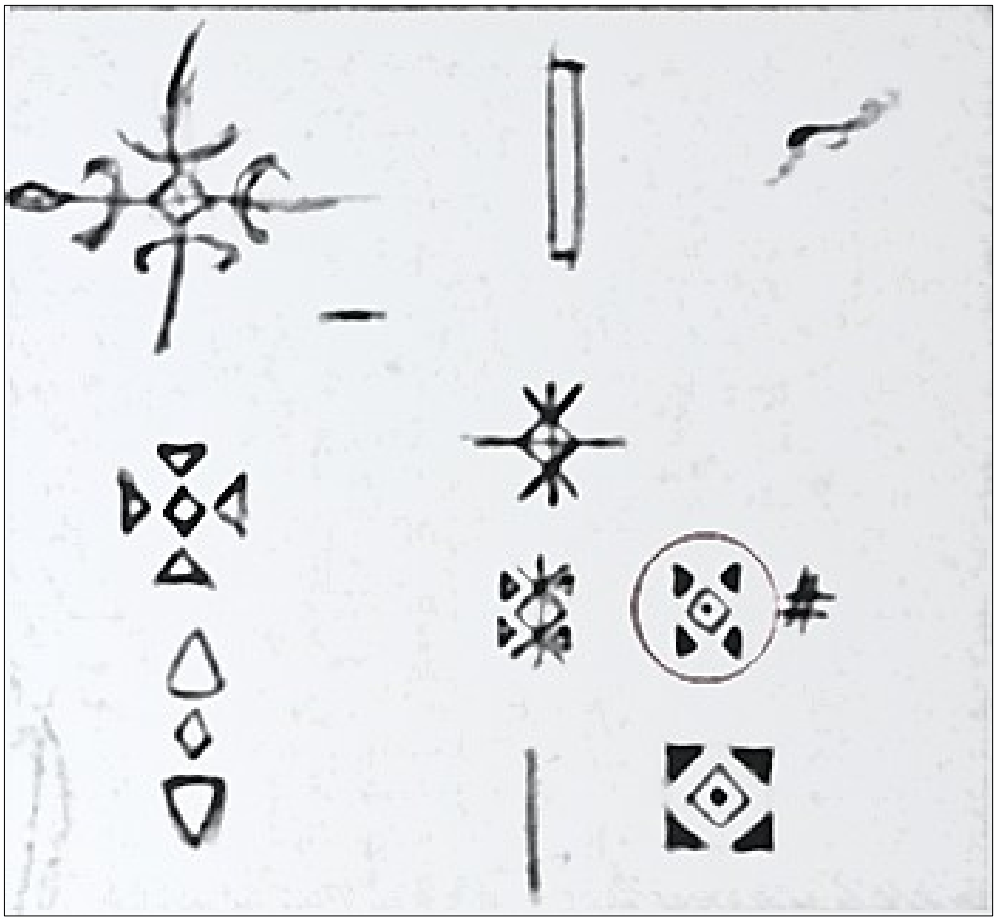

Figure 5.16 Part of Figure 5.13 for purposes of discussion

The client had no choice but to select from the limited number of digitally illustrated ideas the designer presented to him. Why could the designer not present more of the pencil sketches in digital form to increase design space for the selection of the most appropriate design?

5.4.3 Digital Illustration of Ideas

The majority of the participants admitted that they did not know how to use vector software (Adobe Illustrator or CorelDraw). Only thirteen (13) of the participants knew how to use vector software. However, among the thirteen users, three (3) of them admitted they were not good at using it. This means only ten (10), which is less than half of the participants, could use vector software well.

The inability to use vector software is a significant shortcoming in both universities because students were not taught how to use it. Students' lack of skills in the use of vector software affects their approach to the digital illustration of ideas. In an interview with one of the lecturers, he said the issue is not even about the digital illustration of ideas but the fact is:

> *"We do not teach the students how to ideate, how to think, we do not teach them. So, the issue of 'digital' does not even come into the question at all."* (KN Lecturer 1).

He added that if the student does not know how to ideate, he can equally not use the digital devices to achieve that, saying:

> *'If someone doesn't know how to cook, even when you assemble cooking ware and ingredients for the person to cook, the person will still not be able to cook'*. (KN Lecturer 1).

Duan (2014) indicates that the use of computer-assisted systems has supplanted conventional freehand drawing, which has allowed designers to efficiently broaden their thoughts and produce enhanced design effects.

5.4.4 Observations about Pencil Sketches and Digital Ideation

Looking at the four ideas in Figure 5.17, one can be certain that the first idea generated by the designer is the third idea (counting from the left) which is easily identified because of the default thin lines (hairlines) associated with vector software illustrations. The idea is composed of four triangles and two squares that are positioned in the middle. Quick copies of the first idea were made to obtain three more ideas. Commands in the vector software have given each of the ideas a varied look. At a command, the corners of the shapes in first duplicated idea were rounded with increased line thickness, while in the second duplicated idea, the thickness was increased a little further and the corners were left unrounded. This makes it look different from the first one.

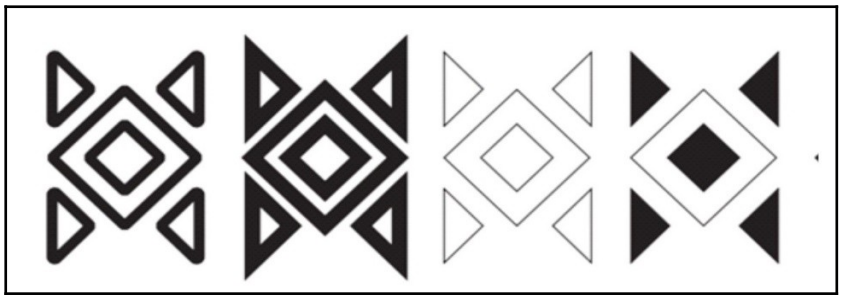

Figure 5.17 Digitally Generated Ideas

The third duplicated idea, which is the fourth idea in Figure 5.17, maintained the line thickness and the same size as the first illustrated idea, except that, five of the six shapes were filled with black colour, making the idea look different from the rest. These four ideas can be created in a space of five minutes depending on the experience of the designer, leaving room for more ideas to be created. Compare this with the pencil sketches in Figure 18**,** where the designer has to spend a considerable amount of time drawing each of the four triangles and the squares each time he wants to create a variation (create a new idea) from the first drawn idea.

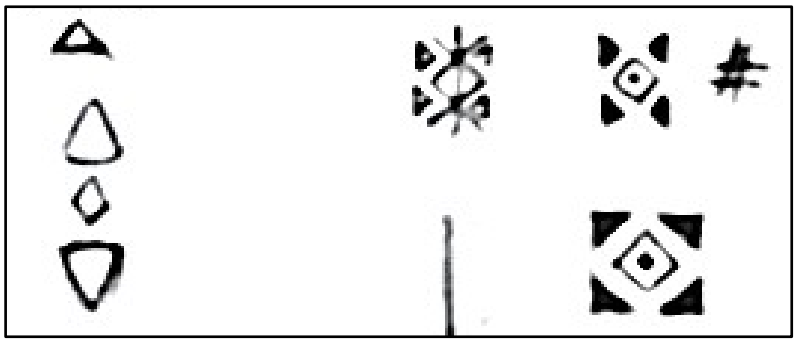

Figure 5.18 Pencil-generated ideas

The time-consuming nature of pencil sketches reduces the number of ideas explored by the designer and this is evident when Figure 5.17 is compared with Figure 5.18. While four related ideas were explored in the design software in Figure 5.17, only two of those ideas were explored in the pencil sketches (see Figure 5.8). That is, more varied ideas (quantity and variation) are explored in the digital ideation than in the pencil sketches. Besides this, precision, consistency, accuracy, and neatness are guaranteed when using design software for illustration as can be seen in Figure 5.17.

Taking the first duplicated idea, for instance, the roundness of the four triangles is the same and none is bigger than the other. Again, unlike the pencil sketches, the size of the triangles and the line thickness are uniform throughout the illustration. In effect, it can be concluded that digital ideation helps generate more varied ideas with better design quality outcomes than pencil sketches. This finding corroborates the statements of some researchers who state that use of digital tools makes design work more convenient with better quality (Wang (2020); offers the user more choices and variety than traditional methods; and further state that drawing tools can be manipulated with ease, can perform subsequent and dynamic linkage of ideas and concepts (Hods 2008), and that digital tools improve artistic expression and creativity (Aboalgasm and Ward 2014). Pencil sketches, according to McGlashan (2017), help build confidence and encourage an unhindered flow of ideas. While this study does not condemn the use of pencil sketches for initial idea capture, it is appropriate to acknowledge the

significant contributions of digital technology to the ideation process and make use of them for successful ideation outcomes.

5.4.5 Summary of Research Question 1

The objective of this section is to find out what characterized the ideation process among the graphic design students from design briefing to idea selection. It is also to discover whether students depend on the traditional approach of pencil sketches or use digital devices during ideation.

i. Research on design brief

It has been observed that students typically receive design briefs from their teachers. Students begin to do research on the brief and this includes visiting potential clients in the shops, market places or offices and searching for information online, or both. This [online] search helps students to understand the design brief better and to reframe the brief for effective idea exploration. As stated by Georgios *et al.* 2019 and Ambrose and Harris (2009), design briefs need to be reframed (redefined) by the designers so they can be well understood, defined and easy to work with.

ii. Brainstorming

Students conduct brainstorming, which is always characterized by round-table discussion and a free flow of ideas from every member. As the discussions continued, students were engaged, once in a while, with their smartphones browsing for information related to the discussion. Responses during the interviews indicated that all the design students considered brainstorming as a necessary tool in design ideation as the session provides team members with the opportunity to provide a multitude of unique concepts and gain a deeper comprehension of the design tasks that leads to creative solutions. It was observed that the brainstorming session was well conducted without any form of judgement of whether an idea was right or wrong, or any criticism of any team member as recommended by

MindManager (2019). This activity provided the grounds for a lateral thinking approach to problem-solving where team members were encouraged to think beyond existing patterns to generate creative ideas (Liubashenko and Kavytska 2020).

iii. Mind mapping

Students identified the central themes in the design briefs and generated mind mapping to help increase their design space during ideation. Liedtka and Ogilvie (2018) state that mind mapping is a tool for visualizing the relationships between thoughts and a central concept. When mind mapping, the creator develops, visualizes, organizes, and categorizes concepts to identify connections that offer crucial design principles. Essentially, ideation is coming up with unique, workable solutions to problems (Bourgeois-Bougrine *et al*., 2017) and mind mapping broadens designers' ideas about a brief, leading to divergent approaches to design problem solving.

iv. Internet for research and inspiration

Graphic design students in both universities depend heavily on the internet during the design ideation process. The internet provides quick access to information anywhere, any time and it is most convenient. As indicated by ECLAC. (2021), online information systems make it possible for data to be stored in the cloud and be accessible at any time, from anywhere. Zhang (2021) states that through the internet, the designer gains access to more visual communication designs that improve design research. In their submission, Al-Qudah and Al-Shari (2020) point out that the online resources greatly increase the productivity and expertise of graphic artists. It was, however, discovered that other sources of inspiration stated in literature such as physical materials, artworks, printed materials, natural occurrences, and daily life were not investigated by the design students.

v. *The use of pencil sketches and digital illustrations in ideation*

After generating ideas, the design students look through the pencil ideas and select those they think are good for presentation. The findings indicate that most of the students (twenty-two out of the twenty-four) used pencil sketches but only 10 of them knew how to use vector software effectively for idea illustration.

vi. *Selection by lecturer, by peer critiquing or by client*

The designers' own selected ideas which are usually in pencil sketches are brought to the lecture or studio and presented to the lecturer who goes through the ideas and selects one for the student to fine-tune. On the other hand, peer critique is conducted during lectures which leads to the selection of the appropriate design for finetuning. Goalbook (2023) indicates that peer criticism is a procedure in which learners provide helpful and constructive criticism to one another on their assignments or other learners' works while an instructor either leads or takes part in the discussion. It helps to improve students' output.

Participants admitted that they sometimes develop ideas for clients and in any such situation, some of the pencil sketches are selected and illustrated on the computer for the clients because they are not interested in the pencil works. They do not accept them. It was observed that the number of ideas illustrated on the computer software were relatvely fewer in comparison to the those generated in pencil sketches. The question actually is, are the few selected pencil sketches selected for digital illustration actually the most creative ones among the sketches done by the designer? Further analysis of this revealed that the selected ideas did not usually represent the most creative ones because the students felt they may have difficulties working with the vector software.

5.4.6 Conclusion

Technology has improved beyond imagination (Ng 2015) and easy access to it has led to a complete transformation of how various tasks are executed in today's world (ECLAC 2021). This has resulted in a considerable change in the expectations of consumers over time. The use of old, or traditional approaches to problem-solving does not attract recommendations anymore as these approaches fail to meet the expected standards of today's clientele. That is to say, what was accepted as excellent a few years ago is, in recent times of technology gratification, outrightly rejected. Today's clients' rejection of pencil sketches, with high interest in digitally illustrated ideas as confirmed by the participants in this study, is a clear indication that there is a change in the taste and expectation of consumers.

It was evident that students effectively used digital devices in researching on design briefs, in brainstorming, and in gathering inspirational materials from different websites. As a result, they have a very rich collection of inspirational materials they need for their design works but this does not usually reflect in the quality of ideas that are digitally illustrated. While some of the pencil-generated ideas are creative enough to be chosen, they are not selected for digital illustration by the designer because they are considered to be too complex or intricate to illustrate. Students' selection of pencil sketches for digital illustration was greatly influenced by their inefficiency in handling vector software. They tended to select ideas that did not require advanced digital skills to illustrate such as pre-existing designs and simple shapes that could be edited by trimming, stretching and rotating.

If students have mastery over the use of vector software, they will have the know-how and the confidence to create their own unique ideas, taking inspirations from the images gathered from design websites or will be able to effectively change the contour of existing vector images to obtain totally different ideas. Digital Technology integration into design ideation is expected to increase idea space exploration resulting in creative and novel

outputs. Effective use of it will yield excellent results. As indicated by ECLAC (2021), institutions using technology will operate more effectively and efficiently.

The best way to remain in business, as it has always been, is to adapt to suit the current demands of the market. In order not to create a mismatch between what is taught in the lecture halls and the expectations of clients, students have to be exposed to vector software and be encouraged to use it for digital idea illustrations.

5.5 How Digital Technologies affect Design Output

This section presents the findings on how digital technologies affect design output. The essence of this section was to identify the various digital devices and software applications used during the design ideation process by graphic design students in the two selected Ghanaian universities and how they affected ideation outcomes. This part focuses on Research Question 2: How do digital technologies affect design output?

5.5.1 Impact of Digital Technology on the Variety, Novelty and Quality of Ideas Developed

When a variety of quality ideas are generated , it is most likely that a novel idea will be generated. This means that a successful final solution is likely to originate by exploring a variety of solution principles (Pahl *et al.* 2007). Literature has established that the use of digital tools makes quality design work more convenient (Wang (2020). Some quotations below indicate the views of participants on the effect of digital devices on the quantity, variety and novelty of ideas.

> *"It makes work easier. With the digital device you can test the variation of colours. You can just mask and test different colours and you can do multiple works in one day. You can have more ideas than when you are using pencil and paper."* (Participant 2a)

> *"I have to generate more designs from other designers or look for more inspiration from other designers so I will search on the net to get more information or ideas from other people's work. Through that I can gather more ideas to add to mine to help me develop mine."* (Participant 3b).

These two participants established the fact that digital devices help them to generate more ideas. The principal essence of design ideation is to create more ideas from which a solution may be selected. As stated in chapter two

by McGlashan (2017), it is important to explore several alternatives that yield a wide variety of concepts from all angles to develop a large number of concepts throughout the design thinking ideation phases. In support of this, Casakin, Koronis and Silva (2019) observed that the primary goal of the design ideation phase is to investigate as many concepts as you can from novel and diverse angles. Technology, according to the participants, is helping them to achieve the essence of ideation.

As can be seen from the interviews, participants agreed that digital devices helped them in diverse ways. Participant 2a was of the view that the designer *'can have more ideas than when you are using pencil and paper.'* and that the designer *'can do multiple works in one day.'* Participant 3b shared a similar view when he said, *'I can gather more ideas to add to mine to help me develop mine'.* He said he goes online to take inspiration from the works of others and by so doing he gains more ideas. This helps to achieve one of the purposes of ideation, which is the development of ideas in good quantities.

> *"With Pinterest and Instagram, there are a lot of people with different styles of design. I prefer to go through people who have vector type of designs. It inspires me."* (Participant 3a)

> *"When you are given a design work you have to brainstorm, walk around the environment, pick inspiration and with the help of the digital gadget, you can just get to your phone and research what you want and pick an inspiration from the works that are already down there. So, they really help."* (Participant 2c)

Participant 3a: mentioned, "*I prefer to go through the work of people who have vector type of designs. It inspires me."*
This designer is particularly interested in the vector types of design and not the JPG or raster type simply because the vector form of drawing gives the designer the flexibility to reshape parts of it to achieve the desired outcome.

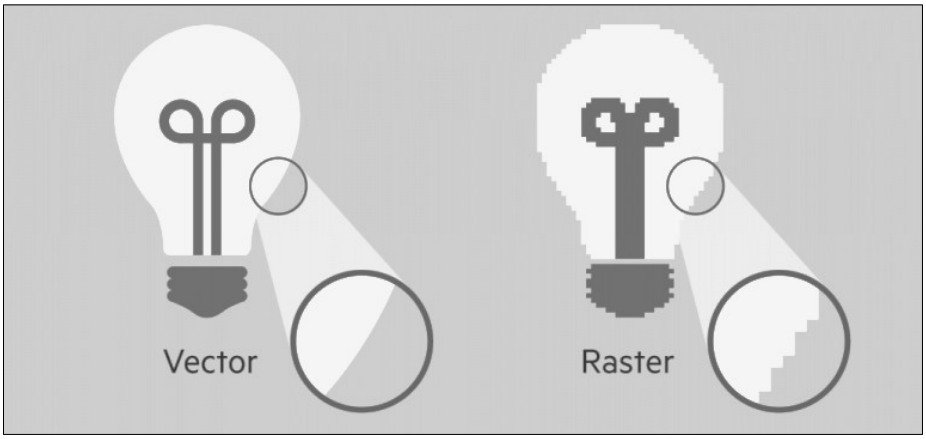

Figure 5.20 Vector and raster images

The resolution of a vector image is unlimited. A vector image may be made in almost any size without sacrificing its resolution. Raster images, on the other hand, only keep their quality when they are sized to a defined specification. The quality decreases as one continues enlarging. The vector file allows the designer to experiment with patterns, hues and effects to produce new, innovative concepts. This layout makes it possible for the designer to blend text and graphic components, which is crucial for creating printed goods or vector logos. Once more, the designer has no trouble going back and making changes repeatedly. In essence, this aids the designers in coming up with a wide range of concepts.

The extent to which the ideas vary (variety) in quantity determines the novelty and the quality. The more the quantity of varied ideas, the more the quality and novelty that can be produced. Generating varieties of design ideas constitutes one of the major creative responsibilities of the designer during the ideation, and the digital technologies, according to the respondents, help in achieving that.

5.5.2 Digital Devices used by Students during Design Ideas Development

Data collected revealed that graphic design students are at liberty to adopt their preferred approach to design ideation. This is to say that the student decided whether to opt for a pencil and paper approach or to use digital devices for idea development. Concerning the possession and use of digital technology, all the participants had smartphones and almost all, except one participant, had laptops. Two (2) participants used only a laptop for design work. These participants did not even use the smartphone for design research or to search for design inspiration but strictly used the laptop for anything related to graphic design. Only one (1) participant used three (3) devices and these were laptop, smartphone and tablet. The rest used laptops and smartphones. None of them used only smartphones for design work. The smartphones were always used in combination with the laptops. In response to an interview question, '*Which digital devices do you use for graphic design work?'* the participants had this to say:

> *"Laptop and mobile phone. Sometimes I do work on the mobile phone and transfer it to the laptop. There is application you can use to design on the mobile phone. If I am not with my laptop and I have to design now, I will work on my mobile phone. We use Hotspot to connect the internet to the laptop."* (Participant KN 2c)

> *"Some software like lightroom used for manipulating photos. I have the phone version that I have been using."* (Participant KN 2b).

> *"The phone. Actually, we have Adobe software on it that can be used for design."* (Participant 2b)

As stated by Hazali *et al.* (2023), mobile applications are designed and used for handheld devices such as smartphones or tablets. You can create

amazing graphic designs with only your mobile smartphones and people who do not have good personal computers or tablets may begin their careers in graphic design using smartphones (Ahmed 2021). The author states that Adobe and other popular graphic design software companies have developed several applications to help people design even if they do not have computers. Available mobile applications that can help the designer, according to the author, are Photoshop Fix, Adobe Lightroom, Adobe Capture, Adobe Comp, Canva and Adobe Spark. According to Superprof (2023), applications such as Autodesk Sketchbook, Adobe Illustrator Draw, and Procreate can be of great help to designers.

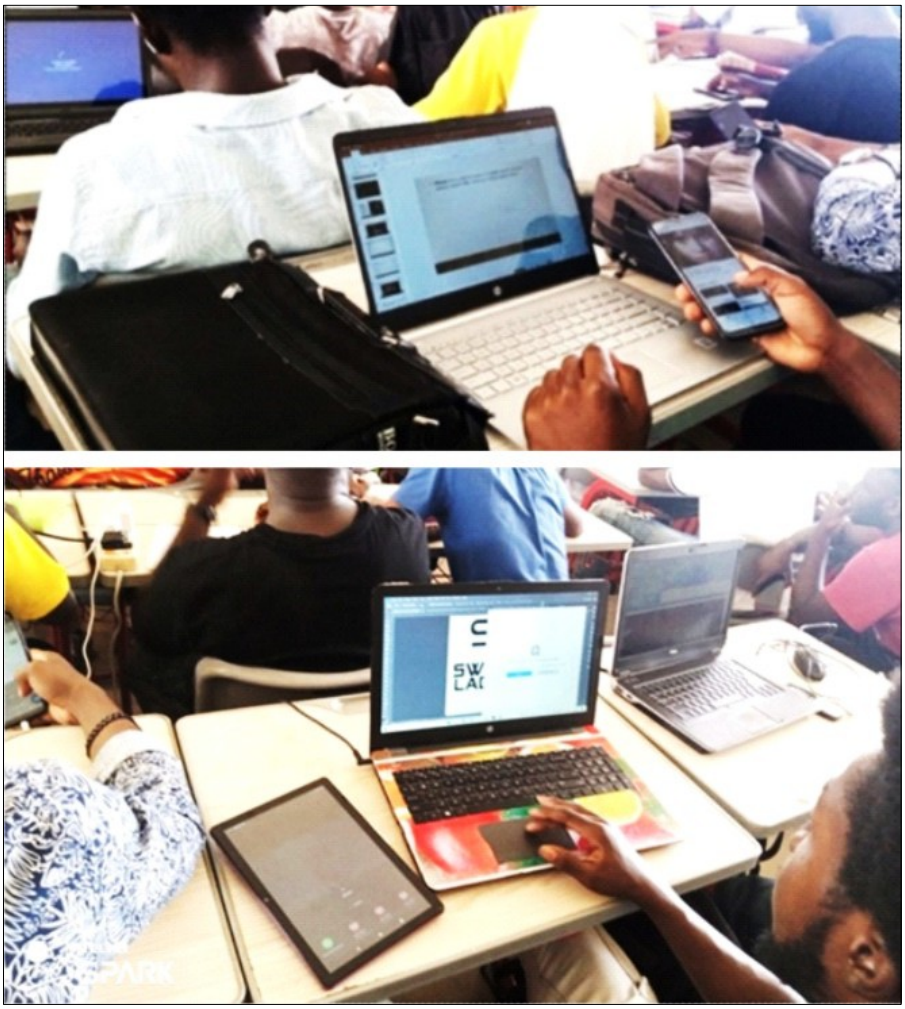

Figure 5.19 Students using smartphones, tablets and laptops for design works

These mobile design applications are explained as follows:

a. Adobe Photoshop Express is excellent for creating assemblages and enhancing designs with flare. This program allows users to create a sticker and add words and effects.

b. Adobe Lightroom: This program offers several templates, filters, and themes in addition to fundamental modifying and resizing features. Simple sliders in Lightroom may be moved upward or downward to adjust the strength of an applied effect. It is excellent for both novices and experts and offers an easy-to-use interface.

c. Adobe Photoshop Fix: This application aids in removing any extraneous elements from a design. It works similarly to Photoshop's mending tool and employs content awareness, which essentially implies that altering won't change the design.

d. Adobe Photoshop Mix is a tool for cutting out and combining different pieces into a single composition like picking out an object in Photoshop, resizing it, and then transferring it into another piece of work.

