Online studios and digital literacy skills among undergraduate students: An activity theory perspective

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MHNBLE002

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(SOME RESOURCES WERE TAKEN FROM PREVIOUS ASSIGNMENTS I.E. LITERATURE REVIEW, THEORETICAL FRAMEWORK)

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"If I have seen further, it is by standing on the shoulders of the giants"

Sir Isaac Newton.

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Hats off to you all!

Blessed A Mhungu.

Abstract

Recently, most higher education institutions have undergone significant technological transformation, largely attributed to the outbreak of COVID-19 pandemic and the subsequent rise in online education and the use of emerging technology tools . Consequently, the prevailing discourse no longer revolves solely around the feasibility of online education as a tool but pivots towards an inquiry into the extent of its usefulness in specialised domains such as design and technology fields. Research on the implementation of online education in design and technology fields is scant and yields inconclusive results, particularly concerning the pedagogical methods and the practicality of online instruction. As a result, investigating the practicality of online studios in enhancing digital literacy skills within the design and technology fields has , thus, become significant and urgent. Success in this endeavour hinges upon lecturers' proficiency with technological tools that facilitate cognitive development. This could necessitate the shift away from the traditional 'master-apprentice' model to a more 'cognitive-apprentice' model, which emphasises deeper understanding of the underlying principles, problem-solving techniques, and decision-making processes used by experts.

The research question posed by the study was: What digital literacy skills do online studios promote among undergraduate students in a discipline-specific setting such design and information technology fields? The goal was to explore how educators in visual communication design programme and multimedia could transition from traditional studio methods to an online studio-based curriculum infused with technology. Theoretically, the study drew on Cultural Historical Activity theory (CHAT) sociocultural learning theory of Vygotsky, its influence on the three generations of activity that Engeström propounded, and the expansive learning model that Engeström developed. CHAT considered studio practices as a system of activities wherein collective work is undertaken by individual and group actors in pursuit of a common goal. Adopting an empirical exploratory case study approach, the study was conducted in a real-world context in real time, using multi-site, multi-method strategy for data collection and analysis. Data collection methods included interviews, focus groups and participant observations from students and lecturers at university of technology's faculty of Informatics and Design. The findings of this study reveal contradictions and tensions within the visual communication design programme and multimedia programme activity systems. Furthermore, the findings suggest that the transition to remote teaching during the COVID-19 pandemic presented an opportunity for lecturers to explore alternative methods to facilitate a studio pedagogy, most of which involve digital modalities of content delivery. The emergence of expansive learning fused with blended learning approach emerged as a 'great-promise' for integrating technology into the studio. This approach is considered crucial in equipping students with relevant 21st century skills and enhancing their digital literacy, thereby addressing the evolving demands of design and technology education in the contemporary digital era.

Keywords: *Studio-based Learning, Studio, Blended Learning; Cultural Historic Activity Theory, Transformation, Digital Literacy skills, Higher Education, Educational Technology.*

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ACRONYMS

4C	Critical thinking, Creativity, Collaboration and Communication
4IR	Fourth Industrial Revolution
AT	Activity Theory
CHAT	Cultural Historic Activity Theory
CILT	Centre for Innovative Learning and Teaching
DL	Digital Literacy
HEIs	Higher Education Institutions
HR	Horizon Report
ICT	Information and Communication Technology
IT	Information Technology
LD	Learning Design
MM	Multimedia
OLD	Online Learning Design
UCT	University of Cape Town
VCD	Visual Communication Design