A number of these applications are designed by Adobe and this is because Adobe is the program of choice for graphic artists across the industry. It is readily available and easy to install. Of all these applications, graphic artists find Adobe Capture to be the most adaptable. Using Adobe Illustrator, the designer can recognize the typefaces, colours, and styles utilized in the shot after taking pictures using the smartphone's camera. Hazali *et al.* (2023) posit that mobile applications have been widely used in line with today’s technology as handheld devices become more powerful.

Smartphones and other handheld devices are designed for internet communication, information retrieval, images, and videos, and have many other features with countless useful applications that render the device a

necessity and, in fact, the most sought-after one in today's age of technology gratification. Mushroor *et al.* (2020) indicate that people have become accustomed to and heavily reliant on technology with the introduction of touch technologies and the widespread usage of mobile devices.

Participant KN 2c mentioned that after he finished working on his smartphone, he transferred his design to the laptop. This is because the laptop offers a wider and more accessible screen size that displays details better than the smartphone when the designer may want to improve on his work. As stated by Arias (2021), because cellphones are usually smaller devices, with limited display capabilities, storage can be a challenge compared to tablets and laptop computers. Besides, the ease with which they can be manipulated is also limited (Kress and Pachler 2007). Limitations such as this may compel a designer to transfer his work to a device with a larger screen such as a tablet or a laptop.

In addition, the designer may want to complete his work with a particular design software that can only be accessed on a laptop as the phones have limited storage capacity and cannot accommodate every software. However, it must be established at this point that very few students use their smartphones to create designs. The majority of them use smartphones for quick access to research information and as a source of internet for their laptops as in the case of Participant 3c who admitted that she uses both a laptop and smartphone for design works and added that *"The phone acts as my source of internet".* Whatever the case might be, the smartphone is seen to be a great asset to today's graphic designer. Other devices used by students are digital camaras and tablets but these devices are used by very few of them.

5.5.3 Design Software that Students were Trained to use

While students in the Technical University admitted that they were taught how to use Adobe Suite and CorelDraw, those in the Traditional University said they were not taught but were introduced to these softwares and were

asked by the lecturers to learn how to use them. The students said they acquired the skills to use the Adobe suite by themselves, through video tutorials on YouTube and some videos provided by some of the lecturers. The Adobe Suite consists of Photoshop, Illustrator, Premiere, After Effect, and InDesign. Of these, it is only Illustrator that can be used for digital ideation and the students do not know how to use it. When the students were asked during an interview session, '*Which software do you use?'* they responded saying:

> *"Photoshop and Premier. I am not really conversant with Adobe Illustrator. I used to have CorelDraw but now I don't even have it on my laptop."* (Participant 5a)

> *"Photoshop and InDesign. I am not good in using Illustrator."* (Participant KN 1a)

> *"I use Adobe Suite, CorelDraw and animate."* (Participant 5b).

The responses of the students indicate that they do not often use vector software and this is because the assignments they are given do not always require their use. Students were not taught how to use vector software which is necessary for digital idea development. This was confirmed in an interview when one of the lecturers (KN Lecturer 1) bluntly mentioned that:

> *"We do not teach the students how to ideate, how to think. We do not teach it and I say that I can talk from what my teachers taught me. How over the years, have adulterated what we have been taught? From the first day of school, the teachers are not teaching them the right way of ideating. So, it is not a matter of digital."*

The statement, '*I can talk from what my teachers taught me'* made by KN Lecturer 1 means that he can teach what his teachers taught him. In other

words, he is transferring what he was taught to the students. His concern is that teachers are not even teaching the *'right way of ideating'.* To him, if students do not know the right way of ideation, the digital approach is of no importance. It is clear from this statement that the students are not receiving any training on the use of vector software for design ideation.

This statement confirms Appiah's (2014:134) finding that the 'university does not offer adequate formal opportunities for promoting computer skills in its ideation programme'. It is clear from the lecturer interviewed that the students were not taught digital ideation because the lecturers did not have the skills to impart it. Digital ideation is done using vector applications such as CorelDraw and Adobe Illustrator. This is the major reasons why most of the students do not use vector applications for complex designs during the creative stage of the ideation process. They tend to search for simple digital illustrations (images) that represent their ideas rather than creating them digitally.

According to Ng (2015), although technology has improved beyond imagination, it has not been fully applied into educational contexts due to barriers at the administrative and individual levels. In the context this study, it is the individual lecturers that form the barrier because they do not have the digital ideation skills to impart.

5.5.4 Students' Use of Vector Software

The vector softwares used by students in both universities are Adobe Illustrator and CorelDraw. Thirteen (13) of the participants knew how to use vector software. Of these, nine (9) could use both Adobe Illustrator and CorelDraw. However, among the thirteen users, three (3) of them said they were not good at using Adobe Illustrator. This means only ten (10) among the participants could use Adobe Illustrator well. It is clear from this data that less than half of the participants used the vector software needed for digital illustration.

In response to the question, “Which software do you use?” participants said:

> *“Photoshop and Premier. I am not really conversant with Adobe illustrator. I used to have Corel but now I don’t even have it on my laptop.”* (Participant 5a).
>
> *“Photoshop and InDesign. I am not good in using Illustrator. I want to learn Illustrator. I will be happy if I know how to use it.”* (Participant KN 1a).
>
> *“I use InDesign, Photoshop and Adobe illustrator but I am not too good at Adobe illustrator.”* (Participant 3e)

As can be seen, the three respondents all knew how to use Photoshop. It was discovered that all the participants, except one of them, knew how to use Adobe photoshop. That is to say, almost all the students knew how to use photo manipulation software. This software was used most often by students in their design tasks.

Clearly, the responses indicate that students had problems working with vector softwares. This is because they were not taught how to use them.

As already established, less than half of the participants knew how to use vector software. There is a need for a shift to the approach of design skills development where digital technology is integrated into the idea creation stage to meet today’s standards. Vector softwares such as CorelDraw and Adobe Illustrator help designers to digitally illustrate ideas to get a perfect representation of what is imagined or sketched in pencil and to achieve the desired ideation outcomes in terms of intricate creative details and aesthetic qualities. Students’ inability to digitally illustrate intricate and complex design details in vector software influences their selection of pencil sketches for digital illustration and this affects their creative outcomes. Thus, students’ inability to transform their best pencil sketches into digital forms affects their

design outputs as they tend to select very simple pencil sketches for digital illustration because of their limited skills in the use of vector software.

Newer and more advanced technologies have been introduced and new skills are being learnt by individuals. Technology has improved beyond imagination (Ng 2015) and different software has made it easier for people to come up with new designs without having the constraints that were associated with the traditional methods of graphic design (Walter and Chimanga 2018). The authors add that newer technologies cause people to imagine new designs that are not possible without the new software. The transformation brought by technology has resulted in a considerable change in the expectations of consumers over time such that the use of traditional approaches to problem-solving is no longer recommended because these approaches fail to meet the expected standards of today's clientele.

This is why graduates being produced by institutions of higher learning have to be acquainted with current approaches to solving problems. However, as noted by Sheila and Waarde (2020), the education system is one of the areas that is still focused on old methods of learning. Again, in a study, Anna (2018) lamented that the traditional methods of teaching skills have not changed. This is why there is need for periodic changes in the approach to solving problems in order to remain relevant in every industry. The adherence to the traditional approach to problem-solving in design was confirmed by KN Lecturer 1, who stated that students were not exposed to the process of ideation that involves using design applications throughout the creative phase. If clients do not accept pencil sketches as participants stated during the interview session, how then can the design students meet the design needs of these clients if they cannot illustrate ideas in vector software? The fact that the traditional pencil sketch idea communication is no longer appreciated by today's clients is a clear signal that the design ideation modus operandi should be changed to meet current expectations. It is in

view of this that this study deems it necessary to propose a model that outlines steps to be taken for effective digital design ideation.

5.5.5 The Contribution of Digital Devices in Gathering Inspiration Materials

It was discovered in the reviewed literature that inspiration is an essential part of idea development. As put by Cui (2020), inspiration is essential to the process of creation because it foretells creativity, facilitates innovation, increases output, and enhances effort. All the participants confirmed that they depended on the internet for design inspiration. Various sources of design inspiration are discussed in the reviewed literature (Laing and Masoodian 2015) such as printed material like magazines, photographs, and books; electronic sources and website links and other physical material such as toys, packaging, hand drawings, and sketches. Again, multimodal sources of inspiration outlined by Tarja-Kaarina and Pirita (2014) include objects and occurrences found in nature and in daily life, as well as materials, pictures, and artifacts, and many others from various disciplines. Despite these rich sources of inspiration outlined by these authors, the majority of students depend heavily on internet websites for inspiration. They do not usually explore the environment for inspiration. This notwithstanding, a few participants engaged in multimodal sources of inspiration which involved taking inspiration from objects and materials in the environment, elements from many fields, pictures and scenes from daily life and the natural world.

Because digital devices are useless without application software installed on them, the term, ‘digital device’ is simply used in the context of this discussion to refer to the digital hardware and the application software installed on it. However, if a discussion seeks to address an issue regarding a particular digital device in terms of its hardware, the specific name of the hardware will be mentioned. Likewise, the name of a software application will be mentioned if a discussion focuses only on a particular one.

The digital devices used by participants include but are not limited to computers, laptops, digital camera, stylus, tablets and smartphones and the design software includes but is not limited to Adobe InDesign, CorelDraw, Adobe Photoshop, Adobe Illustrator, Adobe Capture, and Adobe Lightroom.

It was observed that digital devices, especially the smartphones, helped students gather inspirational materials for their design works. Commenting on whether technology makes ideation easier or not the participants said:

> *"To me yes. Because there are lot of ideas out there. You can look on someone's work and get an inspiration. Even if you wouldn't do the same thing, you get an inspiration of how the work was done and you can do something."* (Participant 3e)

> *"With the phone, we visit other designers, go through their works and take inspiration from there."* (Participant 3a)

> *"When you are given a design work you have to brainstorm, walk around the environment, pick inspiration and with the help of the digital gadget, you can just get to your phone and research what you want and pick an inspiration from the works that are already down there. So, they really help."* (Participant 2c)

> *"Sometimes like when I walk around, maybe when I am at the beach and I see something that I get inspired with, I take photograph of it. Maybe I go round and I see an artwork, I snap it. As for the phone, it actually helps."* (Participant 2b)

Participant 2c made use of the phone in capturing images for inspiration purposes. The respondent admitted that the smartphone was helpful as it helped him capture works of art and images from the environment for design

work. The environment is always full of creative ideas. They exist in great quantities and in a variety of forms but it takes creativity to perceive them.

Nature-inspired designs are usually wonderful, unique and varied. Designers who know how to explore nature very well will always produce creative works. Participant 2c admitted that he walked around the environment to get inspired and was always equipped with a digital device. Similarly, Participant 2b said when he was at the beach and found something interesting, he captured it with his smartphone. Besides this, he also took photographs of artworks.

While some artists will use small sketchpads for quick sketches as they explore the environment, the majority of them will prefer devices such as digital cameras or smartphones. This is because the smartphone helps them get as many images as desired as quickly as possible. The more the images, the more the ideas they are likely to generate.

5.5.6 Multi-functionality of Smartphones in Graphic Design Ideation

Mushroor *et al.* (2020) indicate that the smartphone is a fantastic tool that individuals may use to rapidly get information on any topic. The availability of these mobile smart gadgets also allows people to communicate with others both inside and outside of the community at any time and from any location. It was observed that the students make optimum use of this device as far as their academic issues are concerned. Even though it is a small device, the smartphone performs multiple tasks that are of great help to the designer.

Table 5.2 Multifunctionality of Smartphone

	Function	Description
1	Photograph	Design students take quality inspirational pictures using their smartphones.
2	Voice recording	The smartphone also helps students to do voice recording during lectures, group discussions or when conducting interviews as part of research.
3	Video recording	Students do video recording to keep record of some activities, processes or events that may be useful for design.
4	Note taking	The smartphone is used for note-taking.
5	Research	With internet connectivity, the smartphone is a perfect device for browsing for research purposes.
6	Drawing/ Sketches	There are smartphone applications for drawing that students use for drawing and sketching. These include Photoshop Fix, Adobe Lightroom, Adobe Capture, Adobe Spark, Adobe Comp, and Canva. Others are Autodesk Sketchbook, Adobe Illustrator Draw and Procreate. These software scan be of great help to designers. Most of the time the drawings done on smartphones are transferred to the computer for further improvement.
7	Designing	Some of the smartphone applications allow the graphic designer to complete everyday drawing tasks.
8	Sourcing for inspiration	The design students use smartphones to search for inspirational images during idea development.
9	Connecting computer to the. internet	In instances where internet service is poor on campus, design students use their smartphone to connect internet to their computers by hotspot for browsing.

10	Scanning images	Applications such as Handy scanner, PDF scan or Microsoft Lens are used for perfect scanning of images and pencil sketches drawn during idea development.

It is quite amazing to notice that all the participants depend on the smartphone, in one way or another, during ideation. It is, indeed, a multi-purpose device that has come to make work simpler for designers.

> *"The phone. Actually, we have Adobe software on it that can be used for design."* (Participant 2b)

The statement made by Participant 2b confirms the earlier discussion in this chapter about the use of smartphones and Adobe applications for graphic designing. According to Superprof (2023), applications such as Autodesk Sketchbook, Adobe Illustrator Draw and Procreate can be of great help to designers.

5.5.7 Students' Access and Inaccessibility to a Personal Computer

The personal computer or laptop is one of the most important - if not the most important - digital devices used by today's graphic designers. Given the large number of students enrolled in the graphic design programme and the limited number of computers available for design study, the two selected universities encourage students to have their own laptops for design work.

Skills acquisition in Graphic design requires access and constant hands-on practice with a personal computer or laptop. It was discovered that some students in the two selected universities did not have laptops for their design work. One of the participants in this study also lacked access to a personal laptop. An extract of an interview response from Participant KN 2b who expressed the need to have a computer lab says:

> *"Of course, it is not everyone here who is having the laptop. Some need to wait for their friends to finish work*

before they start work. Some of them cannot meet deadlines."

Again, in responding to the question, *"Do you have a laptop?",* one of the final year students who was in his third year at the Technical University, Participant 2c, said, *"I don't have a laptop".* Responding to a follow-up question that sought to find out how he was coping with design assignments, the participant said:

"I have friends who have laptops so I take their laptops to do my design. The laptop is not for you, [so] when you get it, you do the design fast and give the laptop back to the owner."

Obviously, Participant 2c will be disadvantaged in many ways. He will have limited or very little time to practise the design software that was taught because he has no laptop of his own. His academic performance will also be affected. It is clear in his response that he does not have the luxury of enough time to work on his assignments to the best of his ability as he would have liked to. Within the limited space of time allotted to him by a friend who allows him to use a laptop, he has to practise and at the same time finish working on his assignment. He is compelled to work as fast as he can and return the laptop to the owner without inconveniencing him because he will inevitably need to use the laptop at some other time and does not want to be denied the opportunity. This means he may not have finished what he intended to do but has to return the laptop promptly so that he can again get access to it when he next needs it.

In this situation, even though the respondent was in his third year (final year), he may remain a novice designer as he was not able to explore extensively enough on the laptop to acquire the necessary graphic design skills. It is established in the literature that the more one learns about the abilities of technology, the more creative one becomes (Thangarajathi 2020). This

suggests that the more the students engage in the use of digital technology the more creative they will be. Lack of personal access to digital devices and the inability to engage sufficiently with digital devices can negatively affect a design student's creativity and consequently, their academic performance.

An extract from an interview response with Participant KN 3a which is perfectly related to this subject, but not directly a response to the same question says:

> *"At times, I have a friend who usually uses my laptop for assignments. When I am done with my own, he comes to my hostel and do his. There are times he comes to my place and I am busy with the laptop and he has to wait for a long time. At times I don't finish but I give it to him. At times he rushes to finish. If maybe he had one laptop in his comfort zone for himself, he could have just maybe spent like … A design that he can spend like a day to finish, probably he will spend maybe 30 minutes to do it because he is in a rush."*

It can be inferred from the statement made by Participant KN 3a that the student without the laptop spends half an hour to do what is expected to be done in 24 hours. This raises a concern as an issue regarding the quality of design output is at stake. Lack of personal access to a laptop can be very stressful to students and this will surely affect the quality of students' design works and consequently their academic scores. In a study on *Digital Technology for a New Future*, ECLAC (2021) indicates that a sizable number of kids lack skills and have little exposure to digital devices at home. The author claims that because these pupils are probably not learning as much as they need to, there may be increased course repetition and/or dropout rate. This means that having limited access to digital equipment might cause students to repeat courses or even and drop out. According to Participant KN 3a, if the department were to have a well-resourced computer lab,

students who do not have laptops could visit the lab and spend some time to practising design software and even do their work there.

5.5.8 The Perceptions of Graphic Design Students about the use of Digital Technologies during Ideation

This section seeks to explore the views of students about the use of technology in the ideation process. Students' views were sought about the effectiveness of digital devices in producing the quantity, quality, variety, and novelty of ideas. This part focuses on Research Question three (3): What is the perception of graphic design students regarding the use of digital technologies during ideation?

Because digital devices cannot be used without application software installed on them, the term, 'digital device' is simply used in the context of this discussion to refer to the digital hardware and the application software installed on it. However, if a discussion seeks to address an issue regarding a particular digital device in terms of its hardware, the specific name of the hardware will be mentioned. Likewise, the name of a software application will be mentioned if a discussion focuses only on a particular one.

The digital devices used by participants include but are not limited to computers, laptops, digital camera, stylus, tablets, and smartphones and the design software include but is not limited to Adobe InDesign, CorelDraw, Adobe Photoshop, Adobe Illustrator, Adobe Capture, and Adobe Lightroom.

Data for this question was solicited through interviews. Open-ended questions were used to allow the participants to express their unique experiences and opinions regarding technology utilization in design ideation. Since it is purely qualitative in nature, emphasis is not placed on numerical strengths and percentages in supporting the opinions of participants; however, aggregate details are provided in the summary of this section

5.5.9 Students' Views on Whether or not Digital Technologies make Ideation easier

Interview responses indicate that most of the students use digital devices during idea development. This, in itself, registered a high level of technology

acceptability into design ideation among the students. In their responses to the question on whether digital technologies make ideation easier or not, one participant said:

> *"Yes, with the help of the digital devices, when you use it and you want to improve on an idea, you just take it and you continue."* (Participant 2c)

It could be deduced from the response that Participant 2c is addressing issues related to the use of digital devices in the creation of ideas. To the respondent, the use of digital devices makes ideation easier because when a designer creates an idea and wants to create another as an improvement on the first one, all the designer has to do is to select the first idea by making a copy of it and continue to add more details to it to create a different idea without having to start the drawing over. As indicated in Chapter Two in the review of related literature, the 'copy and paste' as well as the 'scale and rotate' commands in a computer application enable changes to be made more quickly than redoing them by hand (Brady 2003). The transformation capability of digital technology, where previous drawings can be copied, pasted and edited either by skewing, rotation, scaling, and panning, deleting some details and introducing a few others to form a new design, has made the digital approach a very desirable tool for ideation.

Do you think the use of digital technologies make ideation easier?

> *"I wouldn't say yes and I wouldn't say no, because they both work hand in hand. Because drawing it is also one of the ways you can generate ideas and using the internet Is another."* (Participant 3b).

In her response, Participant 3b observed that pencil sketches and the use of the internet are two different approaches. The participant did not consider either of the approaches to be better than the other. The two approaches

have their unique contribution to effective idea generation. Here, equal importance is placed on both approaches. McGlashan (2017) posits that the use of paper sketches for initial idea capture encourages an unimpeded flow of ideas. Radhika (2018) also indicates that the use of digital technology makes task performance flexible, leading to increased productivity. Practically speaking, even though these authors are talking about two different approaches, each of them yields multiple results. Stating that the two approaches '*work hand in hand'* means that Participant 3b supports the combination of the two approaches for effective idea development.

Responding to the same question, participant 3a said:

> *"Yes, they do. It is not every time you have to be thinking about everything. Sometimes you have to visit the internet to get ideas."*

Participant 3a was of the view that digital technology makes ideation easier because the internet supports the sourcing of many inspirational materials that aid quick ideation. The idea here is that searching for design inspiration from other sources, such as the environment or magazines takes up a lot of time and besides that, the materials that are gathered may not be enough compared to the quantity of materials a designer can obtain from the internet. What is required of the designer is for him or her to key in the right words into the search engine and multitudes of images needed by the designer will be generated. In relation to this, Afif (2016) states that modern technology makes it simpler to communicate, obtain information, improve one's abilities and increase output.

To crown it all, a participant responding to a question regarding the use of digital devices for ideation said:

> *"Well, gone were the days when we use the pencil but now everything is on the net. Everything is on that small device we carry around. And it helps. People from different countries, from different tribes, religious and all that. They*

> *all post what they know there. They all post their ideas there and it makes even easy for inspirational purposes. Different people who are good in that field post amazing works there (online). So, the internet is the best option."* (Participant 2a).

It is clear from these responses that the internet cannot be separated from design activities in today's generation. Designers have accepted the internet to such an extent as a necessary and integral part of design that almost all the respondents admitted that they could hardly work without the internet. Some of the websites visited by designers for ideas, as stated by respondents during an interview session, include www.freepik.com, https://www.pexels.com/, https://www.flaticon.com, https://www.ebay.com, https://www.pinterest.com, https://pixabay.com, https://undraw.co and https://www.behance.net. Details of these and many more websites are provided in Table 5.3.

5.5.10 Some Useful Websites for Design Inspiration

Graphic designers across the world post their design works on the internet which serves as a platform for advertising, marketing, finding design partners, and sharing ideas. As a result of this, there are countless design websites flooded with a huge collection of design ideas. Design students, like other designers, visit these websites for design ideas. This Chapter discusses some of the graphic design websites.

Commenting on design websites, a respondent said:

> *"There are times you only have to visit the internet and then by seeing one person's work or another's, you are inspired. There are times that you have a mentor or so. When you hit a creative block and it's like you can't do anything, you visit their site and you find a lot of inspirations to be able to carry out what you want to do*." (Participant 3c).

This is to say, if a designer is stuck at a point in idea development and does not know what to do next as ideas stop flowing, he or she has to seek some support from design websites. Information gathered in this study revealed that all the students visited websites during ideation. When asked about some of the websites visited during idea generation, the participants said:

> *"I use some sites to get ideas and inspiration like Pixabay."* (Participant KN 4a).
>
> *"Most of the time, I go to Pinterest. Maybe people have already done many types of which we are about to do. We go there and we get inspired. We select and develop to make it unique."* (Participant 2b)
>
> *"Pixabay, Vidizee, Behance.com and Undraw."* (Participant 2a).

Digital technology has made it easier to get inspirational materials just by typing the right word on the right website.

Table 5.3 Useful Websites for Design Inspiration

Website	Website description
1. Freepik **www.freepik.com**	Users may access premium photographs, vector graphics, drawings, and PSD files for their artistic endeavours in this search engine. It provides a large selection of free materials. After searching, you may locate them by selecting the "Free" filter from the website's "Filters" menu. This resource is offered without a price at all. A designer only needs to browse through millions of free graphic materials to complete his imaginative creations. When you download Free pictures, don't forget to give credit to the creator by putting a link to www.freepik.com on the page where you use the photos, and adding the attribution line "Designed by Freepik" anywhere on the printed product or digital image you generate.
2. Pixels.com www.pexels.com	Over 10 million people visit Pixels.com each month. The website features excellent photo and art collections. Designers may get inspiration from the high-resolution photos on this page.
3. Flaticon https://www.flaticon.com	Flaticon.com is a great place to get ideas, particularly for logo designs. The website offers a plethora of free design accessory sets that let designers plan, produce, and finish their ideas faster. The designer is free to arrange icons (logos) into collections and save them in formats such as EPS, SVG, PNG, and PSD. It is essential for graphic designers to take advantage of the free resources on this site for excellent creative output.
4. Ebay.com https://www.ebay.com	eBay is a worldwide e-commerce corporation established in San Jose, California that allows businesses and consumers to transact with each other through its website. Designers can get inspiration from the images on this site.

5. Pinterest **https://** **www.pinterest.com**	Pinterest is a well-patronized site worldwide. A designer can always find inspiring ideas from billions of Pins on Pinterest. These ideas can be saved for personal use. Pins can also be created in other to share ideas with others. By typing keywords into the search bar, a designer can access images or videos, discover ideas, people and trends. A designer can use the camera icon to find ideas relevant to his images to narrow the search results. Desired content in the form of images, videos or products can be saved and used.
6. Pixabay **https://pixabay.com**	Pixabay is made up of a group of creative individuals who share royalty-free images, videos, and audio. The of contents of Pixabay can be used without permission or giving credit to any artist because they are under the Content License. Designers may utilize many high-quality images, drawings, and vector graphics on Pixabay.com. The images on Pixabay.com serve as a source of inspiration for designers.
7. Undraw **https://undraw.com**	UnDraw facilitates browsing for pictures that complement the message, adjusts the colour to align with the brand, and may be used as an integrated code, regular image, or directly in a design project. High-quality images are used that can be scaled without degradation. This site provides high-quality graphics with customizable colour schemes, objects that can be mixed and matched to create fresh, captivating visuals, and a design aesthetic that strikes a balance between art and technology to ensure your work is resistant to change. Illustrations on this platform can be used for any project, without attribution. It is a good source of design inspiration.
8. Behance **https://www.behance.net**	Behance is the biggest platform for creatives to find and exhibit their work. You can easily construct a professional portfolio with Behance's easily accessible and high-quality material.

	The designer has access to and may impart expertise about his specialized domains. Some of Adobe Behance's useful features are as follows: a. It is simple to utilize this platform. A designer may easily build a profile on Adobe Behance by visiting their website. b. You may even obtain Behance features; nevertheless, to achieve the greatest outcomes, you must exercise extreme creativity and strive to establish a distinctive presence on this site. c. Anyone using this platform can upload images and links in addition to immediately publishing their design work. d. The designer has the chance to develop his own community in which he may assist others want to begin using his creative abilities. It's a useful forum for learning new things and exchanging expertise. A designer can display his artistic abilities and finished projects so that people from all around the world can see what type of talents and expertise you have. A designer can connect with others for business using the site. The website has a vast amount of art, which is why numerous artists find inspiration from it.
9. Videezy **https://www.videezy.com**	Videezy is a community of creatives who love to create and share stock footage from around the world. Available at the site are videos and After Effects templates that can be used to enhance your creative work. Videezy, which was created to support creative causes, has a huge collection of high-quality footage that makes filmmaking easy and affordable. A large proportion of files are free to download and to use.
10. Pixar	To create computer-animated movies with endearing narratives and enduring characters that will appeal to viewers

https://www.pixar.com	of all age groups, Pixar aims to bring together modern technology with elite creative ability. The collection of works on this website serves as a good source of inspiration for animators worldwide.

Online design inspiration is considered to be very important these days. Other useful websites as outlined by Passionate (2023) include the following:

i. *Design Inspiration*

This site focuses predominantly on the visual and typographic works of experts across the globe. It is just an excellent site for exploring creative ideas by looking for design pieces, selecting a colour, or examining what they have.

ii. *Identity Designed*

Some of the greatest identification designs from throughout the globe are available on Identitydesigned.com. This can be beneficial to a designer working on projects involving branding, packaging, logo design, or any other aspect of visual identification.

iii. *Fonts in Use*

This website features several design projects with fonts to assist designers. This website might be quite beneficial to a designer who is having trouble selecting the perfect font for a project.

iv. *Wix Creative*

This website has informative articles about logos, graphics, and a wide range of other design-related subjects. The cloud-based website development and building platform Wix.com/blog/creative features an excellent blog to aid in the inspiration of designers. It's a useful website for improving your abilities and learning on your own.

Exploring design space using these websites will yield creative results. The number of good ideas will increase as the designer locates ready-to-use

vector files to reshape to form new ideas. According to Nelson *et al.* (2009) what is considered important in ideation is the overall quantity of design concepts produced, the total number of categories of design concepts produced, the originality or distinctiveness of design concepts, and the viability of design concepts. With the availability of numerous design inspirations from these websites, designers have the opportunity to achieve their creative purposes as digital technology has brought new dimensions of design space exploration by offering various digital design tools that support design processes and decision-making in design practice.

In their response regarding the importance of using the internet during design ideation, the participants said:

> *"… Like I mean to design a poster on sustainability. You ask yourself what sustainability is about. And when you go to the internet and type sustainability you will see various kinds of designs on sustainability and it looks like but not necessary to copy. It gives you an inspiration to just do yours. Even the colours to choose."* (Participant KN 3a)

> *"With the phone, we go on the internet, when you are given a topic and maybe you want a wide idea. You go to internet and search, you will get various and different types of ideas then you actually take one you will work on."* (Participant 2b)

Participant KN 3a from the Traditional University and Participant 2b from the Technical University expressed the view that the internet helps them to get a variety of ideas for design ideation. While Participant KN 3a expressed this view by saying "*You will see various kinds of designs,"* Participant 2b said, "*You will get various and different types of ideas."*

This indicates that students visit the internet purposely to obtain a wide spectrum of design ideas on a given design task. The participants'

statements corroborate with that of Wang (2020) who indicates that the use of digital tools (one of which is the internet) makes design work more convenient with good quality and offers the user more choices and variety. A variety of ideas is important in design ideation because it is what qualifies a design to be counted. As stated by Pahl *et al.* (2007), the ideation stage is very important because a successful final solution is likely to originate by exploring a variety of solution principles.

Responding to the same question, Participant 5a, said:

> *"Most people put their ideas over there for us to take inspiration from. For the internet you have to go online and search for ideas."* (Participant 5a)

Like the rest of the respondents, Participant 5a said she takes inspiration from the ideas people put out on the internet. Graphic designers always need inspiration to come out with creative works. Because graphic design is a visual art, the designers gain inspiration from visual materials. While sources of design inspiration include printed materials such as photographs, illustrations, magazines, photographs, books, and other physical materials such as toys, packaging, paper samples, hand drawings, sketches and mood boards, design students predominantly use digital images as their main source of inspiration for their graphic design works. This is done by exploring design websites on the internet as they offer volumes of image resources for use. All the participants said they used the internet during design ideation for design research and gathering images for design inspiration. Zhang (2021) states that the Internet helps the designer gain access to more visual communication designs that improve design research. In their submission, Al-Qudah and Al-Shari (2020) point out that resources on the internet greatly increase the productivity and abilities of graphic artists. The internet provides quick access to information anywhere any time and it is most convenient. It is clear that the internet is a very important tool in today's graphic design ideation process.

Participants were further questioned to find out about their position on the use of digital technology in design ideation. When asked how the use of digital devices affects the quality of your ideation, they said:

> *"It makes work easier. With the digital device you can test the variation of colours. You can just mask and test different colours and you can do multiple works in one day. You can have more ideas than when you are using a pencil and paper."* (Participant 2a).

From this response it is clear that digital technology reduces the stress of thinking about ideas. The statement, '…and *you can do multiple works in one day.'* made by Participant 2a suggests that digital devices retain the flow of design ideas that engage the designer with design tasks. This will help eliminate fixation during design ideation. From the literature, fixation is shown to be a creative output limitation resulting from the recurrence of an earlier concept into later concepts (Vasconcelos *et al.* 2016:3). In the presence of multitudes of ideas, there is the flow of design ideas leading to the elimination of fixation. The advantages of digital technology in design ideation as outlined by Ekströmer and Wever (2019) include simple changes (scaling, rotation, panning, and zooming); the ability to temporarily remove an object or set of elements, making it easier to create forms that are challenging to create by hand (Ranscombe and Bissett-Johnson 2017), and automated redoing and undoing (Ramimian *et al.* 2008; Ranscombe and Bissett-Johnson 2017). Wang (2020) indicates that digital tools make design work more convenient with good quality. Again, it is believed that digital tools offer the user more choices and variety than traditional methods and that drawing tools can be manipulated with ease. Digital tools, according to Aboalgasm and Ward (2014), improve artistic expression and creativity.

In order to probe further regarding the use of digital devices, the researcher asked which is faster to ideate with, pencil or digital device? The respondent said:

> *"If you know how to use the digital device, it is faster."* (Participant 5a).

To Participant 5a, the answer to the question is dependent on whether the designer is conversant with the use of technology in ideation or not. That is, if the designer is adequately equipped with the technological skills needed for ideation, he can execute design work in the shortest possible time; however. if he is not skilful, it may take longer. According to College (2021), there are creative professions and there are technological professions. Again, some professions are both creative and technological. College adds that graphic design is one occupation that combines both creativity and technological proficiency. A graphic artist's work is a journey in lifelong learning and development. Technology never stops evolving, and there are constantly new problems to overcome (College, 2021). This means designers have to keep on updating their skills to remain productive.

Which will you prefer during idea generation, pencil sketches or the use of electronic devices?

> *"Well, I am not a fan of using pencil to design. That is why I go to Pinterest and Instagram. I go through them, start my own and some changes. Unless it is a logo. I use pencil. For logos, I use pencil."* (Participant 3a).

Participant 3a finds it most convenient working out ideas by using digital devices, without having to do any pencil sketches because he visits Pinterest and Instagram where he gets access to designs and effects changes on them to obtain his desired designs. Digital technology, according to Min and Hao (2008), shortens the duration of design projects as opposed to traditional means; gives convenience in proposing new alternative solutions; and offers higher flexibility of modifying alternatives and design process.

How will you encourage designers to adopt digital technology?

> *"I wouldn't condemn them to stop the pencil or the pen work but they should try and improve on it. The pencil is not the only means to generate ideas. The use of the machines (digital devices) can also help bring out more."* (Participant 3b).

Which will you advise designers to use for ideation, pencil or digital devices?

> *"For me I will advise them to use both. It is good to jot down whatever you have in mind before you sit directly behind the machine to work. So that is the advice I will give them. They should be able to have all their ideas jot down, they should mind map, have everything on paper so that when they go behind the machine, they know what they are coming to do and you just focus on it and you are done."* (Participant 3e).

Participant 3e, like some other participants, is of the view that designers should start ideation with pencil and have everything ready on paper in preparation for using the digital device. By doing this preparation, according to the participant, the designer will know exactly what to do when he sits behind the computer. It stands to reason that the participant believes in using both pencil and digital technology in ideating.

Your views on pencil and paper versus digital devices for ideation?

> *"I actually prefer the pencil and paper because I feel it is more flexible for ideation because we sketch a lot of things. With the digital devise, there is a lot of stress especially when you have mistakes and you have to correct it and all that."* (Participant KN 4a).

The participant's statement that it was stressful trying to correct mistakes when using digital devices is a clear indication that he was not exposed to the use of digital devices enough. Other interviewees had a contrary view

with regard to this. They believed that it is much easier to make corrections when using digital devices than pencil as it is just a matter of using the ‘undo’ button. On the other hand, the participant’s adherence to the use of pencil sketches during idea development was highly recommended by some researchers (Amarakoon 2017; Dorta (2014).

Like some other designers, this respondent admitted that it was more flexible to ideate using pencil and paper than using digital devices. This view was supported by Dorta (2014) who states that ideation should be fluid, abstract, ambiguous, imprecise and devoid of the exactness of digital representations. Again, Amarakoon (2017) and Dorta (2014) argue that technology produces an over-sanitized result and exposes designers to so many electronic images that might have a negative impact on imagination. The authors further admit that technology puts mechanical processes between the artist and the finished work of art thereby destroying artistic creativity.

Designers with this opinion may be reluctant to adopt technology into design idea development. However, making them understand that a lot has changed over the decades and technology is continually being improved with far more flexible tools than before will help change their perception. Technology has improved beyond imagination (Ng 2015) and according to ECLAC (2021) access to it has led to a complete transformation of how various tasks are executed in today’s world. There is therefore a need for a shift in the design paradigm where digital technology should be skilfully integrated into design ideation for effective output, most especially in the learning institutions where students are being prepared for the job market to serve clients who will not accept pencil and paper sketches.

Findings in this study indicate that digital technologies make ideation easier. Participants admitted that using digital devices helps in developing quality ideas, testing variations of colours, and executing multiple works. It helps to create new ideas from previous ones much quicker by using the ‘copy and paste’ commands. According to participants, digital technologies reduce the

burden of thinking too much about how to go about design work as assistance is readily available on the internet. Because the internet serves as a digital tool that aids in gathering a multitude of ideas, there is the flow of design ideas leading to the elimination of fixation. Besides this, the degree of design quality relies primarily on the quality and variety of materials collected and how analogies are drawn to arrive at a solution.

All twenty-four participants used at least one digital device (among those devices stated at the beginning of this section) for design work. Out of the twenty-four (24) participants, one (1) reported that he did not have a personal laptop. This indicates that the majority of respondents use digital devices for design work.

While eleven (11) participants believed that it was easier or faster when the digital approach is adopted for graphic design ideation, two (2) were neutral about it, arguing that it all depends on the skills level of the designer and the rest felt it was not easier by adopting digital technology for various reasons. Some of the reasons given were that they were not very good at using digital tools for idea creation; they did not know how to use the vector software; and it was difficult to make corrections when a user made a mistake.

Twenty-two (22) of the participants said they liked doing pencil sketches because it is more flexible for ideation, helps them develop creative ideas and organize ideas for further development. Two (2) of the participants, on the other hand, did not like doing pencil sketches. One of them said he feels lazy to take up a pencil and the other one said he was not a fan of using pencil to design. This indicates that in spite of everything digital tools have to offer, the participants felt the unique contribution of pencil sketches could not be neglected. In all, sixteen (16) participants had positive opinions about digital technology in ideation, six (6) did not, and two (2) were neutral and neither supported nor rejected the method.

5.5.11 Conclusion

This chapter presented the findings on how digital technologies affect design output. It examined the various technologies used by the designers in the design ideation process in two selected Ghanaian universities. The aim of this chapter was to identify the various digital devices and application software used by the design students and how they affect design ideation outcomes.

It was generally observed that the devices used by students include laptops, smartphones, tablets and digital camaras. Students predominantly use their personal laptops and smartphones for their design tasks. While the laptop is seen as the main digital device necessary for design in general, the smartphone is considered to be the most important device that supports the laptop for effective design ideation output. It is almost impossible for a graphic designer to work without the smartphone. Participants consider this device to be so important that they wondered what design work would be like without the use of it. While the smartphone is widely used by students for quick access to information, gathering of images for inspiration, and for purposes of research, it is also used as a source of internet for browsing on their laptops.

The majority of participants admitted to using the data on their phones for accessing internet connection on their laptops because the Wi-Fi on campus was not reliable. The smartphone is therefore highly indispensable in the design ideation process. It was also evident that students used smartphones as a substitute for the computer. They reported during an interview session that they sometimes use Adobe applications and some other software to do their design works on the smartphone. According to them, they use the smartphone when a laptop is not readily available. This is helpful as it saves time and the work output in terms of quality is as good as that of the laptop.

The impact of digital technology in ideation included gathering quantities of inspirational materials for ideation through the use of the internet; manipulation of vector types of images to obtain varied of ideas and testing colour variations. By use of these inspirational materials designers were able to generate more ideas from which creative ones were selected. Lack of personal access to laptops among some of the students was a great concern and the institutions need to provide some interventions to help students in such a situation.

Ideation is crucial and the most interesting part of the design process. Design ideation is a key aspect of design thinking because it is where new concepts are generated and developed (Kim 2020). In spite of the divergent views expressed by the participants about the use of digital technology for ideation, the majority of them believed that the integration of pencil and digital technology is the ideal approach for effective design ideation. Thus, while they appreciate the significant impact digital tools have brought into design ideation, they believe that it is more flexible to use both pencil sketches and digital tools for design ideation. This finding corroborates the study of Novica *et al.* (2023) regarding Sketching and Concept Generation in Design Instruction, in which the participants in their study indicatet that integrating both digital and traditional sketching could be the best course of action to enhance students' design outcomes. Again, in support of this, Day and Orthel (2016) opine in their study that students should be taught both analogue and digital approaches and be made to comprehend the entire process of design.

The participants in this study considered technology to be very relevant, especially in increasing idea counts (quantity of ideas generated) that lead to creative ideation outputs. In all, participants had positive attitudes towards the use of digital devices; however, a good number of them did not possess the necessary skills in using vector software needed for design idea creation simply because they were not taught how to use them and were not

compelled to use them in design ideation. Sufficient exposure of students to vector software will change their view about their use.

CHAPTER SIX

Development of a Model for Effective Digital Design Ideation

6.0 Overview

The previous chapter dealt with research questions one, two, and three. These research questions were combined to form Chapter Five because they are related. They are associated with how graphic design ideas are generated, the tools used for ideation and students' perceptions of these tools. Even though they are combined, each question was analyzed separately. Question one covers the ideation processes adopted by students such as research on design briefs; brainstorming; mind mapping; Internet use, gathering design inspiration, and evaluation of ideas generated by participants. Research question two also focused on the various digital devices and applications software used during the design ideation process by graphic design students in the two selected Ghanaian universities and how they affect ideation outcomes, while research question three explored the views of students about the use of technology in the ideation process and It is related to students' perception of the impact of digital technology on ideation outcomes that were discussed. In other words, students' views about the effectiveness of digital devices and design application software in producing quality, variety, quantity and novelty of ideas were sought. Various findings, including on the digital devices, software and websites used by students for purposes of design idea development, the ideation processes they adopted and the design websites students visit for design inspiration are analyzed and discussed in the chapter.

This chapter seeks to develop a model for an effective digital ideation process that will help improve graphic design ideation for present-day practices among students and professionals in the graphic design industry. The development of the model was influenced typically by the findings in the study and based on design practices as they were discovered in the review of the literature related to this study. The chapter focuses on Research

Question 4: How can digital technology be effectively used to improve the design ideation process among students?

6.1 An Overview of the Model

The Digital Ideation Model is housed in a rectangular area with circles, ovals, and horizontal rectangles that give descriptive information about its contents. The whole model is divided vertically into two equal halves. The first half, as indicated by the dark green horizontal bar beneath, covers design research and digital design idea exploration and the second half with the dark blue horizontal bar focuses on digital design ideation and ideation outcomes. Each half consists of three (3) stages, making six (6) stages in all.

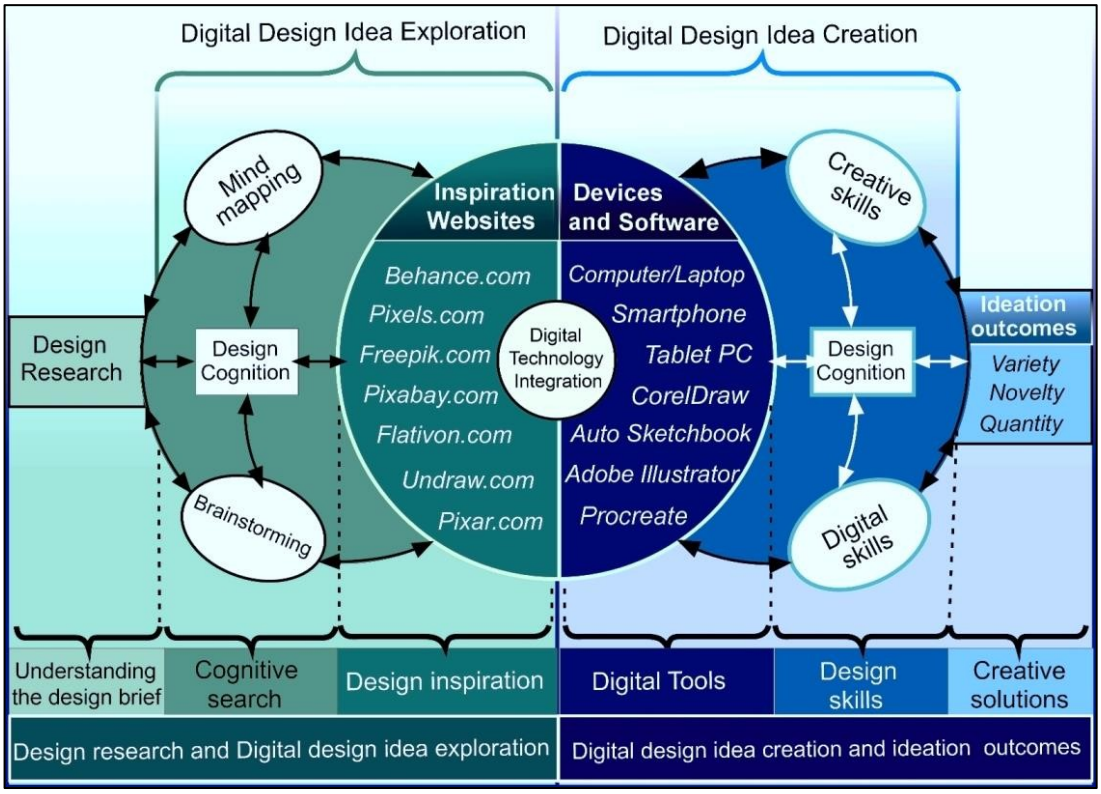

Figure 6.1 Digital Design Ideation Model

As seen in the model, two-directional arrows link the constructs, indicating the fact that they are interconnected and the process can be revisited back and forth to refine an idea. The model is iterative in nature and not linear or ridged. This is to allow the designer to continuously improve upon design concepts or ideas by repeating and revisiting the constructs for improvement in the design outcome. Thus, if the designer is not satisfied with an outcome at any stage of the ideation process, he or she can repeat the process with the aim of achieving a creative solution. As indicated in Figure 6.2, a designer who is browsing an inspirational website, for instance, can move back to Mind Mapping or Design Cognition and Design Research, all depending on what he intends to correct or review.

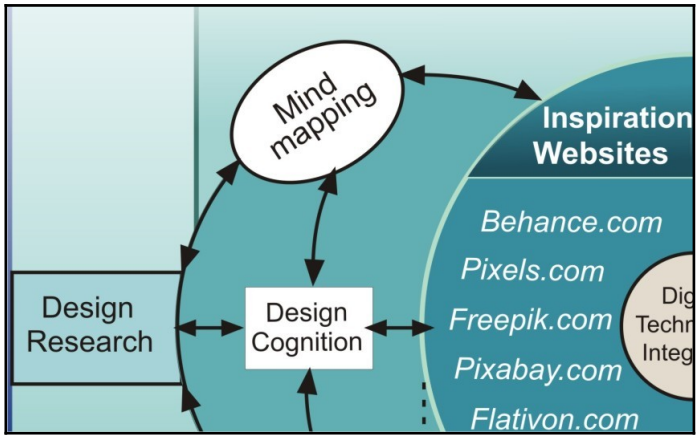

Figure 6.2 Iterative Nature of Design Ideation

It should therefore be noted that the model is not intended to be used in a step-by-step linear approach, as it projects various constructs with flexible interactions and movements. This describes the intertwined and iterative nature of design ideation in particular and the creative process in general. The process is descriptive rather than prescriptive. For better understanding, the first half with its three stages is discussed first, and then the second half with its stages.

6.2 The Constructs of the Digital Ideation Model

6.2.1 Research

At this stage, the designer seeks to comprehend all the design project objectives and intended outcomes as stated in the design brief (Kang *et al.* (2019). Gathering necessary information about the brief by way of research is essential in creating quality ideas. According to Stevenson (2020), it provides a clear and thorough comprehension of a brief and gives the direction to design for effective decision-making. A good understanding gained at this stage helps to benefit design cognition and the rest of the ideation process. Research prepares the designer for an effective ideation process and the internet is a valuable asset in achieving purpose in this regard. It also helps the designer to know about other design works related

to the brief, which helps the designer to introduce something unique in the new design.

Internet technology has become a very important tool and has changed people's daily lives. Zhang (2021) states that through the Internet, the designer gains access to more visual communication designs that improve design research. In their submission, Al-Qudah and Al Shari (2020) point out that the internet as a tool highly improves graphic designers' efficiencies and skills. Digital devices play a significant role as they help in the quick acquisition of information in multimodal forms such as images, audio, visual, and text. The devices usually used for this purpose include laptops, smartphones, and tablets.

These are necessary research approaches and it is proposed that designers adopt them to widen their understanding of design briefs and to prepare them enough to execute the creative.

6.2.2 Mind mapping

The information acquired by the designer at the research stage helps the designer to engage meaningfully in mind mapping and brainstorming. Mind mapping works out the relationship between ideas (Kumbhar 2018). As discussed earlier in Chapter Five, mind mapping is searching the mind and noting down all the interconnected ideas that are linked to a theme or task at hand. Liedtka and Ogilvie (2018) mention that mind mapping illustrates the connections between ideas and a principal topic. The central idea or theme is the first idea that inspires other ideas. From the central theme, other ideas are generated. In other words, the main topic of the design task is noted in the middle, and sub-topics and details are connected to it. The mind mapping technique was developed in cognizance of how the brain works when processing information (Hidayati and Subur 2023)

While mind mapping is meant to help the designer generate design ideas, it also helps to further understand the design task as it opens up the mind for divergent and lateral thinking. The internet helps in achieving success in

mind mapping as it provides quick access to linking words or related ideas. Again, OneNote offers a flexible approach to mind mapping. It is a digital notebook that automatically saves and syncs the notes as it is used. This Microsoft application works effectively on tablets, laptops and smartphones. Creating a map of every thought can help a designer come up with even more ideas. The application allows the designer to draw lines to connect to circles with freehand, type ideas, choose favourite shapes, highlight information, and colour and import images into the note with ease. During mind mapping, OneNote helps the designer to organize specific ideas about the central theme into preferred circles. It is easy to use and can help organize ideas effectively. Mind mapping is very important because the designer has to mind map to discover more possible ideas that may be useful for the design task.

6.2.3 Design Cognition

Design cognition is the thought processes and mental models that go into design creation (Hay *et al.* 2017) and the term is used to categorize all the activities that occur in the design process (Chan 2015). Every activity in the ideation process is guided by the designer's cognitive faculty. This means design cognition runs through the whole ideation process from the research stage to the ideation outcomes. Design is considered a problem-solving and decision-making activity. As can be seen in Figure 6.1, design cognition is strategically positioned to connect all the constructs in the model to indicate that it covers the entire design process.

Some cognitive activities in design ideation are reflecting on ideas, refining them and selecting ideas. Comparing ideas to determine if they qualify to be counted as varied ideas, editing elements of design to achieve variation and to improve on design quality, and questioning oneself leading to the acceptability or rejection of an idea are all part of cognitive activities that take place during design ideation. Effective cognitive process and decision-making leads to the generation of novel and unconventional ideas.

6.2.4 Brainstorming

Brainstorming, like mind mapping, aims at gathering ideas to solve a problem but the difference is that while mind mapping has to do with deriving sub-topics from a central theme, which is usually done by an individual, brainstorming is usually a collaborative engagement involving a number of team members who come together to bring their ideas on board to solve a particular problem. Brainstorming is therefore a team-based problem-solving approach. Kumbhar (2018) considers brainstorming as a problem-solving technique that uses the ability of a group of individuals to use their combined creativity to generate many solutions for an issue in a shorter time. Brainstorming is used to solve situations as creatively as possible. This conference strategy involves gathering all the participants' unexpected suggestions to try to solve a problem. Brainstorming is a very important tool for the graphic designer because it ignites creativity. In design ideation, brainstorming helps the designers in the generation of a variety of ideas in quantities as each team member comes up with his unique collection of ideas and this usually leads to achieving creative solutions. Digital technology plays a significant role as a search on the internet offers team members with volumes of ideas to bring to the table during brainstorming.

6.2.5 Design Inspiration

Design inspiration was discussed in depth in Chapters Two and Three. It is a necessary component of the design ideation process that promotes creativity. The more inspirations a designer has the more he is likely to generate ideas in significant quantities. Designers have to gather necessary inspirational materials in preparation for creative idea generation. There are numerous sources of design inspiration in physical and digital forms; however, graphic designers in today’s age prefer to explore design inspirations digitally as it is less expensive, fast to access and of high quality. In view of this, an effort was made in this study to explore the various websites where designers can get quality design inspirations (high-resolution graphic images) for their design work. These websites are made available

in Table 5.3 with details of what they offer; however, some of them are presented in the current model. This stage proposes that designers should engage in an iterative process of collecting visual inspirational materials from design websites and composing them into digital mood boards or simply organizing them in folders for ideation purposes.

Digital technology, according to Hamid and Alshamari (2016), offers the artist the ability to quickly and easily gather pictures, shapes, media, and colours from the computer's memory. Digital technology gives the design artist extraordinary freedom to create digital graphic forms.

The multimodality of digital design resources available on the internet is an added advantage to design ideation. Various websites offer an almost unbelievable quantity of divergent design perspectives for designers to explore ideas for creative purposes. Design students have the opportunity to engage in these digital activities to widen their creative perspectives and prepare them sufficiently for the generation of novel ideas with ease.

6.2.6 Digital Tools

In this model, digital tools refer to the hardware and software used for design works, including laptops, smartphones, tablets, CorelDraw, Adobe Illustrator, and Autodesk Sketchbook. Effective use of these tools will help the designer in design idea creation.

6.2.7 Design Skills

Idea development requires thinking activities influenced by cognitive operations (Chan 2015) The two most important skills needed in digital design ideation as indicated in the model, are creative and digital skills. These skills require thinking and the ability to effectively apply thought and know-how to solve a problem.

1. *Creative skills* are required in design ideation as it is the capacity to create novel concepts by using one's imagination. It is an approach to thinking about an issue in a unique manner. These skills enable the designer to find interesting ways to approach tasks and solve complex design problems. Activities involved in creative skills include writing down ideas, drawing, reflecting on design elements, attempting unusual design paths that broaden the designer’s viewpoint and inspiring new approaches, organizing ideas in different ways, sorting, eliminating, and adding details.
2. *Digital skills*

   Digital technology, according to Hamid and Alshamari (2016), offers the artist the ability to quickly and easily gather pictures, shapes, media, and colours from the computer's memory. Digital technology gives extraordinary freedom to create digital graphic forms.

   It is expected that today’s designers are knowledgeable about the use of digital technology and are able to apply the needed skills to digital devices to solve design problems. The various digital tools used by the design students, the digital skills applied to the tools, and the ideation outcomes are of great interest in the model. Effective use of digital devices in problem-solving is therefore a required skill in digital ideation. Digital skills in this study include the ability to gather necessary information on the internet; the ability to use a computer or portable devices such as tablets and smartphones with graphic design software applications effectively for idea illustration.

Digital Idea development requires thinking activities influenced by cognitive operations and the application of creative and digital skills on digital devices. Cognitively formed ideas should be externalized by creative and digital skills expressions for the best output. The more successfully creative and digital skills are employed in the ideation process, the more novel the ideation outcomes a designer will be able to obtain.

6.2.8 Digital Technology Integration

The use of appropriate digital tools in problem-solving is referred to as digital integration. In graphic design, digital integration involves the use of digital devices and application software with or without the internet in problem-solving. In graphic design ideation, designers have to use vector-base software such as CorelDraw and Adobe Illustrator. As already established in Chapter Three, these softwares help in illustrating new ideas or the manipulation of existing vector images to create the desired ones. Effective use of vector software leads to creative idea development. Positioned at the central part of the model, Digital Technology Integration in design ideation is the core essence of developing this model as a guide to help designers achieve creative purpose.

6.2.9 Ideation Outcomes

Effective input by way of design research and digital design idea exploration (seen in the first half of the model) and digital design idea creation by way of integrating digital tools and design skills for design idea creation will result in novel ideation outputs. This means technology integration in design ideation widens design space exploration leading to good quantity of ideas and an increase in the quality of varied ideas and novelty.

Table 6.1 Simplified digital ideation steps

s/n	construct	description
1	Understanding the design brief	Conduct research to understand the design brief.
2	Cognitive search	Conduct mind mapping and brainstorming for divergent ideas on the design task.
3	Design inspiration	Visit and explore design websites for multimodal design resources for design inspiration.
4	Digital tools application	Use digital devices and application software for creative idea development.
5	Design skills	1. Creative skills: Thinking about how to generate ideas in different ways to solve a problem. 2. Digital skills: Apply digital know-how to digital tools for solving design problems.
6	Digital technology integration	Digital technology integration into design ideas is very vital as it enhances the development of creative output.
7	Creative Solution	Adopting the constructs of this model will help the designer to create varied and quality ideas in great quality leading to novel solutions to design problems.

6.3 Conclusion

All these are necessary activities a designer has to engage in to widen the design space exploration for creative output. Following the constructs of this model will help designers to develop novel and unconventional ideas. The fact remains that effective digital skills application shortens the duration of design projects, makes it easier to provide fresh options, offers increased adaptability when changing options and design procedures, and assists in process control with cutting-edge data extraction and storage (Min and Hao 2008). Digital technology guarantees better quality of design outcomes. What is needed is requisite skills acquisition and constant practice. It is, therefore, necessary for students to acquire the needed digital skills for effective and novel ideation outcomes.

The goal of this model is to project relevant ideation constructs and provide steps that designers can adopt to increase the overall design space exploration leading to creative and novel idea development. The model is also meant to create awareness among graphic designers about the importance of digital technology in enhancing design idea generation. Even though it was designed with the graphic designer in mind, it can be used by other design-related professions such as product designers, fashion designers, interior designers, and architects for effective ideation process.

CHAPTER SEVEN

GENERAL CONCLUSION AND RECOMMENDATIONS

7.0 Overview

This final chapter starts with a brief overview of the topic and outlines the review of the study from chapters one (1) to seven (7). It also gives a reflection on the methodological stance of the study. It further discusses the contribution of the study to the existing body of knowledge. A summary of findings is given based on each of the research questions, a conclusion is drawn based on the summary, and recommendations are given based on the conclusion.

This research explores the effectiveness of digital technology in graphic design ideation and students' perception of digital technology adoption during idea development among Ghanaian university students. It exposes the reader to the usefulness and the integral essence of digital technology in today's design ideation in particular and graphic design in general.

The study aims to investigate how digital technology can be effectively utilised in the graphic design ideation process to enhance design outputs. Design ideation is a crucial step in the design process which starts with a design brief and produces a variety of design possibilities that are expressed in the form of thumbnail sketches and/ or rough sketches (Taegyun 2020). This helps to visualize and concretize concepts so that new solutions may be designed more effectively (Dell'era *et al.* 2020). The aim of ideation is to produce a significant number of concepts that can be reduced to the most creative ones to stimulate effective design solution and product (Rikke and Teo 2020). Design ideation's overarching objective is to produce original or imaginative answers to the design requirement. The total effectiveness of the design process and its results are greatly influenced by the quality of the concept produced during the design ideation stage (Orthel and Day 2016).

The study sought to find answers to five research questions and these are:

i. How do design students in Ghana generate graphic design ideas?
ii. How do digital technologies affect the students' ideation process and design ideation output?
iii. What is the perception of graphic design students regarding the use of digital technologies during the ideation stage of the design process?
iv. How can digital technology be effectively used to improve design ideation process among students?

7.1 Reflection on the Contributions of the Study

This section focuses on the various contributions the research has made. The contributions are in two categories and these are the methodological contribution and the theoretical contribution. The key areas are elaborated in the next sections.

7.1.1 Theoretical contribution

There is little existing literature related to Digital Technology in the Ideation Process. While reducing the gap, this study also adds literature to the existing body of knowledge.

The research makes a specific contribution to filling the gap regarding the lack of a model for digital technology integration into graphic design idea development. The study, therefore, sought to bridge the gap by developing a Digital Technology Ideation Model. The goal of this model is to provide steps that designers can take to ensure that the ideation process is enhanced through the use of digital technology that will help increase the overall design space exploration leading to creative and novel idea development.

It is also to create awareness among graphic designers about the importance of digital technology in design idea generation to advance more academic discussions on digital technology utilization in ideation that will lead to a shift from the wholistic adherence to a traditional approach to a more advanced

and industrially accepted approach of technology integration for outstanding ideation outputs and today's client satisfaction.

The model is interactive and offers a complete guide on steps to take for effective digital ideation with the necessary software and websites provided. Even though it was designed with the graphic designer in mind, it can be used by other design-related professions such as product designers, fashion designers, interior designers, and architects.

Again, the Tripartite Concept of Technology with its three components: 1. thing (it may be theoretical and practical knowledge, or artefacts), 2. process (skills or the demonstration/ application of practical knowledge) and 3. solution or result (products and services) is a major contribution from this study that is going to add to the body of literature. The concept says, 'Technology is not a thing (artefact, tool or device), neither is it a skill (technique or know-how) nor a product (expected end or result). These three components–a thing (artefact, tool or device), skills (technique or know-how) and solution (product, service or expected result)–are altogether very important to give the word 'technology' its holistic definition and it is inappropriate to isolate one out of these three components and term it as technology. Each of these three components plays an important role in the definition. Therefore, in a very simple definition, technology is a practical process of skills application to a tool to solve a problem. Note that the three components (skills, tools, and the solution to the problem) are included in this definition.

7.2 Summary of Major Findings

Five research questions guided the study and sufficient data were collected and analyzed to answer the research questions. The summary of findings and conclusions based on each of the questions are now presented.

7.2.1 Summary of Findings on Research Question 1

This research question focuses on how graphic design ideas are generated by design students. It was observed that the design briefs that students usually work on always come from their lecturers. Upon receiving the brief (see Appendix 15), just like every designer does, the students conduct design research to have a good understanding of the design task. With the information gathered in the research, the design students engage in the cognitive activity of mind mapping to generate ideas by linking sub-topics to a central theme. The process helps students better understand the design brief. Mind maps are considered to be a great way to organize thoughts more productively.

Inspirational materials are gathered from design websites based on the design tasks. It was discovered that the internet was predominantly used when researching briefs and when gathering inspirational materials for idea development. This technology, according to the participants, is very helpful. Generating varieties of design ideas in good quantity constitutes one of the major creative responsibilities of the designer during ideation and digital technologies, according to the respondents, help in achieving that.

In the creative stage, students did pencil sketches of ideas on paper and later transferred these ideas to the computer for digital illustration. The design softwares used were Adobe Illustrator and Adobe Photoshop. It was observed that pencil ideas selected for digital illustration were not based on the creativity of the design but on the simplicity of the design. That is, selected ideas included simple shapes and pre-existing designs that did not require advanced digital skills to illustrate and were subjected to simple editing such as trimming, stretching, and rotating. While some of the pencil-

generated ideas were creative enough to be selected, they were not selected for digital illustration by the design students because they were considered to be too complex or intricate to illustrate in vector software. Thus, students' selection of pencil sketches for digital illustration was mostly influenced by their lack of expertise in handling vector software such as CorelDraw and Adobe Illustrator. Ideas generated by the students were generally not of sufficient quantity and consequently, most of their ideas lacked novelty. This is because they were not exposed to the use of design software in the creative stage of the ideation process and this was confirmed by KN Lecturer 1 in an interview. It was also reported by the participants that clients they had worked with no longer accepted ideas generated in pencil and paper. They are only interested in digitally illustrated ideas. There is therefore a compelling need to use design software in illustrating ideas.

Today's clients' rejection of pencil sketches, with high interest in digitally illustrated ideas as confirmed by the participants in this study, is a clear indication of change in the taste and expectation of consumers. This necessitates that every designer has to know how to illustrate ideas digitally. Students' inability to use vector software is affecting their ideation output. The selection of ideas based on simplicity cannot lead to creativity. Digital technology integration into design ideation is expected to increase idea space exploration resulting in creative and novel outputs. Effective use of it will yield excellent results. As indicated by ECLAC (2021), the adoption of technologies by institutions would increase efficiency and effectiveness.

7.2.2 Summary of Findings on Research Question 2

This research question sought to find the types of digital technology used by students, how the technologies are used and the impact they have on the ideas generated. The study discovered that the major digital technologies used by students include digital devices, the internet, a variety of websites and different software. It was observed that participants generally used devices such as laptops, smartphones, tablets and digital cameras. While the laptop was generally accepted as the main digital device necessary for

design, the smartphone was considered to be the one most important device that supported the laptop for effective design output. It is almost impossible for a graphic designer to work without the smartphone. Participants considered these devices to be so important that they wondered what the design work would be like without their use. While the smartphone was widely used by students for quick access to information, gathering of images for inspiration, and for purposes of research, it was also used as a source of accessing the internet for browsing on their laptops. The majority of participants admitted they used the data on their phones for accessing internet connection on their laptops because the Wi-Fi on campus was not reliable. The smartphone was therefore highly indispensable in the design ideation process. It was evident that students used smartphones as a substitute for the computer. They reported during an interview session that they sometimes used Adobe applications and some other software to do their design works on the smartphone. According to them they used a smartphone when a laptop was not readily available to them. The smartphone was helpful as it saved time and the work output in terms of quality is as good as that produced on the laptop. The impact of digital technology in ideation included gathering quantities of inspirational materials ifor ideation through the use of the internet; manipulation of vector types of images to obtain variations of ideas, and testing colour variations. By using these inspirational materials, the designers were able to generate more ideas from which creative ones were selected.

Lack of personal access to laptops among some students was a great concern and the institutions need to provide interventions to help students in such a situation.

The digital technologies used by students include digital devices, the internet, a variety of websites, and different software. The smartphone and laptop were considered to be the most important tools for the designer. The two devices work perfectly together for effective design ideation. The impact of these technologies, such as gathering quantities of inspirational materials ,

creating varied ideas, adding variations of colour, and bringing out aesthetic qualities in designs, altogether means that they are indispensable to the designers. This is why the lack of digital devices, especially laptops among some students, was a great concern.

7.2.3 Summary of Findings on Research Question 3

Ideation is a crucial and the most interesting part of the design process. Design ideation is a crucial component of design thinking since it serves as the source for the development of novel ideas (Kim 2020). Findings in this study indicate that the use of digital technologies makes ideation easier. Participants admitted that digital devices help in developing quality ideas, testing variations of colours and executing multiple works. It helps to create new ideas from previous ones much quicker by using the copy and paste commands. According to the participants, digital technologies reduce the burden of thinking too much about how to go about design work as assistance is readily available on the internet. Because the internet serves as a digital technology that aids in gathering multitudes of ideas, there is the flow of design ideas leading to the elimination of fixation.

In spite of the divergent views expressed by the participants about the use of digital technology for ideation, the majority of them believed that the integration of pencil and digital technology is the ideal approach for design ideation. They considered technology to be very relevant, especially in increasing idea counts (quantity of ideas generated) that leads to creative ideation outputs. In all, the students have a positive attitude towards the use of digital devices; however, a good number of them did not possess the necessary skills in using vector software needed for design idea creation simply because were not taught how to use them or compelled to use them in design ideation.

The general perception held by the participants is that technologies make ideation faster, help execute multiple tasks, create new ideas from previous ones much quicker by using copy and paste commands and reduce the

burden of overthinking. The view of the majority of the participants that the integration of pencil and digital technologies is the ideal approach for design ideation is simply because each of these technologies is unique and each has something significant to contribute towards effective ideation.

7.2.4 Summary of Findings on Research Question 4

This research question sought to find out how the various design situations emerging from the previous research questions could be addressed by developing a conceptual model for an effective digital ideation process that would help improve graphic design ideation for present-day practices among students and professionals in the graphic design industry.

Based on the findings of the previous research questions and design practices as they were discovered in the review of literature related to this study, a conceptual model for effective digital ideation was developed. The constructs of this model include research on briefs, mind mapping, brainstorming, design inspiration, design cognition, creative skills, digital skills and digital technology integration and ideation outcomes which include variety, quality and novelty. These constructs were well discussed for easy understanding and application.

The goal of this model is to project relevant ideation constructs and provide steps that designers can adopt to increase the overall design space exploration leading to creative and novel idea development. The model is also meant to create awareness among designers about the importance of digital technology in enhancing design idea generation. Even though the model was designed with the graphic designer in mind, it can be used by other design-related professions such as product designers, fashion designers, interior designers, and architects.

7.3 Recommendations

This study was not conducted in order to criticize educators for their approach to delivery, or to find fault with students' approach to learning, or to condemn any university management for what they may not be doing

correctly. It was intended to explore the design ideation process of current technological advancement in order to find possible ways of improving the design process. The following recommendations are given, based on the findings of this study.

1. Designers should be encouraged to conduct research, mind mapping and brainstorming in preparation for idea creation. These activities are effective in helping designers to understand design briefs, and generate sufficient divergent ideas that can lead to creative solutions.

2. It became clear that today's clients do not accept pencil sketches. They are only interested in digitally illustrated ideas as confirmed by the participants in this study. Students should therefore be taught how to use vector software such as CorelDraw and Adobe Illustrator for purposes of design ideation so that they can satisfy their clients with digital illustrations. Students should be engaged in design activities that require the use of this software to improve their digital ideation skills.

3. Smartphones and laptops are considered to be the most important tools for graphic designers and some students do not have both these devices. The graphic departments should introduce an intervention to assist students who do not have laptops to access departmental computers to use for skills practice in the department.

4. For students to develop skills in using design software with ease, it is very important to equip them with basic computer skills, which is the single most important enabler that students need to prepare them for hands-on digital technology (computer) demands during their digital design practices. The graphic departments in the universities should support students by equipping them with basic computer skills from the first semester as a way of preparing them for effective digital skills acquisition in design.

5. As part of their marking scheme, lecturers should assess students' ideation processes and not only the developed and finished ideas. This will encourage students to develop creative ideas.

6. Lecturers should be encouraged to periodically enrol for further education courses to upgrade their knowledge and expertise. They may also go for industrial attachment to help them keep abreast of industry currency and technology.

7. The proposed Digital Design Ideation Model should be adopted by educators for effective digital design idea development for creative output.

8. Further study should be conducted on how the instructional digital environment influences students' ideation processes.

9. A study should be conducted on the impact of artificial intelligence on the ideation process in today's graphic design industry.

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APPENDICES

Appendix 1: Letter of Information to Participants

LETTER OF INFORMATION

Title of the Research Study: Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students

Principal Investigator/s/researcher: (Ametordzi Sylvanus)

Co-Investigator/s/supervisor/s: (Dr. Folasayo Enoch Olalere)

Good day,

I am a second-year student at DUT doing research for PhD in Visual and Performing Arts.

I would like to invite you to participate in the research on **Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students**

Brief Introduction and Purpose of the Study:

Idea development, which is usually referred to as ideation by many design professionals, starts as an abstract idea in the mind with no physical or concrete evidence. In graphic design, the abstract ideas are usually communicated through a series of sketches on paper among which one may be selected for the actual design production.

With the advent of technology and the increasing expectation of today's design consumers in terms of quality, it is prudent to shift from the 'pencil on paper' idea development to the digital approach.

In response to a concern raised by Appiah (2014) on the limited use of technology during graphic design ideation among the Ghanaian tertiary students, the purpose

of this qualitative study is to investigate how digital technology can be effectively utilized in the graphic ideation process to enhance design outputs.

Digital sketching technology has been shown to have significant positive effect on design idea generation (Self *et al*. 2016). A combined framework of Shah's (2003) theory of measuring the effectiveness of the ideation process from four perspectives namely: 1. quantity, 2. quality, 3. variety and 4. novelty together with the concept of positive effect of technology on design idea generation (Self *et al.* 2016) informed the research questions and will support the inquiry, analysis, and interpretation of data.

For purposes of clarification related to the research, you are eligible to ask as many questions as you want. You are also entitled to discuss the study with others if you wish.

Outline of the Procedures:

Summary of the Research.

Design ideation is a core stage in the design process that begins with a design problem and results in generating several design idea developments from which a suitable one can be selected. Often referred to as ideation by many design professionals, design ideation starts as an abstract idea in the mind. In graphic design, the abstract ideas are usually communicated visually through a series of sketches on paper among which one may be selected for the actual design production.

Research Aims

The purpose of this qualitative study is to investigate how digital technology can be effectively utilised in the graphic ideation process to enhance design outputs.

Research Objectives

The objectives of the research are to:

i. investigate how graphic design students in Ghana generate design ideas.
ii. explore the effect of digital technology use on the design ideation process and output.
iii. examine the perception of graphic design students on the use of digital technologies during design idea development.

iv. develop a conceptual model for effective digital ideation process that improves students' design outputs.

Description of the procedures to be followed.

We will schedule a time for one-on-one interviews on an agreed day and a place with the least distraction in the department or on campus.

Because it is a semi-structured interview, I will be asking questions I have already prepared on graphic design idea generation, the use of technology in ideation and the skills you would like to acquire to improve on design idea development. It will be very interactive, and you are allowed to ask for clarification on questions that are not very clear to you. Based on your responses I may also ask supplementary questions for clarification.

I will be taking written notes of your statements alongside our interaction. With your permission, I will make an audio recording of the interview to complement the notes.

The information gathered will be used solely for research purposes and no one, outside the study, will be allowed access to this recording without your written permission. The whole meeting will last for 15 to 30 minutes.

Responsibilities of the participant

After completing and submitting the information consent form, you need to avail yourself in the lecture hall and studios for the study and give truthful information.

Interview details

An interview date and time will be scheduled with you. The interview will take place in the lecture hall, design studio or any convenient place in your department. The interview will last no more than 30 minutes and with your permission, it will be audio recorded. The interview is generally on your idea about the use of electronic devices in graphic design idea development.

With regards to observation, the researcher will avail himself during design studio and lecture halls to observe activities related to design ideation. This will take place for eight consecutive weeks.

Venue details

The venue for the study will be the lecture halls and design studios

Inclusion / exclusion criteria

Data will be collected from design students in (2) selected Ghanaian universities. First year students at the selected universities will be excluded from the study. Only the 2nd, 3rd and 4th year of university students will be considered in this study as they may have been exposed to the use of technology and are more likely to respond adequately to questions related to digital technology in design ideation process.

Measurement outcomes

The study will be used for the purpose of a PhD thesis. The completed research work will be submitted to the Durban University of Technology. The outcome of the research will also be published in journals and presented in conferences.

Follow-ups

The result of the study will help develop a digital ideation guide. The guide will be made available to both students and lecturers for use during ideation. To evaluate the effectiveness of the guide, there will be follow-ups to the departments where data was collected.

How much time is required of participants?

Interview sessions with students and lecturers in the field of graphic design will last between 15 and 30 minutes on average. Participants will be allowed to take a break if they so wish. However, the researcher will carry out observations for eight (8) weeks.

What is expected of participants, randomization/ group allocation?

For the selection of sample, a random digit table will be used. Thus, if there are 80 students in a class, each of them will be numbered from 1 to 80. If I want to interview 30 students out of the 80, I will use the random digit table to select 30 numbers. Students with the numbers that are randomly drawn from the table will be called out to represent the sample for the study.

The selected students (sample) will be scheduled for one-on-one interviews with the researcher on an agreed day, time and place (which is likely to be the department). Because all the samples cannot be interviewed on the same day, the researcher will

schedule to meet the participants in batches and this will cover a number of days dependent on the sample size and the number of students interviewed in a day.

The expected duration of the participant's commitment

Data collection may cover a period of eight (8) weeks. There will be 10 hours of interviews per week. Two (2) hours will be spent on four (4) participants each day (that is 30 minutes with each participant). Six (6) hours observation will be carried out per week.

The approximate number of participants to be involved in the study

The total number of participants for the study is estimated to be 40. This includes graphic design students and lecturers from two Ghanaian universities.

Risks or discomfort to the participant

There is no foreseeable risk or discomfort to participants as far as this research is concerned.

Explain to the participant the reasons he/she may be withdraw from the Study

You may be withdrawn from participating in the research for non-compliance, illness, or refusal to submit a signed information consent form.

You are entitled to withdraw from the study at any time should you wish to do so. You may inform the researcher formally in writing or informally by verbally communicating your intention.

Benefits: (A description of any benefits to the participant or others which may reasonably be expected from the research – both during and after the research. Detail the nature of the benefits, if any.)

Whilst there are no immediate benefits for those in the 4th year as at the time data will be collected those in the 2nd and 3rd year may benefit from the study as they may have access to digital ideation guide that will be developed at the end of the study. The guide will be an intervention measure to help improve ideation process.

Remuneration: (Will the participant receive any monetary or other types of remuneration? What, if any, compensation will be paid to the participant; whether reimbursements are *pro rata* if the participant does not complete the study.)

Because this study is purely for academic purposes and has no foreseeable risk involved, there is no monetary or other form of remuneration attached to it.

Costs of the Study: (Will the participant be expected to cover any costs towards the study, including treatment.)
You will not be required under any circumstance to make any payment during the conduct of this study.

Confidentiality:
Your information will only be used for the purpose of this research. All the information that will be collected during the research will be kept strictly confidential. The researcher will not take your details of name and address. In instances where names have to accompany a statement made by a participant, alphabets, numbers or pseudonyms will be used. Confidentiality and anonymity are fully assured.

Results: (Explain how the researcher plans to disseminate the results of the research. Explain if any significant new findings developed during the course of the research how it will be conveyed to the participant.)
The results of the study will be published in journals, presented at national conferences and meetings in academic institutions. Websites will be made available for easy access online.

Research-related injury
There is no foreseen hazard posed by the study as data will be collected through interviews and observation.

Storage of all electronic and hard copies including tape recordings (How, where, who has access, security measures in place, duration of storage, fate of the data at the end of the study, etc.)
Electronic data will be stored on eternal devices and will be password protected. They will be regularly backed up to avoid and protect against loss. Data collected in hard copies will be securely put under lock. Collected data will be stored for 5 years after the study before they are finally disposed by formatting the devices on which they are (in the case of electronic copies) and by burning in the case of hard copies.

Persons to contact in the Event of Any Problems or Queries: (Supervisor and details) Please contact the researcher (tel no. +233 244971649), my supervisor, Dr Folasayo E Olalere (tel no. 031 373 6686) or the Institutional Research Ethics

Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Appendix 2: Participant Consent Form

CONSENT

Full title of the study: Effectiveness of Digital Technology in the Ideation Process: A Case Study of Ghanaian Graphic Design Students

Name of researcher/s: Sylvanus Ametordzi

Statement of agreement to participate in the research study:

I hereby confirm that I have been informed by the researcher (Sylvanus Ametordzi) about the nature, conduct, benefit and risks of the study - Research ethics clearance number …….

- 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 the research, I agree that the data collected during this study can be processed in a computerized 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) declared 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**

I, …….. hereby confirm that the above participant has been fully informed about the nature, conduct and risks of the 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 3: Data Generation Schedule – Face-to-Face Interview

INTERVIEW SCHEDULES

Title of the Research Study:

Effectiveness of Digital Technology in Ideation Process:
A Case of Ghanaian Graphic Design Students

PRINCIPAL INVESTIGATOR/S/RESEARCHER

Researcher: Ametordzi Sylvanus)

Student Number: 22175203

Email: lebamet@yahoo.com

Mobile: 00233 244971649

CO-INVESTIGATOR/S/SUPERVISOR/S
Supervisor: Dr. Folasayo Enoch Olalere
Co-Supervisor: Dr Harry Barton Essel

QUESTIONS TO BE ASKED DURING THE INTERVIEW SESSION WITH STUDENTS

Note: Electronic devices used for graphic design include scanner, stylus, camera, laptop and printer.

Research Question 2. (How do digital technologies affect design output?)

1. Which digital devices do you use for graphic design work?
2. Which software are students trained to use for designing?
3. How does the use of digital devices affect the quality, quantity, variety and novelty of ideas development?
4. How do digital devices help in gathering visual materials (inspiration) for ideation?
5. Why would you prefer to use digital devices instead of pencil and paper for idea development?

6. How does internet help you in design inspiration?

Research Question 3 (What is the perception of graphic design students regarding the use of digital technologies during the ideation stage of the design process?)

7. Do you think the use of digital technologies have made ideation easier? How?
8. Which will you prefer: to use pencil sketches or to use of electronic devices during idea generation? Why?
9. Which form of ideation do you think you potential customers will prefer? Pencil sketch or digitally generated ideation.
10. What do you think about the use of the internet during idea development?

Research Question 4 (How can digital technology be effectively used to improve design ideation process among students?)

11. In your view, how can ideation be improved through the use of technology?
12. What are some useful websites from which great design ideas can be generated?
13. Which graphic design softwares do you think are ideal for idea development? Why?

QUESTIONS ASKED DURING INTERVIEW SESSION WITH LECTURERS

1. How do you see the graphic design teaching environment?
2. What do you think should be done to improve the situation(s)?
3. Why are students not allowed to use the computer lab?
4. Are you comfortable with the student numbers?
5. What do you say about classroom size and student numbers?
6. What strategies do you adopt to reduce workload?
7. Do you support the use of the computer for idea development?
8. Are students encouraged to use pencils for idea development?
9. Do you check other students' pencil sketches or digital idea development?
10. Do you look at other students' mind mapping details?
11. Are students given assignments that demand the use of vector software like CorelDraw and Adobe Illustrator?
12. Do you have any other thing to say?

Outline of the Procedures

We will schedule a time for one-on-one interviews on an agreed day and a place with the least distraction in the department or on campus.

Because it is a semi-structured interview, I will be asking questions I have already prepared on graphic design idea generation, the use of technology in ideation and the skills you would like to acquire to improve on design idea development. It will be very interactive, and you are allowed to ask for clarifications on questions that are very clear to you. Based on your responses I may also ask supplementary questions for clarification.

I will be taking written notes of your statements alongside our interaction. With your permission, I will take audio recording of the interview as a complement to notes.

The information gathered will be used solely for research purposes and no one, outside the study, will be allowed access to this recording without your written permission. The whole meeting will last for 15 to 30 minutes.

Persons to contact in the Event of Any Problems or Queries:(Supervisor and details) Please contact the researcher (tel no. +233 244971649.),-my supervisor (tel no. +27 031 373 6686) or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Appendix 4: Data Generation Schedule - Observation Guide

OBSERVATION GUIDE

Title of the Research Study:
Effectiveness of Digital Technology in Ideation Process:
A Case of Ghanaian Graphic Design Students

PRINCIPAL INVESTIGATOR/S/RESEARCHER
Researcher: Ametordzi Sylvanus
Student Number: 22175203
Email: lebamet@yahoo.com
Mobile: 00233 244971649

CO-INVESTIGATOR/S/SUPERVISOR/S
Supervisor: Dr. Folasayo Enoch Olalere
Co-Supervisor: Dr Harry Barton Essel

Semi-Structured Observation Guide

Research Question 1 (How are graphic design ideas generated by design students in Ghana?)

Data was collected through observation. The researcher observed to find out if the students:

1. use at least one electronic device when developing design ideas.
2. are proficient in the use at least one drawing software.
3. have access to a personal computer
4. (some of them) depends on their friend's computer to work.
5. have internet access for browsing any time they want
6. use only electronic devices for idea development or in combination with pencil sketches.
7. use multiple electronic devices when developing an idea

8. how effectively students utilize digital devices in searching for multimodal sources of inspiration for creative ideas.
9. are put into groups to work on a project in the classroom
10. like working in groups and if they identified some benefits.

Appendix 5: Request for Permission to Conduct Research -TTU Registrar's Office

Cape Coast Technical University,
School of Applied Arts,
Department of Fashion Design and Textiles Studies,
P. O. Box LD 50,
Cape Coast. Ghana.

15th April, 2022.

The Registrar,
Takoradi Technical University,
P. O. Box 256,
Takoradi. Ghana.

Dear Sir,

Request for Permission to Conduct Research

My name is Ametordzi Sylvanus, a PhD. student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis is on 'Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students'.

I am hereby seeking your consent to be allowed access to the Department of Graphic Design and Technology of your institution to carry out interviews and observations with selected students and lecturers.

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 0244971649 and lebamet@yahoo.com. Thank you for your time and consideration in this matter.

Yours sincerely,

[Ametordzi Sylvanus]

Durban University of Technology.

Appendix 6: Request for Permission to Conduct Research - TTU Graphic Design Department

Cape Coast Technical University,
School of Applied Arts,
Department of Fashion Design and Textiles Studies,
P. O. Box LD 50,
Cape Coast. Ghana.

15th April, 2022.

The Head of Department,
Department of Graphic Design and Technology,
Takoradi Technical University,
P. O. Box 256,
Takoradi. Ghana.

Dear Sir,

Request for Permission to Conduct Research

My name is Ametordzi Sylvanus, a PhD. student at the Durban University of Technology, South Africa. The research I wish to conduct for my Doctoral thesis is on 'Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students'.

I am hereby seeking your consent to be allowed access to your department to carry out interviews and observations with selected students and lecturers.

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 0244971649 and lebamet@yahoo.com. Thank you for your time and consideration in this matter.

Yours sincerely,

[Ametordzi Sylvanus]
Durban University of Technology.

Appendix 7: Request for Permission to Conduct Research - KNUST Registrar's Office

Cape Coast Technical University,
School of Applied Arts,
Department of Fashion Design and Textiles Studies,
P. O. Box LD 50,
Cape Coast. Ghana.

15th April, 2022.

The Registrar,
Private Mail Bag
University Post Office
KNUST
Kumasi, Ghana

Dear Sir,

Request for Permission to Conduct Research

My name is Ametordzi Sylvanus, a PhD. student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis is on 'Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students'.

I am hereby seeking your consent to be allowed access to the Department of Communication Design of your institution to carry out interviews and observations with selected students and lectures.

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 on 0244971649 and lebamet@yahoo.com. Thank you for your time and consideration in this matter.

Yours sincerely,

[Ametordzi Sylvanus]
Durban University of Technology.

Appendix 8: Request for Permission to Conduct Research - KNUST Graphic Design Department

Cape Coast Technical University,
School of Applied Arts,
Department of Fashion Design and Textiles Studies,
P. O. Box LD 50,
Cape Coast. Ghana.

15th April, 2022.

The Head of Department,
Department of Communication Design
Private Mail Bag
University Post Office
KNUST
Kumasi, Ghana

Dear Sir,

Request for Permission to Conduct Research

My name is Ametordzi Sylvanus, a PhD. student at the Durban University of Technology. The research I wish to conduct for my Doctoral thesis is on 'Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students'.

I am hereby seeking your consent to be allowed access to your department to carry out interviews and observations with selected students and lecturers.

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 on 0244971649 and lebamet@yahoo.com. Thank you for your time and consideration in this matter.

Yours sincerely,

[Ametordzi Sylvanus]
Durban University of Technology.

Appendix- 9: The Ethical Clearance to Conduct Research

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: [redacted]
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

10 November 2022

Mr S Ametordzi
Cape Coast Technical University
P.O. Box DL 50
Central Region
Ghana

Dear Mr Ametordzi

EFFECTIVENESS OF DIGITAL TECHNOLOGY IN IDEATION PROCESS: A CASE OF GHANAIAN GRAPHIC DESIGN STUDENTS
Ethical Clearance Number: 117/22

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

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.

Yours Sincerely

[redacted]

Prof J K Adam
Chairperson: DUT-IREC

Appendix 10: Permission Letter from a Head of Department

Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Art and Built Environment
FACULTY OF ART

DEPARTMENT OF COMMUNICATION DESIGN

CABE/CD/DF/Vol.4

2nd August, 2022

Mr. Sylvanus Ametordzi
Department of Visual Communication Design
Graphic Design Programme
Faculty of Arts and Design
Durban University of Technology
City Campus, Anton Lembede Road
Durban, 4001
P.O. Box 1334, Durban 4000,
South Africa

Dear Sir

PERMISSION TO CONDUCT RESEARCH AT THE DEPARTMENT OF COMMUNICATION DESIGN

Mr. Sylvanus Ametordzi, a PhD student from Durban University of Technology, has permission to conduct research interviews and observations on selected students and lecturers at the Department of Communication Design, Faculty of Art, College of Art and Built Environment, KNUST.

This is for his Doctoral Thesis on "Effectiveness of Digital Technology in Ideation Process: A Case of Ghanaian Graphic Design Students".

Kindly consult my office if you need further assistance in this area.

I wish you the best in your research.

Yours faithfully,

REV. MARTIN ADI-DAKO
HEAD OF DEPARTMENT

HEAD OF DEPARTMENT
DEPARTMENT OF COMMUNICATION DESIGN
FACULTY OF ART
COLLEGE OF ART & BUILT ENVIRONMENT
KNUST, KUMASI

PMB UPO, KNUST, Kumasi Tel: +233 506 831 116 Email:commdesign@knust.edu.gh Website:decode.knust.edu.gh

Appendix 11: Permission Letter from a Head of Department

TAKORADI TECHNICAL UNIVERSITY

DEPARTMENT OF GRAPHIC DESIGN TECHNOLOGY
P. O. BOX 256, TAKORADI - GHANA
Website: www.ttu.edu.gh **Email:** graphics@ttu.edu.gh

Mr. Sylvanus Ametordzi
Department of Visual Communication Design
Graphic Design Programme
Faculty of Arts and Design
Durban University of Technology
City Campus Anton Lembede Road
Durban, 4001
P. o. box 1334, Durban 4000
South Africa

Dear Sir,

PERMISSION GRANTED TO MR. SYLVANUS AMETORDZI TO CONDUCT A RESEARCH AT THE DEPARTMENT OF GRAPHIC DESIGN TECHNOLOGY

Mr. Sylvanus Ametordzi, a PhD candidate at the Durban University of Technology, South Africa has been granted the permission to conduct a research through both interviews and observations on selected students and lecturers at the Department of Graphic Design Technology, Faculty of applied Arts and Technology, Takoradi Technical University.

The permission has been granted based on his Doctoral Thesis entitled "Effectiveness Digital Technology in Ideation Process: A case of Ghanaian Design Students".

Kindly consult the office as and when the need arises for further assistance in the area of the research.

I wish you the best in your academic pursuit at the highest level.

Yours faithful,

Kwadwo Essuman Amissah (PhD)

Head of Department

H.O.D., Graphic Design Tech.
Takoradi Technical University
Takoradi

ADWEN, AKOMA NA NSA MA MPUNTU

Appendix 12: Permission Letter from the Office of the Registrar – KNUST

Kwame Nkrumah
University of Science
and Technology, Kumasi

OFFICE OF THE REGISTRAR

RO/CEN/ADM

August 26, 2022

Mr. Sylvanus Ametordzi
Department of Visual Communication Design
Graphic Design Programme
Faculty of Arts and Design
Durban University of Technology
City Campus, Anton Lembede Road
Durban, 4001
P.O.Box 1334, Durban 4000
South Africa

Dear Mr. Ametordzi,

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I write on behalf of the Registrar to inform you that approval has been granted to enable you collect data for your research on the topic, ***"Effectiveness of Digital Technology in Ideation Process: A case of Ghanaian Graphic Design Students"*** in the KNUST.

We note that the research intends to engage the Department of Communication Design to get a deeper understanding about the efficacy of their Digital Technology systems and its relevance. It is our hope that you will make available to the University your findings for our records.

By copies of this letter, all Staff and students of the Department of Communication Design are being informed of the research and respectfully requested to accord you all the courtesies in this regard.

Sincerely Yours,

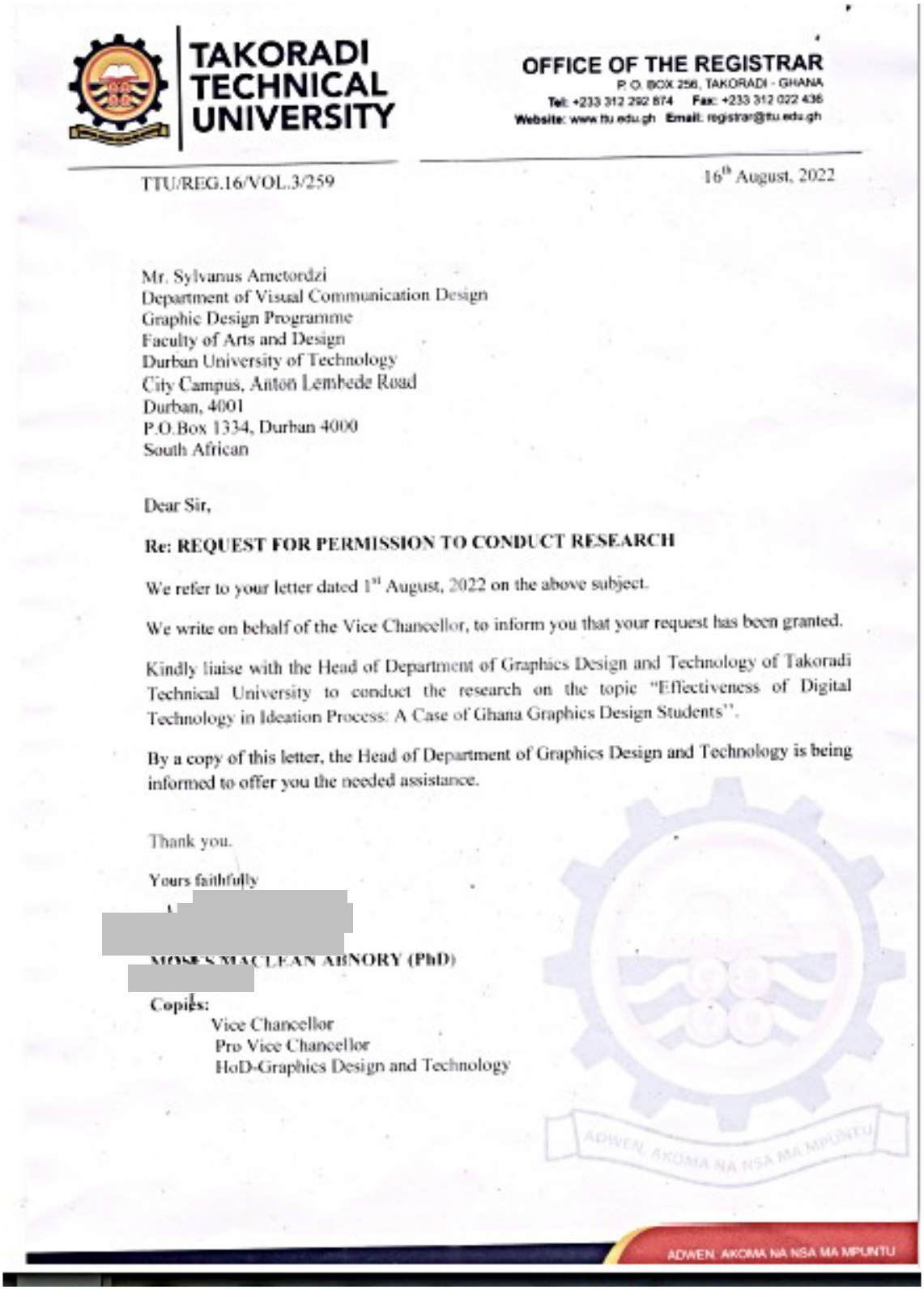
[redacted]

Elvis Twum-Barimah (Rev)
JUNIOR ASSISTANT REGISTRAR (RO)
for: REGISTRAR

cc: Vice- Chancellor
Pro Vice-Chancellor
Dean, Faculty of Arts and Built Environment
Head, Department of Communication Design
Deputy Registrar (HRD)
Deputy Registrar (Academic Affairs)

PMB UPO, KNUST, Kumasi, Ghana. Tel: +233-3220-60331 Email: registrar@knust.edu.gh Website: www.knust.edu.gh

Appendix 13: Permission Letter from the Office of the Registrar - TTU



TAKORADI TECHNICAL UNIVERSITY

OFFICE OF THE REGISTRAR
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16th August, 2022

Mr. Sylvanus Ametordzi
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P.O.Box 1334, Durban 4000
South African

Dear Sir,

Re: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

We refer to your letter dated 1st August, 2022 on the above subject.

We write on behalf of the Vice Chancellor, to inform you that your request has been granted.

Kindly liaise with the Head of Department of Graphics Design and Technology of Takoradi Technical University to conduct the research on the topic "Effectiveness of Digital Technology in Ideation Process: A Case of Ghana Graphics Design Students".

By a copy of this letter, the Head of Department of Graphics Design and Technology is being informed to offer you the needed assistance.

Thank you.

Yours faithfully

[redacted]

MOSES MACLEAN ABNORY (PhD)

[redacted]

Copies:
Vice Chancellor
Pro Vice Chancellor
HoD-Graphics Design and Technology

ADWEN AKOMA NA NSA MA MPUNTU

Appendix 14: Certificate of Editing

UNIVERSITY OF CAPE COAST
DEPARTMENT OF ENGLISH LANGUAGE
CAPE COAST, GHANA.

12th August, 2023.

To whom it may concern,

CERTIFICATE OF EDITING

I, John York-Williams, confirm and certify that I have read and edited the entire thesis, EFFECTIVENESS OF DIGITAL TECHNOLOGY IN IDEATION PROCESS: A CASE OF GHANAIAN GRAPHIC DESIGN STUDENTS, submitted by Sylvanus Ametordzi in fulfilment of the requirements for the degree of Doctor of Philosophy in Visual and Performing Arts Faculty of Arts and Design at the Durban University of Technology – South Africa.

I am a demonstrator at the Department of English, currently reading an MPHIL (Literature-in-English) and qualify to edit such a thesis for cohesion and coherence.

However, it must be noted that the views expressed herein, remain those of the researcher.

Yours sincerely

J.Y.

John York-Williams.

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Appendix 15: Design Briefs

1. Design a logo for your dream company using mind mapping as an ideation process.

2. Develop ideas to be used for a brand identity for a videography company.

3. Build a brand for a company that provides cloud storage for individuals and companies. Give the company a suitable name that reflects the brand identity of the company. Design some items with the brand logo.

   Steps to consider:

   a. Research your target audience and your competitors.
   b. Pick your focus and personality.
   c. Choose your business name.
   d. Choose the look of your brand (colors and font).
   e. Design your brand logo.

4. As a group of innovative graphic designers who have come together to use your diverse talents for creative solutions for design customers in the regions, formulate a name and design a suitable logo for the group.

Appendix 16: Subscript of Interviews Conducted by the Researcher

Research Topic:

EFFECTIVENESS OF DIGITAL TECHNOLOGY IN IDEATION:

A CASE OF GHANAIAN GRAPHIC DESIGN STUDENTS

Codes

Participants named with a letter and a number, for instance 1a, 2b or 3a are Takoradi Technical university students.

Participants named with KN preceding a letter and a number, for instance, Participant KN 2c and Participant KN 4b are students from Kwame Nkrumah University of Science and Technology.

Participants named with 'KN Lecturer' preceding a number are Lecturers from Kwame Nkrumah University of Science and Technology.

Participants named with 'TT Lecturer' preceding a number are Lecturers from Takoradi Technical university.

Participant 1a

Interviewer: How do you see the design environment?

Participant 1a: With the resources available on campus, I think it is not much because the labs are not open. You can't access it whenever you want. Unless you have a class with a particular lecturer to visit that place. You will like to visit the studio but because don't have anyone to supervise you there you not be able to use the place.

'With ideation the environment is conducive enough because we have internet access so that you can develop ideas. You can consult some people's. you can get inspiration from people's work. The internet is that strong but most of the time I depend on the school internet.'

Interviewer: Do you have design studio?

Participant 1a: ‘The graphic design studio is basically the lab (computer lab) but we don’t get access to it unless we a class’.

Interviewer: Where do you usually do your design work?

Participant 1a: ‘I usually do it in the hostel’.

Interviewer: Are there times in the classroom you have the opportunity of working for the lecturer to supervise?

Participant 1a: ‘Yes please, when a lecturer is taking us through a way of executing a particular problem go round to see if we are picking it up or we are understanding whatever he is doing.

Interviewer: What change do you think is necessary to improve the design environment on campus?

Participant 1a: What I wish the institution can develop is they can give a wider class or they should rebuild a new modern studio for us so that if the place is wide enough they might get a security as we can be visiting there as we have been visiting our various libraries. So that it might not necessarily mean that you have to come with a lecturer before you can enter the place.

Interviewer: So, you have your own laptop, right?

Participant 1a: Yes

Interviewer: Which digital devices do you use?

Participant 1a: Laptop, phone and tablet.

Interviewer: Which software do you use?

Participant 1a: Now I am acquainted with CorelDraw, indesign photoshop and illustrator.

Participant 2a

Participant 2a: How do you see the classroom conditions? Is it favourable for designing?

The classroom is too small and we don't have internet for us to go online to look at samples of what you are doing.

Interviewer: Which teaching facilities do you think you need to improve the situation?

We have to get a big hall with internet facilities. We need Wacom tab. It is good for designing. Like you doing the sketching and it will appear on the screen, maybe like logo designing or cartooning you can use the Wacom tab.

Interviewer: Where do you usually do your design when you given work to do?

Participant 2a: In the hostel.

Interviewer: How will the lecturer know that you have done the work? Or sometimes you ask friends to help you.

Participant 2a: Yes.

Interviewer: In that case how will you learn the skills?

Participant 2a: Maybe if he comes to class like this. Maybe like he will teach us how to use this tool and how to use this tool and he will give work for us to go and try it at home.

Interviewer: What changes do you think is necessary in order to improve design work?

Participant 2a: Not all of us have personal computers so if they can give us time to work inside the lab.

And here too the school Wi-Fi is very slow and here if you are using your personal phone to go online the network too is very slow on campus.

Interviewer: Aare you allowed to work in your preferred design environment?

Participant 2a: Yea yea.

Interviewer: Which electronic devices do you use when you are given design work to do?

Participant 2a: Phone and laptop. We use webcom in the lab

Interviewer: Which software do you use?

Participant 2a: Coreldraw, photshop, indesign and illustrator

Interviewer: How does electronic device affect the quality of your work?

Participant 2a: It depends on the machine you are using. Maybe some machines don't have quality graphics so you will find it difficult when working with them. Electronic devices help to get quality.

Interviewer: Do you use your pencil sometimes for ideation?

Participant 2a: That is if you don't know how to use the paint application to do your rough sketches or coreldraw you can use the pencil and jotter. I prefer using the wabcom tab but now I am not having it.

Interviewer: Do you use internet for idea development?

Participant 2a: Yes, if I am doing a logo for myself like OS that is to combine O and S for a design I will go online and go and search how to combine O and S to form a design.

Interviewer: When did you start using digital devices for ideation?

Participant 2a: I started using it in 2019 before I came to the university

Interviewer: Do you think digital technologies have made ideation easy?

Participant 2a: Yes, because like if you are given a work to design a flyer and you don't know how to put maybe the text a tone side and the pictures at

one side, it can help you to develop something but you don't have to copy or do the same thing. You have to change one or two things.

Interviewer: Which form of ideation will your customer prefer - a pencil drawing or a computer design?

Participant 2a: Computer design. They want to see maybe the colour.

Interviewer: Are you sometimes put in groups?

Participant 2a: Yea. A group of five or seven. If you are in a group, some people will have to go out for information and pictures and maybe two people can sit down and design. We go out to collect information before we design. It is like you doing a newspaper you have to go out for the information.

Interviewer: How can technology help to improve ideation?

Participant 2a: Apart from the computer, which other digital devices do you use?

My phone. Yes, we have some apps for designing on the phone.

Participant 2b

Interviewer: Are the conditions in the classroom favourable for designing?

Participant 2b: Actually, we have a computer lab but as like if you go to the classroom the condition is not that ok because some of the plugs are spoilt. So normally we come with multi-socket so that we connect each other because the plugs are not enough. But for the computer lab, that one everything is intact.

Interviewer: Are you allowed access to the computer lab any time you want?

Participant 2b: No unless we have a designing period with the lecturer.

Interviewer: Which teaching facilities do you think you need to improve design work?

Participant 2b: Maybe having advanced laptops for our work. Not any laptop. Some laptops are slow. And maybe for animation and those things, wabcom tablet.

Interviewer: Do you have one (wabcom tablet)?

Participant 2b: No.

Interviewer: Do you have a laptop?

Participant 2b: I don't have a laptop

Interviewer: How do you do your design? You are in the third year. So how do you do your assignment?

Participant 2b: I have friends who have laptops so I take their laptops to do my design. The laptop is not for you when you get you do the design fast and give the laptop back to the owner.

Personal Comment

The student faces this situation and the computer lab too is not accessible for use. The situation would have been better if the computer lab were accessible,

Interviewer: Where do you prefer working?

Participant 2b: Most of the time like I actually want to work in the school so that maybe if there is something wrong my lecturers will correct it but sometimes when they give assignment, that one you have to take it home. For I prefer doing it in the classroom whiles I am doing it, they will be going round and checking.

Personal Comment

The gentleman needs supervision simply because he does not have his own laptop to practise and so he needs assistance to cope with the pace during contact hours. He lacks basic digital skills.

Interviewer: What are the changes do you think can bring improvement in graphic design in the department?

Participant 2b: First of all is the supply of computers. The computers in the lab are not enough. We come in batches. We have A, B and C. I am in A and all the A batch cannot find space in the lab at the same time. Like we will all enter but not all of us will get machine to work with. So, some of us have to sit down and watch our colleagues.

Interviewer: Are you allowed to work in group?

Participant 2b: Yes, we are encouraged to work in groups so that we can learn from our colleagues.

Interviewer: Which digital device, apart from the laptop, do you use for design?

Participant 2b: The phone. Actually, we have adobe software on it that can be used for design.

Interviewer: Which software were you trained to use?

Participant 2b: We are to use photoshop, illustrator, coreldraw and indesign.

Interviewer: How do digital devices help you in gathering visual materials?

Participant 2b: Sometimes like when I walk around, maybe when I am in the beach and I see something that I get inspired with, I take photograph of it. Maybe I go round and I see an artwork, I snap it. As for the phone, it actually helps.

With the phone, we go on the internet, when you are given a topic and maybe you want a wide idea. You go to internet and search, you will get

various and different types of ideas then you actually take one you will work on.

Interviewer: Do electronic devices help you to develop quality ideas?

Participant 2b: Yes

Interviewer: Do you use pencil for you design work?

Participant 2b: Our lecturers actually ask us to acquire sketch pads to do our ideation inside. We do our preliminary sketches inside it. Later on we transfer it onto the phone. We actually do everythinh with sketch pads. If it is approved,then we go to the software and design. At the end of the day we use both the pencil and the digital.

Interviewer: When did you start using digital devices?

Participant 2b: I used to use it before I came to the university. We used to use in SHS. I did Visual Art and we actually had a computer lab.

Interviewer: Do you think electronic devices make ideation easier?

Participant 2b: Yes, Because after you finish designing it will be easy for you to send it to your phone and share it.

Interviewer: Do your friends like working with you in a group?

Participant 2b: Yes

Participant 2c: Why?

Participant 2b: Because I contribute a lot.

Interviewer: Do you have some websites where you get design inspiration?

Participant 2b: Most of the time, I go to pinterest Maybe people have already done many types of which we are about to do. We go there and we get inspired. We select and develop to make it unique.

Interviewer: Which graphic design software do you think are good for idea development?

Participant 2b: CorelDraw and Illustrator

Participant 2c

Interviewer: How are the conditions in the classroom?

Participant 2c: Mostly, the lecture halls are for lecturing. We are mot mostly allowed to bring our laptops to design. If we have a design class we mostly go to the studio.

Interviewer: Do you always have access to that place?

Participant 2c: We only go there for lectures. In level 200 when we were having a class because the lab is not big enough to accommodate we all the student, some of them use the classrooms. So people went to the studio and others were in the classroom.

Interviewer: Do you have your personal laptop or you work with someone?

Yes

Interviewer: Where do you usually do your design?

Participant 2c: Mostly if I have been given a task at lecture hall I just wait and mostly I like designing at mid night. When you wake up fresh your mind is also fresh. It helps you to aquire more inspirations. Starting fresh also helps you. Just imagin you are from class very tired and you down sit you want to design something, the ideas wont drop because your mind is stressed out.so, mostly that's what I like doing.

Interviewer: So do you think designing involves thinking?

Participant 2c: Of course. It involves thinking a lot. And one thing about me is sometimes when I walk around, I observe. Sometimes you might see a

nice design out there and I just take a photograph, come back and try to improve on what I saw.

Interviewer: What changes do you think are necessary to improve design work?

Participant 2c: Ok firstly, I will talk about the environment. For designers, you need a peace of mind for you to thimk. Just imaging you are designing and the thinking process there are noise around. Ii doesnt really help. So if we get sound proof in the designing studio so that there wouldnt be outside noise entering the studio so that when you desining you have a peace of mind. And with the classroom too, we are really suffering with projection. We remove it and come and fix it. So plaguing, unplaguing, plaguing, unplaguing, it causes damage and so if we get a fixed one that's every lecture hall so that when the lecturer wants to project some thing it will be very easy.

Interviewer: Which digital devices do you use?

Participant 2c: Well for me I use laptop and I have a friend who uses phone to design and his works are really good.

Interviewer: Do you use tablet sometimes?

Participant 2c: With tablet I will say when you are dealing with adobe illustrator, yes, it is a software for logos so without the mouse pad we use the drawing tablet with the drawing pen then you connect it to your device and it also helps.

The adobe package that is what they recommend for us to learn because that is what most businesses use.

Interviewer: How does electronic device influence the quality of your design?

Participant 2c: When you are given a design work you have to brainstorm, walk around the environment, pick inspiration and with the help of the digital gadget, you can just get to your phone and research what you want and pick

an inspiration from the works that are already down there. So they really help.

Interviewer: Do you have knowledge how to use computer before you came to the university?

Participant 2c: Yes, I worked with a designer for one year before I came to school.

Interviewer: Do you think digital technologies make ideation easier?

Participant 2c: Yes, with the help of the digital devices, when you use that one and you want to improve on it, you just take it and you continue.

There are some works you need to brainstorm with book and pencil just to jot down the points before you transfer them. That is normally with logos because logos, it usually require thinking. You have to sit down and think deeply to get not less than three thumbnail sketches before you further it with the computer.

Personal Note

There is clear evidence that students use multiple software during designing

Participant 2c: With the logo and idea development, you with those adobe products, they are really good. But the blender I was talking about, after designing the logo with adobe product, you can transfer them to blender and give it a 3D feel. It makes it more visible. You can feel it, it gives quality and makes it pronounced that make people desires it.

Interviewer: So, it means in one assignment you can use more than one software?

Participant 2c: Yes, yes. Sometimes three.

Participant 3a

Interviewer: What the changes you will suggest for improved design work?

Participant 3a: Personally, I think the projectors are not helping. The reason being that the projectors don't give us the good resolutions we need. With me I think in the near future we should be using wide screens. All our machines on campus here are ok. They are very good.

Interviewer: Where do you do your design?

Participant 3a: I do it off campus

Interviewer: What about the plugs for connecting your devices. Are they ok?

Participant 3a: The plugs are there but they have a few problems. Sometimes we work on them. That one I think it is a challenge.

Interviewer: Which digital devices do you use for your work?

Participant 3a: My phone and laptop.

Interviewer: How does the digital devices affect your design?

Participant 3a: With the phone, we visit other designers, go through their works and take inspiration from there.

Interviewer: How does electronic device affect the variety of your design?

Participant 3a: With pinterest and Instagram, there are a lot of people with different styles of design. I prefer to go through people who have vector type of designs. It inspires me.

Interviewer: Why would you like to use digital only or pencil for you design.

Participant 3a: Well, I am not a fun of using pencil to design. That is why I go to pinterest and Instagram. I go through them, start my own and some changes. Unless it is a logo. I use pencil. For logos, I use pencil.

Interviewer: Do you think digital devices make ideation easier?

Participant 3a: Yes, they do. It is not every time you have to be thinking about everything. Sometimes you have to visit the internet to get ideas. Without internet, design will not be difficult though but it helps add something to the design.

Interviewer: Which form of ideation do you think your potential customers will prefer? A finished work in pencil idea or a printed digital work?

Participant 3a: Ok, actually with customers I have met so far, there hasn't been anyone who has asked for pencil work. Actually, they all asked for at least three of my final works then they select one from it. But with the logo, as I was saying, I start with pencil and I create three to five logos then capture it to the client to choose one from it then I start designing it.

Interviewer: Are you put in group? Does it help?

Participant 3a: Yes we are put in group. Sometimes it helps and sometimes it doesn't help. Some of our mate are actually not serious. It helps because we learn from each other. It really helps. We learn more from our friends.

Wacom can be used for sketches. At least they should help us, if possible, at the university level they can provide us with Wacom in the lab.

Interviewer: Which digital devices do you use

Participant 3a: Computer and phone

Interviewer: What is the best way to encourage a designer to use digital device in design ideation?

Participant 3a: I am not really into the pencil side. The reason being that I feel lazy to take pencil. But a friend advised me that it helps. He advised me to get a small sketchpad, get a pencil and at my leisure time, just do sketches. I can get ideas from it. I think using the pencil is also good but digitally, sometimes after the drawing, you might leave it somewhere but digitally, you can record whatever you do. I think both of them, they are all important one way or the other.

Personal Note

Sites that students visit for design inspiration include:

Freepik, Instagram, Unsplash.com, Ebay.com, Pixar, Flaticon, Pinterest, Pixabay, Undraw, Behance.com, Videezy, Pixles.com for downloading high resolution images.

Participant 3b

Interviewer: How do you see the design environment?

Participant 3b: We don't normally do the design in the classroom. When we get to our hostels, we do it and submit but sometimes you come to the classroom and work. No one will restrict you that don't work here.

Interviewer: What about teaching facilities.?

Participant 3b: Frankly speaking our chairs are not enough. Sometimes you come to a class and you to go and get a chair for yourself. When it comes to projection, it is not always that the lecturer projects and sometimes when it is needful for the lecturer to project the he can do that.

I will be happy if the lecturers could project all the time

Interviewer: Do you like group work?

Participant 3b: Yes, in the sense that everyone has his abilities, strength and weaknesses. There will be particular areas I can be having challenges and there

Interviewer: Which digital devices do you use?

Participant 3b: For me, it is only the laptop.

Interviewer: What about software?

Participant 3b: inDesign for bookwork, Adobe Illustrator, CorelDraw

Interviewer: How do digital devices help you to gather materials for inspiration?

Participant 3b: Gone were the days when there was nothing like internet access or laptops or whatever. They were using pencil and pens for ideation. But there has been a modernization so the machines (electronic devices) help do the work faster than you can think of.

Interviewer: How do electronic devices help you to achieve variety of ideas?

Participant 3b: I have to generate more designs from other designers or look for more inspiration from other designers. So due to that, I will search on the net to get more information or ideas from other people's work. So through that I can gather more ideas to add to mine to help me develop mine.

Interviewer: Do you think the use of digital technologies make ideation easier?

Participant 3b: I wouldn't say yes and I wouldn't say no, because they both work hand in hand. Because you drawing it is also one of the ways you can generate ideas and you using the internet Is another.

Interviewer: Do you sometimes use pencil?

Participant 3b: Yes, I use pencil especially when it is logo. You have to make your thumbnail sketches, develop it and generate it with the machine.

Interviewer: How will you encourage designers to adopt digital technology?

Participant 3b: I wouldn't condemn them to stop the pencil or the pen work but they should try and improve on it. The pencil is not the only means to generate ideas. The use of the machines (digital devices) can also help bring out more.

Interviewer: How is the class environment?

Participant 3c: I feel as creatives, we find inspiration from many sources and there are times that you want to work on a piece or something and you take a walk around and look at just nature and it inspires you a lot. There are times you only have to visit the internet and then by seeing one person's work or another's, you are inspired. There are times that you have a mentor

or so. When you hit a creative block and it's like you can't do anything, you visit their site and you find a lot of inspirations to be able to carry out what you want to do. But if you look at our lecture halls are such that they expose us to some of those things, it will go a long way … if our lecture halls are such that we can see even from inside what is happening outside, it will do us a lot of good

Personal Note:

It was observed that there were no pictures or images anywhere in the instructional space to serve as a source of inspiration.

While one interviewee prefers that the lecture hall should be sound proof with no disturbance from outside, another interviewee said she likes working where there is loud music and the classroom does not offer her that kind of environment.

Participant 3c

Interviewer: Which teaching facilities do you think are needed to improve design?

Participant 3c: With the teaching facilities, we definitely have to talk about the projector and PA system. Of course, you will come across lecturer A whose voice is ok and there comes in another lecturer … you get it. Not only for their good but for our good as well. Of course, me personally, I always try to sit in front ok because of some of these challenges. I mean if it were such that we could hear them from wherever you sit, I wouldn't have been discussing this. The PA system will do us a lot of good. And then projectors. There are projectors but they are few but the quality of the few we have is even another conversation to have, if today for another day ok? We are creatives and always exposed, almost always exposed to the computer which means that chances that we have eye problems are very high and so if

our projectors, you know, are of poor resolution such that they project anything and we cannot see it, I think there is an issue to look at.

And then again, we barely have electric plugs in our halls. I have colleagues whose laptops are plug and play and will definitely need electric source.

Interviewer: Where do you usually do your design work?

Participant 3c: Preferably, I would want to do it I n my private space. Yes, it is said that creativity thrives in freedom. Sometimes when you are given a piece to work on, but if your environment doesn't help, I am not sure you can give your best, because you a creative even if you are given two minutes to put up something, you can. But I am sure that's not what we want to do. I'm sure if we have the space, we would want to give our best and all of that. But you see, we don't have that liberty in our various hostels. My hostel room is very small and I cannot put a table and a chair in that tiny room I am left with no option than to come here (library) with my laptop. Sometimes the conditions around are not ... you understand? There are times that I come here into the library and we barely have plugs to sustain your laptop battery.

Interviewer: Which digital device do you use?

Participant 3c: The laptop and my phone as well. The phone acts as my source of internet.

Interviewer: Which software do you usually use?

Participant 3c: CorelDraw and adobe suit

Interviewer: How do electronic devices influence your creativity?

Participant 3c: I should say once or twice in a week, I visit the Instagram page of the person that inspires me the most. I go look at his work and my phone does a lot in helping me with that. You the chance to come across things that on a normal day you wouldn't see around. You will find somebody's design and then you take inspiration.

Interviewer: What are the benefits of using the internet for ideation?

Participant 3c: Benefits of using the internet during ideation is if am supposed to work on say, ‘e-commerce’ I will simply type e-commerce and add logos to it and you will be surprised the results that will come out with. So hardly do I take my pen to go through this ideation process. You sit back and look at ten ‘e- commerce’ logos designed by somebody. It exposes you to what you wouldn’t have known.

Interviewer: How long have you started using the pc?

Participant 3c: I use to use pc before I came to the university.

Interviewer: Which do your customers prefer, a well shaded work digitally printed work.

Participant 3c: Honestly, the customer’s interest, really, is the finished work. The finished work is what they are interested in. They come with a problem and they need a solution. They don’t want information on the process.

Because with corel, is a vector-based software you can do a lot with it. But there are other software that work with it real faster. Corel demands you to and draw. Other software have some of these things as preset already. You only have to visit and pick them and start working with them. I am not sure anyone would like to miss the easy way. I know CorelDraw. I have learnt a little bit of the Illustrator but because I grew up with coreldraw, I am conversant working with it. It is difficult switching and all of that but sometimes I regret it.

Interviewer: Does groupwork help?

Participant 3c: If we were three seated here and you ask this question. One would have said, ‘Yes’ and the other person might t have said ‘No’. I am saying this because, it depends on the role you are playing in the group. There are times you find yourself in a group of people who barely understand what the group is about. In a situation like that the entire onus seem to lies on the shoulders of only one person. There are times that I find myself up the

whole night sometimes three nights trying to organize stuff for an entire group of seven sometimes a group of eight. So it depends on the role you are playing. The other person at the benefiting end will say ‘oh I like group meeting’ and things like that all because his input might be zero.

Well, maybe I am just yet to come across a scenario where the use of technology did not help me with ideation. If I am suppose to just sit back and do ideation with my pen and paper, it is real work, it is really tough but the if it has to do with the computer, it is just a matter of keying in what is right and will just fee me with what I need. So maybe what I would like to say is that the information or the result I get, more should be added …

Interviewer: How can you encourage people to use technology for ideation?

Participant 3c: I will not discourage people from using the pencil and the reason is that technology has been helpful but we still cannot throw away our pencil. Talking about wabcom and things like that, all of these things were built on the concept of the use of pencils and papers.

Interviewer: How do you see your environment?

Participant 3d

Participant 3d: Sometimes when we come to class we have to go to another class and look for chairs. We are about hundred. And sometimes when the classrooms are full, some of us will stand.

Interviewer: What are some of the suggestions you will give for the classroom to be improved?

Participant 3d: We need enough chairs. Some of the plug are not working. So sometimes when we come to the class and our your battery runs down you have to go back to the hostel and charge it.

Interviewer: Where do you usually do your design work? Do you design on campus?

Participant 3d: No, when I go home.

Interviewer: How does the use of electronic device affect the quality of your design work?

Participant 3d: Me for example, when I am designing I have to sketch first with pencil or pen then I transfer it to the PC. I scan it using my phone and transfer it to the PC, then I sketch it and work on it.

Interviewer: How does the digital device help you to gather inspirations?

Participant 3d: For this one, let's say when I am creating a logo for someone I will do about 5 or 6 sketches on a sheet of paper the I select the best or the person select the best and that is what I will transfer to the machine (computer).

Interviewer: Do you think electronic devices make ideation easier?

Participant 3d: Yes.

Clients usually want to see the finished design but for logo designs I sketch in the sketch pad and send it by phone to the client.

Interviewer: Do you think the group work help?

Participant 3d: Yes. Sometimes, for example, the 40 page magazine work we were given, the price was a little expensive and the material we would use to print is also expensive. So by that you could contribute and financially it reduces burden.

Participant 3e

Interviewer: How do you see your design environment?

Participant 3e: We don't really have equipment and other things. There should be a projector in every lecture hall but there are just two projectors and like you sign in the head of department's office before you have it. They

are supposed to have the equipment we need but the equipment really aren't there.

Interviewer: Where do you do your design work?

Participant 3e: I do it off campus. Because no one can visit the lab to work. Sometime the internet connectivity isn't available. I am someone who likes listening to loud music when I am working. Sometimes inspirations come from beach at night, sometimes inspirations come from the music. So far as I have everything I have planned out, I don't have much of a problem working.

Personal Note

Responses from all the interviewees indicate that their lecturers allowed them to work in their own preferred environment. This decision caters for the divergent preference of working environment among participants so that anyone who wants a quiet environment, will get it and those who like an environment with loud music will also secures a place.

Interviewer: so, which digital devices do you use?

Participant 3e: Laptop and phone.

Interviewer: which software do you use most of the time?

Participant 3e: InDesign, photoshop and adobe illustrator but I am not too good at adobe illustrator.

Interviewer: So what about the vector one?

Participant 3e: No, I am not good at it. I don't like CorelDraw.

Interviewer: How do digital devices help in gathering inspiration?

Participant 3e: If I develop my idea on a paper, sometimes I need to go online to get ideas of what people have done using my phone before I now sit down to get my information.

Interviewer: Which do you use for you design ideation, pencil or digital?

Participant 3e: I use both pencil and digital devices for my work.

Interviewer: When did you start using the computer, before or during university education?

Participant 3e: I started using pc before I came to the university.

Interviewer: Do you think technology makes ideation easier?

Participant 3e: To me, yes. Because, there are lot of ideas out there. You can look on someone's work and get an inspiration. Even if you wouldn't do the same thing, you get an inspiration of how the work was done and you can do something.

Interviewer: The form of ideation preferred by customers?

Participant 3e: Today's customers I work with, they want to see the final product. Some people do not like the process. They think it is stress. They give the briefing and expect you to give them the work. If they find a fault, they tell you that I have a fault here. So you have to go back and make corrections.

Interviewer: Do like group work?

Participant 3e: Yes. We are able to get ideas from each person, we are able to learn about people's thought, about what they think about a particular subject.

Interviewer: How can the digital design environment be improved?

Participant 3e: First and foremost, I would want to say, for it to help student, they shouldn't start in the university. They should start from SHS or JHS. So that they have a fair idea of some of the software they are going to use. Secondly, in the school environment they should have the equipment that are needed, internet and other things that student can easily have access to and do what they have to do.

Interviewer: Which will you advice designers to use, pencil or digital devices?

Participant 3e: For me I will advise them to use both. It is good to jot down whatever you have in mind before you sit directly behind the machine to work. So when I was growing up this is what my grampa thought me. Before my homework, I should have a jotter to do the homework in before you go to the main homework. So that is the advice I will give them. They should be able to have all their ideas jot down, they should mind map, have everything on paper so that when they go behind the machine, they know what they are coming to do and you just focus on it and you are done.

Participant 5a

Interviewer: Design environment

Participant 5a: We have a studio and per number of students, I don't think we should have a studio. Sometimes we all go into the studio. Lets say 20 people and the whole place will be hot. The whole place will be noisy so the lecturer will have to send the students out and they have to come in in pairs. I don't think that is the best way because it time consuming. Because that time that we have to be waiting for two people to come we could done something profitable. So the facilities are not enough.

Interviewer: Which software do you use?

Participant 5a: Photoshop and premier. I am not really conversant with adobe illustrator. I use to have corel but now I don't even have on my laptop.

Interviewer: Did you have a laptop during HND?

Participant 5a: It was getting to the end of HND that I had a laptop. I used friend's laptop and sometimes the lecturers'. I was able to make the grades but if I had the laptop, it would have been better.

Interviewer: Which digital device do you use?

Participant 5a: I use camera and mostly I use my phone for research.

Interviewer: Internet

Participant 5a: The services are not good and sometimes you wouldn't even get it at all.

Interviewer: Benefits of using the internet during ideation

Participant 5a: Most people put their ideas over there for us to take inspiration from. For the internet you have to go online and search for ideas.

Interviewer: Do your lecturers create the environment where they supervise you as you when you are ideating?

Participant 5a: Yes, they do it. Sometimes we give the work one guy in front to project it and then we talk about the work. So the lecturer shows us our mistake

Interviewer: Which one do customers prefer, digital or pencil sketch?

Participant 5a: Digital, and it easier to produce.

Interviewer: Does group work help?

Participant 5a: Doing work in group beneficial to us and the lectures as well. On the lecturer side, maybe you are seven in a group, you only have one thing to mark. For students, we meet to share ideas, get to know certain things that we don't know and things we even know we improve upon them. Sometimes others also build their confidence. It creates violence too. Even though it has benefits, it creates violence. Like yesterday when we met, one point we discuss it for about an hour and we were not getting to the end of it. So working in group has its advantages and disadvantages.

Interviewer: Where do you do your design work?

Participant 5a: I work either in the house or the hostel.

Interviewer: Which is faster to ideate with, pencil or digital?

Participant 5a: If you know how to use the digital, it is faster.

INTERVIEW 5b

Interviewer: How do you see your working environment?

Participant 5b: We want more improvements. The power plugs are faulty. some of the power plugs are actually spoilt. But the classroom is wide enough contain all of us. But, it actually depends if there is no class in maybe, the one and that is when we able to open this partition. But if there is a class after the one we are in, we are packed in the same place. Not everyone can get use their laptop. Actually we don't sit singularly. We pack the tables together, so.

Interviewer: Where do you do your design work? Is it in the classroom or outside the classroom?

Participant 5b: Sometimes we go to the lab but the computers are actually not enough. We are more than the number.

Interviewer: In that case how do they teach you? Do you go in batches?

No, we don't go in batches. We go as a class and it is actually projected on the board so.

so some people have access to the pc and work with as the lecturer teaches. The others watch as their friends work. I would love to work while my friends are around at least to share ideas but because the people have their schedules drawn already, so maybe they can't spare that time.

Interviewer: Why would love to work when your friends are around?

Participant 5b: Just like how we learn. Quality is assured so for more ideas.

Interviewer: Do you like group work?

Participant 5b: The will help because you will get people that are conversant with the software. You will learn new skills, new steps, new procedures.

Interviewer: How long is it when you started using digital devices for design?

Participant 5b: When I came to the university. Here they don't take you through the basics. They assume you know it. So I joined an online group where I was almost everything.

Interviewer: Which software do you use?

Participant 5b: Adobe suite, corel and animate.

Interviewer: Does the campus internet help you?

Participant 5b: Actually, it is effective particular places like the faculty. If you are working from the halls, don't get access to the Wi-Fi.

Interviewer: Which devices do you use for design work?

Participant 5b: Laptop and phone. I connect my phone to the PC for internet access.

Interviewer: How do the electronic devices help in gathering inspiration?

Participant 5b: For example, like the phone with the help of Google, you are able to enhance on a particular topic, maybe a flyer design. You get the privilege to samples of that design. So it helps a lot. Something like the phone for instance, it makes it easier because everything is on the net, the photographs, the samples, best colours to use in a design and the best fonts are all there.

Interviewer: You said it is much easier using the digital for ideation**.**

Participant 5b: well, the world is changing. Gone were the days when we used the pencil but now everything is on that small device we carry around and it helps. People from different countries, from different tribes, from different race, religious and all that, they all post their ideas there and it makes even easy for inspirational purposes. There are a couple of people who better than you. That why the internet favours us. Because different

people there, people that are good in that field post some amazing works there. So the internet is the best option.

Interviewer: How will you convince someone to adopt digital devices for ideation?

Participant 5b: Well, gone were the days when we use the pencil but now everything is on the net. Everything is on that small device we carry around and it helps. People from different countries, from different tribes, religious and all that. They all post what they know there. They all post their ideas there and it makes even easy for inspirational purposes. Different people who are good in that field post amazing works there (online). So the internet is the best option.

Interviewer: Do you like working in group?

Participant 5b: sometimes you are so unlucky you meet lazy people so you do everything yourself. Because it is a group you won't say people are not contributing so you won't do the whole thing, so they won't contribute. There will be that one person who will do the work. I actually like group work because you get new ideas. We all think differently so we get new ideas from people; we get acquainted to new people.

Interviewer: We were you taught how to develop a portfolio

Participant 5b: No. we were not taught how to do it.

Interviewer: What about mood board?

Participant 5b: Actually, today is the very first day I am hearing that word.

Participant KN 1a

Interviewer: How are the Facilities in the department?

Participant KN 1a: My problem is about the chairs. There are not enough chairs. There will be a class and you have to stand or wait when a class

closes then you go and take a chair and come and sit. We are many. We about a hundred and something in our class

Interviewer: What about things related to design?

Participant KN 1a: The plug in the classrooms are all disconnected except for the one used for projection. We have a studio but we don't work in the studio

Interviewer: Teaching facilities?

Participant KN 1a: As for the teaching facilities, there is no problem with them. The projectors are in good condition

Interviewer: Where do you do your design work?

Participant KN 1a: Normally in my Hostel. I don't work on campus. I feel comfortable when I am in my room.

Interviewer: Ever heard about digital mood board?

Participant KN 1a: 'I don't think so'

Interviewer: How do you get inspiration for ideas?

Participant KN 1a: I communicate with friends about work to be done and I draw images out of their response. I get ideas on the internet.

Interviewer: Are you allowed to work in your preferred environment?

Participant KN 1a: Yes,

Interviewer: Which software do use?

Participant KN 1a: Photoshop and InDesign. I am not good in using illustrator.

Interviewer: Which works for you in ideation, digital devices or pen and paper?

Participant KN 1a: Pen and paper. I create something on paper before I transfer it into the laptop.

Interviewer: How long have been using the computer?

Participant KN 1a: 2nd year of the university

Interviewer: How many software were you taught?

Participant KN 1a: They introduced the software to us. They did not take their time to teach us. We watched videos in youtube. Lecturers sometimes give us video tutorials.

I want to learn illustrator. I will be happy if I know how to use it.

Interviewer: What will like the department to do to improve design ideation?

Participant KN 1a: We need teaching assistance who will be helping us.

Personal Note

The digital divide among students and its effect on ideation

A number of students expressed the need to have teaching assistance. They this will help them develop the needed digital skill for effective ideation. The category of students who made this request included those who did not have any skill in the use of computer prior to their coming to the university and those who do not have laptops. It is observed that these categories of students also desire their colleague to be around as they do their work.

Participant KN 2a

Interviewer: How do you see the facilities in the department?

Participant KN 2a: In the 1st year we don't use computers. We use pencil, poster colours and the like. In the 2nd year we are introduced to electronics for ideation and designing.

We need more computers and a larger ICT lab. The current ICT lab is just a quarter of our number.

Interviewer: Do you have graphic design studio?

Participant KN 2a: Yes. We have desktop computers over there but they are parked because students use their own laptops when they go to the lab. The desktop computers are only used during examination

Interviewer: Where do you work when you are given a design work?

Participant KN 2a: In the library because the Wi-Fi is stronger there.

Interviewer: Do you use Wi-Fi for your design?

Participant KN 2a: Yes, for research and inspirations.

Interviewer: Do you have digital mood boards?

Participant KN 2a: Yes

Interviewer: What about portfolio?

Participant KN 2a: No

Interviewer: What are some of the sites you visit?

Participant KN 2a: Pixabay, Videezy, Behance.com and Undraw

Interviewer: Which improvement do you think is needed in the department?

Participant KN 2a: The studio should be made bigger. Provide wifi

Interviewer: Which digital devices do you use for design?

Participant KN 2a: Laptop and phone

Interviewer: Which software do you use?

Participant KN 2a: Photoshop, InDesign and illustrator

Interviewer: Do lecturers supervise you as you Work?

Participant KN 2a: In the 1st year one lecturer used to do that but now because of our large number, they give us work for you to go and do.

Interviewer: How will the lecturer know that the student did the work himself?

Participant KN 2a: That is the problem.

Interviewer: How does the use of electronic devices affect the quality of your ideation?

Participant KN 2a: It makes work easier. With the digital device you can test the variation of colours. You can just mask and test different colours and you can do multiple works in one day. You can have more idea than when you are using pencil and paper.

Interviewer: Do you work in group?

Participant KN 2a: Yes, always. The advantage is We share information. When someone says something and you don't understand they explain. Sometimes the assignment is not even clear but when a group member explains, we all understand it. We divide the assignment into groups. So individuals in the groups work on different aspects of the assignment which makes it even faster. We vote on the right answer and we develop the idea.

Participant KN 2b

Interviewer: How do you see design environment?

Participant KN 2b: It quite ok. We have about 70% of what we need. We are not equipped with everything but what is necessary for us to accomplish our goals are in place. We want a photography studio. When we are talking about photography we only know the theory aspect but when it comes to the practical aspect, we are lacking that aspect.

Interviewer: What about the graphic design aspect?

Participant KN 2b: Yes, that one too, if we have an ICT lab that is equipped with ICT tools like the monitors and all those things. Of course, it is not everyone here who is having the laptop. Some need to wait for their friends to finish work before they start work. Some of them cannot meet deadlines.

Interviewer: Where do you usually work?

Participant KN 2b: It all depends on the work and your mood. If you think you can be comfortable in your hostel then you can stay there. But sometimes if it is a group work or those things you have to meet on campus then you discuss. So we have various areas. That is if you go to the library, you have areas for study group, work and stuff.

Interviewer: How many graphic design software are you a master of?

Participant KN 2b: For me, I am good at only two; Adobe illustrator and photoshop.

Interviewer: What about InDesign?

Participant KN 2b: InDesign, now that I am learning it

Interviewer: Which other software have you heard about that you want know how to use it?

We have myar, blender, affinity photo, and capture one.

Interviewer: Now, how do you get your ideas for design?

Participant KN 2b: Most at time I always visit Pinterest and we also have Pixabay, Ebay, Unsplash too is there.

Interviewer: Phone for ideation

Participant KN 2b: Some software like lightroom used for manipulating photos. I have the phone version that I have been using them too.

Interviewer: Which do you use, pencil sketches or digital?

Participant KN 2b: I think with the pencil, it give you a rough sketch of your idea and the electronic gives you the actual thing that you are looking for. So it gives you the perfection of the rough idea you have.

Interviewer: What are the advantages of using of pencil?

Participant KN 2b: I think it is the starting point. It all depends on the designer. We have people who are very talented with the and also the pc. With the software, if you are a professional, what you can use pencil to do

you can also use the machine to do it. But here comes the case where 2, 3 or 4 ideas will come into your mind. With the pencil it gives a rough sketch of the 4 ideas but when you are using the pc you have to finish one before you start with another. By the time you finish with the 1st one maybe you can forget the 4th one. For me, I use both.

Interviewer: Do you love group work?

Participant KN 2b: At first I did not like it because I was a very shy type and I saw that I am very comfortable with people like working together but as time goes on, like level 100 we were facing all these difficulties. We have got understand that when go out there in the industry, it is a team work and so you have to adjust. You have to know how to work with people. And working with groups, you can achieve greater things.

Interviewer: Is the time the lecturers give you for submission work ok?

Participant KN 2b: I can say they are training us to be professional. So as a professional if they give you any problem to solve, the client determines the time to finish it. Because it is money, you find way and means to get your money. And if they give us assignment, they give us deadline and it is very manageable.

Interviewer: Do you have a Portfolio?

Participant KN 2b: Yes, a digital portfolio

Interviewer: What about mood board?

Participant KN 2b: I create a mood board for a guide.

Participant KN 2c

Interviewer: How do you see the design environment?

Participant KN 2c: There a lot they have to do. Our laptops are plug and use. There is not enough socket to connect the laptops.

Interviewer: Where do you your design?

Participant KN 2c: In the hostel. I am the kind of person who is not social so I tend to do my assignment in the hostel. When I am designing, I don't want others interrupt because I know what I am doing. He said that his laptop is not very powerful.

Interviewer: Which type of laptop will you like to use?

Participant KN 2c: I will like to have HP pavilion 15 gaming laptop. It is very good. Has 16 gb ram, 1 tb hdd and extra for ss and then the graphics is very good.

Interviewer: Which devices do used?

Participant KN 2c: Laptop and mobile phone. Sometimes I do work on the mobile phone and transfer it to the laptop. There is application you can use to design on the mobile phone. If I am not with my laptop and I have to design now, I will work on my mobile phone. We use Hotspot to connect internet to the laptop.

Interviewer: Where do you get your inspiration?

Participant KN 2c: I get inspiration everywhere; because when you are walking, the way you perceive things give some idea. When I am watching tv commercial, I some inspirations from there. When you are drawing, maybe you are there and you feel like should something, you don't know what you are drawing but you are drawing something. When a work is given to you find a concept in that drawing or part oof the drawing and add it to your design,

Interviewer: Do you have digital mood board?

Participant KN 2c: Yes, any image that you feel like you can develop something from, then pick and place in a file maybe pdf. When you are given a work then you go through and some idea from it.

Participant KN 3a

Interviewer: How do you see the design environment?

Participant KN 3a: There is need for improvement. In terms of studio which can accommodate all the students at a go.

Interviewer: The software that were taught

Participant KN 3a: We were introduced to photoshop. I know photoshop, InDesign, illustrator and recently, I am learning affinity.

Interviewer: How do you get design inspiration?

Participant KN 3a: I take inspiration from existing designs. I have a portfolio, I get some ideas from online. I take inspiration from freepick.

Interviewer: What role does the internet play in our design world today?

Participant KN 3a: It gives inspiration. At times I tell myself if you want to start a design from the scratch, it is really, really difficult. Maybe once you have an idea about what the thing is, let say sustainability. Like I mean design a poster on sustainability. You ask yourself what sustainability is about. And when you go to the internet and type sustainability you will see various kinds of designs on sustainability and it looks like but not necessary to copy. It gives you an inspiration to just do yours. Even the colours to choose. Sustainability has to do greens browns and those things.

Participant KN 3a

Interviewer: Which devices do you use?

Participant KN 3a: Tablet, laptop, camera and at times my phone also. I use tablet for illustrator.

Interviewer: Do you use pencil and paper and use the computer also?

Participant KN 3a: With pencil and paper, at times maybe when I have logo design, I do my sketches on paper. Afterwards I transfer it. I scan it and

transfer it to the computer. When the drawings are very sharp, I just take a short of it with my phone.

Interviewer: Where do you work?

Participant KN 3a: If it is group work, we meet at the faculty here and do it.

Interviewer: If an NGO wants to help the department what are the things you will suggest that they do?

Participant KN 3a: Aside the large room they should provide, they should provide laptops and computers because it is not all the students are able to afford laptops. At times, I have a friend who usually uses my laptop for assignment. When I am done with my own, he comes to my hostel and do his. Supposing we had a studio full with laptops, he could have just come here and work and just put it on a pen drive so that when it is time for submission he goes and submit. There are times he comes to my place and I am busy with the laptop and he has to for a long time. At times I don't finish but I give it to him. At times he rushes to finish. A design that he has to use a day to finish, he will maybe 30 minutes to do it.

Personal notes

This will surely affect the quality of their design work.

Being a Technical university graduate who came to enroll in the traditional university at level 200, I asked him to compare how design skills are acquired in the two institutions**.**

Participant KN 3a: I always tell myself. Going to the Technical university before coming to here, I don't regret because most of my mate here 80% of them don't really know how to use the software. We did more of practical works at the technical university. Here you can only learn the software yourself. No one will come and teach you. Some people are in the 3rd year who cannot even design call cards but they call themselves communication design students.

Participant KN 4a

Interviewer: How do you see your design environment?

Participant KN 4a: The plugs are not enough for us to use our laptops. And we don't really have source of inspiration from our environment too. Since we graphic designers, for me I was thinking that we have some works on display which can give us some concepts from the environment to work with and not pressured. Displays as in other people's work printed out and played on our classroom wall because we have open walls and we don't really use them.

Interviewer: Do you have studio?

Participant KN 4a No, we don't have studios

Interviewer: Where do you do your work?

Participant KN 4a In the room because you can't use the classroom all the time. We need a studio. A studio is more relaxed and it specified for particular class and for that one is more relax and helpful.

Interviewer: Do you have laptop?
Participant KN 4a: Yes, I do have my own laptop since 1st year.
Interviewer: Digital \portfolio
Participant KN 4a: Yes
Interviewer: Are you allowed to work in your preferred environment?
Participant KN 4a: Yes
Interviewer: Which devices do you use?
Participant KN 4a: The laptop, camera and phone /
Interviewer: What about software?
Participant KN 4a: Adobe suit and corel.

Interviewer: Do the devices help you to quality work?

Participant KN 4a Quality, if it is in terms of the look of the work, I think so, but if it is terms of your idea, your concept, then no. because the concept comes from you and your thinking, your mind but if it is aesthetics, the type

of software you use … CorelDraw allows you to even shapes and letters easily but Photoshop is only known for photo editing and so depending on the software you use, it can help aesthetically.

Interviewer: How do digital devices help in gathering inspiration?

Participant KN 4a I use some sites get to ideas and inspiration like pixabay.

Interviewer: How does the electronic device help in producing variety of ideas?

Participant KN 4a For electronic devices, I doubt if they give you a variety of ideas. Because as I said earlier, the concept comes from you so if there is supposed to be a variation in the idea, it is supposed to be what you taught of and how you see the ideas in different ways. It is not necessarily about the device.

Interviewer: Pencil and paper verses digital devices for ideation

Participant KN 4a I actually prefer the Pencil and paper because I feel it is more flexible for ideation because we sketch a lot of things. With the digital devise, there is a lot of stress especially when you have mistakes and you have to correct it and all that.

Personal note:

As a matter of fact, other interviewees have a contrary view this subject. They believe that it is much easier to make corrections when using digital devices than pencil.

Interviewer: How does the internet help in ideation?

Participant KN 4a It helps a lot because you kind of know what is already there, what people have and what people haven't done by researching. And you can also put different ideas together and come out with your own.

Interviewer: Do you think digital devices make ideation easier?

Participant KN 4a I suppose in certain aspects.

Interviewer: Which will customers prefer, printed work or pencil shaded

Participant KN 4a They want to see the final work. They want to see how beautiful it is but with pencil and paper can't really bring out the aesthetic that much but with the digital you have the colour and other thing that can help.

Interviewer: How can ideation process be improved?

Participant KN 4a Teaching at the early stages, maybe those who visual art at the secondary school should be taught how to use the software so that they get used to it.

Participant KN 4b

Interviewer: How do you see your design environment?

Participant KN 4b: For a student to be creative, this environment is not good. It is too basic. There is nothing inspiring. It is just tables and chairs and empty classroom students are supposed to create and there should like hangings for students to work. There should be things that inspires.

The classroom is not conducive. We need more. At least the walls should be painted. That alone will give us some inspiration. Even there is an illustration at the front of the school but nothing shows that it is an art faculty.

Interviewer: What do you think the department needs?

Participant KN 4b: Easels, paints brushes, sketch pads, sheets and art supplies. The projectors and TV are just decorations. They are not working. They are all for show.

Interviewer: Where do you usually do your design works?

Participant KN 4b: In our rooms. Honestly if we have a studio, that will be very perfect, I am doing my work and I see my friends doing their and that will be very encouraging but I am in my room doing my work and in two

minutes it is like am tired. We meet only when we have contact hours. We see ourselves only when come we for lectures.

Interviewer: Do you have your own laptop?

Participant KN 4b: Yes

Interviewer: Which device do you use for your inspiration?

Participant KN 4b: I use my phone alongside the laptop

Interviewer: How do you handle the images gathered for inspirations?

Participant KN 4b: Ok sometimes you see a design and you like the layout or text and in another design you like the colour and then you take the colour scheme from here and take the layout from another design and put them together to create your own design.

Interviewer: Which design software do you use?

Participant KN 4b: Photoshop and illustrator

Interviewer: How importance is the internet in ideation?

Participant KN 4b: It makes every efficient. It keeps me updated. That is where I get to know the current art styles, it makes work easier.

Interviewer: Which form of ideation do customers prefer?

Participant KN 4b: The digital form because with the digital, they are able to see details.

Interviewer: When did you start using the digital devices for design purposes

Participant KN 4b: When we came to university

Interviewer: What are some advantages of group works?

Participant KN 4b: We share ideas, we work faster.

KN Lecturer 1

Interviewer: How do you handle the students given their large number?

KN Lecturer 1: For resources, since they are using their own resources, there is no problem. Now facilities, this is not a regular space designed for computer lab and they have to bring their laptop and the power sources are 2 or 3 and they are 60 and they all have to be connected to the power source. They don't have a permanent class they unable to organize themselves. They are all the time moving things up and down.

Interviewer: What teaching strategies do you put in place to ensure teaching is effective?

KN Lecturer 1: I use pear assessment where I assign each student to two assessors. If the student have any doubt about the comments of the assessors they can seek assistance from the lecturer. And so you have been assessed, you go on to assess other people. These assessments are not mark oriented. It is just about helping the students shape their ideas as the lecturer cannot go round to supervise all of them. So it is to empower the students to know how to do peer critique.

Interviewer: Do you sometimes put the students into groups to reduce the number markings you have to do?

KN Lecturer 1: No, unless it is a project presentation. When they are presenting on a theoretical presentation but if it is about studio, it is on individual basis because the individual is supposed to have some mastery.

Interviewer: The students do their designs at home so how do you know the process they passed through to complete their works?

KN Lecturer 1: It takes about 3 to 4 weeks to complete a design work. The 1st week you give the brief. The next week you take their initial ideas then the following week, the refined idea and the fourth week before they present the final idea. So there will be records to show. the

Interviewer: Do you sometimes look at their pencil work prior to the finished work?

KN Lecturer 1: Yes, and they need a lot of encouragement.

Interviewer: Earlier in our discussion you mentioned that ideations not really taught.

KN Lecturer 1: Ideation is about techniques and strategy. One technique is having the confidence to draw. Another technique is how to modify, moderate, eliminate, scamper. That is also how stretch, how to compress, how to distort which is also another set of technique that the student will have to go through.

Now I if taught them in the 1st year and the lecturers are not referring to them the students will think that they had done for the 1st year lecturer and have finished with that. They are not seeing the connection. Then another technique that has to do with ideation has to do with brainstorming section. Having them in groups and then encouraging them to share ideas is also a technique that the individual is supposed to have – the confidence that he will listen to other people ideas to improve his or her idea. The brainstorming section is a technique that the students would have to be encouraged to use.

Interviewer: Do lecturers teach students how to develop portfolio?

KN Lecturer 1: It depends on the lecturer. I once upon a time taught portfolio when I was teaching a lower year. That is why I told The students that another reason we have to work on an individual study is to build a portfolio which will be a guarantee for your job placement after school.

Where you can show from your sketch books, from the ideas, that you know how to think, how to ideas from the scratch, that is what is used in building a portfolio.

Our responsibility at every point in time is how to fill in the missing link.

We do not teach it and I can say it. I can talk from what my teachers taught me. How over the years, have adulterated what we have been taught. From the first day of school, the teachers are not teaching them the right way of ideating. Baffour started the whole design school. He had a systematic way of educating people. The kind of exercises that they have to do. Now if those exercises, the teachers are not teaching the students how to do these exercises, the likelihood that they will not be able to ideate is greater. So, it is not a matter of digital.

KN Lecturer 2

Interviewer: How do you see the teaching environment? When I talk about the environment generally I am talking about the adequacy of the materials, the quality and things like that.

KN Lecturer 2: Yes, for those ones, they are good. The only issue I think is the numbers. I feel that for graphic design, the numbers are too great for the facilities that we have available.

Interviewer: But the facilities are actually in good shape.

KN Lecturer 2: Oh Yes, we have a whole functioning multi-media lab with very good computers, we have a photography lab. For equipment, we have it, the only issue is the numbers. The numbers are too much.

Interviewer: What do you think can be done to improve it?

KN Lecturer 2: Ok, for example, for this department, I think if we will not reduce the numbers, then we have increase the facility. Currently, those in first year, they are over four hundred students. The classes we have there the capacity is maximum, 80.

Interviewer: It is supposed to take 80 so now it is housing about 400 students.

KN Lecturer 2: Yes, maximum 80. And now look at the size. We have studios over here, an exhibition room and then we have a packaging workshop. The classroom there can probably accommodate 30 or 40 students. The number is huge.

Interviewer: Even when all of them have laptops, they cannot use it. They need to connect.

KN Lecturer 2: They can't use it. Even if they are not even using the laptop, they all will not have access to table and chair. You will see some of them standing at the back. Some of them will be standing outside.

Interviewer: So, in that case, do you put them in batches?

KN Lecturer 2: Yes, so we have to now split the classes up. So for example, let's say for advanced photography, we have multi-media, we advertising and then media marketing and then we have visual communication. I am teaching them the same thing but because of the numbers, I can't meet them at the same time. So I will go to multi-media and then I come back visual communication and I have to say the same thing I said in the 1st class because they all have the same class. You see the difficulty is that one question might come up here and it wouldn't come up over there. So I wouldn't even have the opportunity of addressing that issue to another group. But ideally, because they are all doing the same course code, it would have been ok if I could meet all of them at the same time.

Interviewer: So, the supervision aspect; how do the lecturers ensure that whatever work they have brought, at least their effort is inside? Do you question their stages or I mean the process or how do you go about it?

KN Lecturer 2: As for the supervision, if all of the should bring their gears to classroom, it will be very difficult for them to work, which means they have to work around the studio or in their hostels. It very difficult for you go to every single one trying to monitor what they are doing. In those cases, it will very difficult for to monitor them when they are in the class.

Interviewer: Given the number, the work load is too much. Which strategies are are you putting in place to reduce work for yourself?

KN Lecturer 2: Personally what I do is, I reduce the number of projects. I also employ online tools. So I use the blended system to teach. So I have Google classroom and then the face to face. So I do have some lectures online and I post it so that they can watch is at their own convenient time and also, all my assignments are online now. So they submit and it is easier for men to access online. And again the other issue has to do with I split the classes up. We have the theory section and we have the practical. So the theory class is face to face and then the theory section they go and work. The studios are available. Those who will be able to make it the studio, I can supervise them over there. We schedule the use of the studio. So come in groups.

Interviewer: So the group system helps.

KN Lecturer 2: Yes, the group helps. Even now, final year projects, majority are doing group work. So you have like six people working on one topic.

Interviewer: Well are students encouraged during ideation to use pencil?

KN Lecturer 2: I thing I also do is that in my first series of lectures, I talk about academic integrity and ethics. For example, I do encourage the use of digital media or having inspiration from online, looking at what others have done, building this kind of visual bank which is also very important. But what I don't like is plagiarism. You know, you can't take somedy's work and embellish a way and present it as though it is yours. That is just to give an idea or more or less to inspire you. That is not the same as lifting it. The other issue has to do with the design process. So I emphasize on the use of the design process. Any work you do, I want to see your project report and the project report should indicate if whether or not you used the design process because every single aspect of the design process will commensurate with a particular sub-heading. So more or less like ideation; what did you do in ideation and how did you do it. Then you come to

refinement or idea selection; what did you do under ide selection? And you are supposed to provide evidence of ideation in the report. All you thumbnail sketches, all you research, you are supposed to scan them and add them to the report. If I don't see that then it means that you just stole the work.

Interviewer: So internet service for ideation; what do you say about that.

KN Lecturer 2: I think is critical. It is very important.

Interviewer: So what about the internet service here. Is it ok for students to work?

KN Lecturer 2: The only thing they will say is that the data is not enough because students use data for anything else but to study. I think one time someone was telling that they only get about 1.4gb. I think they don't understand the idea behind the bundles they have been given. If visit multimedia sites and stream that's how the data runs up.

Interviewer: The duration you give your students when you give them work and you say next week I am collecting it. How do you see their design response?

KN Lecturer 2: I don't have a fix work period for my projects. I think it is project dependent. Sometimes there are certain projects that I will give a week. Because of the structure of our lectures, my minimum is a week. Because, if I give you the project today, I will take it a day before the next lecture. Sometimes it might take two weeks, depending on the gravity of the project. So if the project requires that they do extensive research, then I will extend the time. And most of the time, all my project for the semester, will be uploaded before mid-semester, which means that I post the works ahead of time. The only thing you will have there is the deadlines. So you know what you are doing at the end of the semester so you start working towards it. So any time I teach you, I am adding up information that will help you accomplish that. What we do is that between now and the end of the semester; these are all your projects.

Interviewer: How is their fluency in the use of design software?

KN Lecturer 2: As for the software, in industrial art, I teach them adobe illustrator and what I have observed is that there is this general lack of soft skills already, even with word, PowerPoint. You realize that they have this detachment from the computer itself.

Interviewer: Students of today rather?

KN Lecturer 2: Yea, they are very comfortable with their smartphones. You give them assignment, they will type it on their phone. They do everything on their phones. They understand their phones better than the computer in front of them. The computer, they use it to watch movies, series and playing games. Last year, a whole final year student, her whole thesis, she was using her phone to type it. When you are teaching, you have a significant number of students with their heads on the table, punching their phones. You ask them what they are doing, they will say I am typing the note.

TT Lecturer 1

Interviewer: How do you see the design environment?

TT Lecturer 1: In our setting, in Takoradi Technical University, the environment is near conducive. This is because we have a functioning computer laboratory where digitally assigned works are done especially is has to do with computer design where students are expected to be in that learning environment. There is a computer lab made up with 50 computers with modern user applications where our students are sent to undertake all ideation processes leading to the development of a design. So, yes, the environment, I wouldn't say it is perfect but in a modern classroom, yes it is a conducive one.

For the normal classroom, we have large classroom space that is also conducive for learning. When it comes to drawing, for instance where students are expected to use sketchpads and drawing ink, yes, tables are arranged based on whatever the lecturers looking out for from the students. Either they are formally arranged in arrow or in circular form where the lecturer is able to interact with each student taking part in the lesson. So, indeed I will say it is a near perfect learning environment. Yes, of course, the situation here is that we have so many students. That is why I am saying it is a near conducive because the classes are broken into smaller units assigned with different periods of time so that the impact will be much better. In fact, graphic students, we have about close to three hundred students. Obviously the three hundred cannot go into one class. So it is divided into smaller units. So we have three batches; HND 3 we have A, B, C. Because of the large size, when admission is done, and they notice that this particular class is so big, management decides to break them into smaller units for easy handling. In some cases, some lecturers try to put all students together because they never want to repeat the learning. They want to avoid repeat teaching because they will all write the same exam any way. So you endeavor to say the same thing you say in class A, B and C. So to avoid that they will go and put all the students into one long stretch hall and deliver the lecture at once. But you know that scenario is not effective with graphic design where you are expecting students to do creative work. So that is why in our case, you don't see lecturers putting students together like almost three hundred students in one class.

Interviewer: So talking about supervision, are able to supervise them in that case, from individual to individual?

TT Lecturer 1: Yes, again, because of the number, you can only sample some of the works and discuss them in class and hoping that based on the understanding students will get from those sample discussion, those that are not attended, to they will learn from them. Obviously, the class is large so you not be able to… because some of the classes, Computer graphics for

instance, it is 2 credit hours and you are dealing with let's say 90 students for 2 hours. So many at time, we develop our course outline such that majority of the work is done by the students after they receive instruction from the classroom they do the rest of the work at home and come back the next week for review. They display their works and we discuss the outcome of those works.

Interviewer: So what do you think could be done to reduce your stress of meeting them in batches?

TT Lecturer 1: You know during the COVID, it came with some good news. The COVID also came with new paradigm delivering content where you don't need to meet all students in one classroom to deliver lessons so via the internet; you deliver your lessons to them. So, even as at now, we do blended-learning. The previous semesters we were doing blended learning. Blended learning simply means setting percentage for having contact with students in the classroom and another percentage having contact with students online. So if it is an online, as many students as you have will be listening to you so far as they are able to hook up to your platform, whether Team or Zoom. Once they are able to join the feed, they will be able to listen to you in their respective location. These are some of the strategies we have adopted at the time of the COVID.

Interviewer: Per my information during the interview with the students, they express a lot of desire to have practical time with the computer. In fact, some of them said they don't have personal computer. So if they could be allowed to use the computer lab at a time may be there no lectures that will be a great help so that they can practice. What is preventing the students from using the computer after contact hours?

TT Lecturer 1: Classes are assigned based on the time table. So if a class is ended, it is expected that there will be another class just after that. So in such a scenario, no student will be allowed to stay on when there is another

class coming in. Unless there is no class coming in, it is expected that the TA who is assigned to man the computer lab… Any student who wants to practice could have access to the computer lab at any material time within the regulated period. So long as there is no class going on, students should be able to walk there especially those who do not have their personal laptops should be able to go there at their own time and be guided by any TA that they find over there. In fact that was the reason why the computer lab was designed. So I am even surprised why they will be disallowed to us it. If there is no class taking place every student is expected to go and practice.

Interviewer: What about idea development. You know interestingly, the last time I came I saw mind mapping and thing like that. Tell me about it before I ask my questions.

TT Lecturer 1: You know mind mapping is also one of ideation procedures for design and it is something that I personally introduced since I start teaching computer graphics and I also noticed that because idea development many students are not able to come out with creative work so there was the need to processes that are already out there that they could use to learn how to generate ideas. So for instance, you are asked to design a logo for a newly established company, right? This company need an identity calls for the development of a logo that task requires brainstorming as in what kind of logo will be more representational to that particular company? And that will call for mind mapping. Mind mapping, if you take the two words ‘mind’ that is the human mind and ‘mapping’ that a session out your mind to know what will work best. It a procedure where anything that comes to mind must be interconnected. Let’s say I am designing an ID for agro-business. The word agribusiness, even though it is the name of the company but you could see what they will be doing, agricultural materials and it is commercial also. So you are going to mind map to look for shapes or design elements that can be related to this particular name. so you ask the students to do mind mapping by writing the name of the company down and then anything that comes the student’s about that name, they should write it

by connecting it to the name. for instance you come out with agriculture, farming, hoes, human beings, the value chain, anything that comes into mind business, trading, banking. You see the reason is that you don't know where the idea will come from. So your to sample all manner of names of items or services. Now when this is done, then you look for illustrations that can be supported by some of these names. For instance, if I draw a leaf, definitely you know that is an organic shape and it is more agricultural element. When this done, you look at all the images that come which you can assign to the writings. Because, you would have written a lot of words that are connected to agribusiness. Then you assign drawing to all of them. So out of those shapes will come an idea that will form the basis of your logo design. So, this basically is what the mind mapping is stands for. Then from there, you now say ok I think I need this shape, I need that shape or I need shape, plus shape, plus this shape together or I need this shape minus this shape. You see, this subtraction and addition all result intone common goal called the final design you are looking for. So these are the process you will go in mind mapping. And let me add that mind mapping is not only for design. Mind mapping could be used any time you want to search you mind to look for solution for any problem. So, we apply it in the context of design and it works for us.

Interviewer: So, what about the area of brainstorming?

TT Lecturer 1: So brainstorming here, you could do brainstorming by one person or multiple persons where you are discussing the issue to know the best way possible. It can be done one person or conference discussion. For instance, if you finish doing mind mapping you could brainstorm over the results of the images or the drawings that come. You have four, you need only one. You could brainstorm and see which carries more impact when it comes to the identity design we are going to do. So that becomes the brainstorming section.

Interviewer: But what about ideation; which form of it were the students taught to do? Is it the pencil one or the computer one?

TT Lecturer 1: Our normal class is what I will call the analogue way of delivering content so the usual pen and pencil and eraser. Because only few students who have laptop. Even laptop, they don't other input devices like wabcom tablet where they will use to there sketch direct into the computer. In fact in my case for instance, each student is supposed to have a sketch pad. So that's the first thing I asked them to do even if you if you're your own wabcom tablet because the normal sketches also gives students that foundation of thinking. This is the traditional way of developing idea until technology brought wabcom tablets just yesterday. So that process still carries lots of fidelity in my view where it is easy to sketch multiple sketch, thumbnails of ideas and be able to look through then and be able to say ok I think this is ok, this is not ok.

Interviewer: Do check the students' sketchpads to see their works?

TT Lecturer 1: In my case, without sketchpad you cant pass my exam. In my way of teaching, the processes leading to the design is equally important as the final output. Because we in a technology where students are used to cutting and pasting. So to be sure that whatever the sy=tudent is producing is his own thinking, I always want to see how the student arrive at that point. So I look at the sketch.

Interviewer: Do you teach your students digital ideation?

TT Lecturer 1: Digital ideations, not really. What we do, after the sketches are done, it is scanned on to the computer for further function of the design. That one has nothing to do with the ideation. Ideation is done with pencil and paper. Let me also say that those who are endowed with some facilities and they have wabcom tablet, they do their sketches right on the computer.

Interviewer: Well, my questions are exhausted. But do you have anything you want to add to just finalize it?

TT Lecturer 1: Maybe, let me throw more light on the very first question which has to do with the graphic design learning environment. With the advent of artificial intelligence, it is expected that higher institutions of

learning should adopt what is called learning 5.0 or education 5.0. In fact today, we are fortunate to even be introduced to machine learning processes and artificial intelligence which is actually advancing the frontier of education or educational content delivery. I think that we can advance our environment by integrating smart boards instead of the white boards. These smart boards allow direct interaction between the instructor and the board. So instead of using the marker to write, this time around, you are using the stylus pen to write directly on the smart board. That same smart board allows to show video tutorials and can do simulations everything instantly. It is also connected to the internet. So with such facility, it is expecte that students will be more attracted to learning because they will feel that this is a higher learning environment. I believe that all learning environment especially, graphic design should have that kind of facility. It aids easy delivery of content to students. Because instead of me coming to taking paper, pencil and be drawing before scanning before getting to the computer, this is done direct onto the smart board.

Interviewer: Thank you so much for this time because it is a great contribution to my thesis. Hopefully, I think this information is going to push my work forward.

TT Lecturer 2

Interviewer: How do you see the graphic design environment?

TT Lecturer 2: Well, I think the environment, as you have defined it, is the best we can have to support graphic design education but under the situation that is what we have. In a scale of 0 to 10, I will say 5 or six basically.

Interviewer: When you say 5, that means there is room for improvement.

TT Lecturer 2: Yes, yes.

Interviewer: If there is room for improvement, what are some of the things you think should be worked on for a better environment?

TT Lecturer 2: I think, first of all, the student- teacher ratio is not the best. Too many student for a lecturer to handle at a time putting a lot of pressure on the lecturers and again, I think the need for a lot more investment to be made in terms of digital infrastructure where some computers may have to be procured and then we need some other devices like ipad, cameras, projectors and other stuffs because graphic designing is very digital. If we don't have the infrastructure to support us, it will be difficult.

Interviewer: Information I gathered from the students, generally indicate that the graphic design department has a very good computer lab with computers that ar fast to wprk with but they are more than the facility,that is the computers so they even have to go in batches if they have practical works to do. That is during contact hours and after contact hours, they are not allowed to use the computer lab. Why is it so?

TT Lecturer 2: Alright, so that is a good question. Like I said earlier on, everything boils down to the number in question. The lab is not meant for only graphic design. It is for the whole school of applied art. So if the time that students are allocated so far as graphic design is concerned, has elapsed, you cannot continue to stay there, then it will mean that you are block the people's chance of using the lab.

So if on the time table a class, the graphic design class is to spend three hours at the lab and because all the numbers cannot go into the lab, what happens is that the lecturer would have to divide the class into three. And instead of each student spending three hours, each group will now spend one hour. Then they leave another group will come so that by the three hours' span we can have all the three groups. What happens then is that, yes every student gets the opportunity to go to the lab but the contact hours is reduced from three hours to an hour. Once the three hour that has been allocated to you is up, you cannot continue staying there with your students because other department would need the place to use as well. You know, in art, it is not only graphic designers who use computer. Sculpters are using it,

textile designers and all other people are using it. Painters are using computers now.

Interviewer: Ok, well, given the student number, what strategy do you adopt to reduce workload in terms of supervision, in terms of marking and things like that?

TT Lecturer 2: Well, I think that the laws are not working. I mean the NCTE, now we call them GTEC has a range in our Ghanaian context where there is a certain number of students that a professor is supposed to handle. I think the ratio is about 1 to either 40 or45. I am not very sure. So, it means that, technically, if we have more students than 45 then we should have additional lecturers to teach those number of students we have. I mean, the situation in Ghana is just too absurd; to have one lecturer teaching about three hundred students, four hundred students simply because the university decides to take in all this number of students, without thinking about the health of the lecturers and all of that.

Interviewer: In my conversation with some the lecturers they said they adopted team work, putting them in a group of three or so. By that the number of scripts to mark or exercise to work on is reduced for them. It is a strategy they have adopted. While they are encouraging teamwork, it is also helping them with the assessment. That is to reduce the number of work that they will be assessing. Do you also go by that some of the time?

TT Lecturer 2: I don't subscribe to that. Letting students work in group is just one of the pedagogical strategies a lecturer can adopt but over reliance on that has its own consequences. Then it means that you might not be in a position to know the individual student's strength. Because in a situation where student work in group you may have a situation where just one or two students will be doing the works and the rest will just be enjoying in the glory of those few students who are actually doing the work. So if you continue doing team work because you have so much number to handle, and you want things to be easy for as lecturer, how are you able to assess the

strength of the individual student? In my teaching approach, I use a lot of strategy. Teamwork or group work is just one of those strategies.

Interviewer: Well, talking about idea development, ideation which has to do with making series of drawings on a brief before one is selected for final designing. We usually use sketches, pencil and paper like that but these days there is a digital approach to it. I want to know, how do your students go about idea development?

TT Lecturer 2: Fine, the thing about idea development is that there is no hard and fast rule about one particular approach. It is like everybody has his or her own style of generating ideas, which way to go; whether to go pen and paper or digital. I do not direct them as to a specific way they should approach a project in terms of generating ideas. I leave them to do what works for them. Whether generating the ideas digitally or by using the traditional pencil and paper method.

Interviewer: But talking about the digital, which software do your students use?

TT Lecturer 2: It depends on the project they are working on. If they are working on a vector based project like logo design, then they will use CorelDraw or illustrator for generating the ideas. If they are using a bitmap based project, then they will be using Photoshop.

Interviewer: Before you assess the final work that they have done, do you sometimes do you look at the idea development that led to the final design?

Not always. It depends on the rubrics I have set for myself. If the assessment criteria call for me to look at the idea development stages, I call for it. If it doesn't, then I don't always look at idea development.

Interviewer: Do you see traces of artificial intelligence in students' approach to graphic design?

Of course if those digital tools are available for use, why not? They will rely on it. The students always don't execute every assignment in the classroom

under the supervision of the lecturer. So it is quite difficult sometimes for the lecturer to know how they go about the work. And I think that is one of the issues we having to grumble with. It is difficult for teachers to tell if all the students are doing the work themselves or somebody is assisting them because the numbers will not just permit that and so they most of the work at home and bring for assessment. The only way teachers are able to interrogate a bit is to ask students questions and through their responses, teachers are able to come to a conclusion as to whether the students did the work themselves or otherwise.

Interviewer: Ok. Thank you very much. Your contributions are very good and going to be helpful to me.