CHAPTER 1: INTRODUCTION

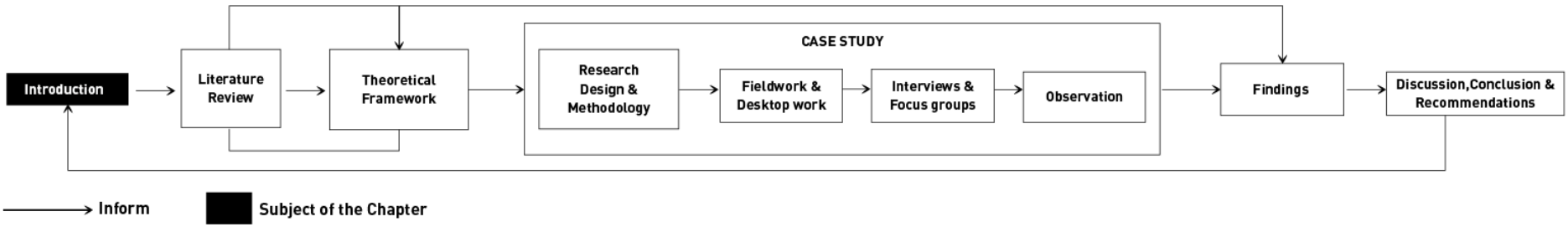

Figure 1. 1: *Outline of Chapter 1*

1.1 Introduction

Most higher education institutions experienced significant technological transformation largely attributed to sudden rise in the use of emerging technology and digital technology tools for teaching and learning since the outbreak of COVID-19 pandemic. The notion that online education can be used as tool to enhance teaching and learning is no longer disputed in academia. Consequently, the prevailing discourse on online education no longer revolves around the usefulness of online education as a tool in general but pivots towards its promotion in specialised domains such as visual communication design and multimedia design programmes."

Several studies have highlighted the potential of online education when situated within a framework of student-centred learning that emphasise collaboration, instead of the conventional teacher-centered practices that continue to dominate higher education (Said et al., 2014; Fleischmann, 2021). Research shows that online education continues to gain popularity in higher education since the outbreak of COVID-19 pandemic, albeit with varying degree of impact – with design – related courses being most adversely affected (Fleischmann, 2022).

Research on the implementation of online education in design fields remains limited and inconclusive. An investigation of the appropriateness of online education to foster digital literacy skills among undergraduate students in design and technology related fields has, thus, become urgent. However, challenges still exist in these fields such as high dropout rates, students struggling with digital literacy skills and failing to complete their courses on time (Smith & Johnson, 2021). Despite these challenges, there is an urgent need to foster digital literacy skills as a majority of countries are shifting from manufacturing-based economies to knowledge-based economies. By implication, a digital knowledge production process will require digital literacy skills such as the ability to: communicate, collaborate, use digital technology tools to access and communicate information (technical skills), think creatively, question the usefulness of digital information (cognitive skills); and create content either individually or collaboratively with others (social emotional skills), in online digital spaces (Mayisela, 2019).

1.2 Background

Over the past two decades, South Africa's higher education institutions underwent digital transformation caused by emerging technology and digital technology tools for digital content creation. According to European Science Hub (2019) *in* Mayisela (2019), digital content creation involves "creat[ing] and edit[ing] digital content to improve and integrate information and content into an existing body of knowledge while understanding how copyright and licenses are to be applied".

Similarly, the demand continues to grow in educational studio related courses. Educational studio spaces unlike other traditional disciplines follow a unique pedagogy often regarded as a 'signature pedagogy' (Ioannou, 2018, p.2). A 'signature pedagogy' is a teaching and learning strategy and a place where "a professional situation is reproduced in an academic context" (Ioannou, 2018, p.2; Masdeu & Fuses, 2017, p.8). Laurillard (2012, p.220) for example described the educational studio as a "place where students are taught to be professionals in a specific subject matter context". In addition, Schön's (1987, p.70) study refers to the educational studio as a 'reflective practice' - a place where students are taught to be subject matter experts.

Schön (1987, p.70) describes this reflective practice as "learning-by-doing" – Shulman (2005, p. 52), more so defines the studio as a teaching environment that "organises the fundamental ways in which future practitioners are educated for their profession". The scholars like Ioannou (2018, p.2) and Shulman (2005, p.52) -distinguish the educational studio from other pedagogies by highlighting three dimensions that characterise studio-based learning as a signature pedagogy: firstly, a deep structure of assumptions about how to best impact knowledge; secondly, an implicit structure as a set of beliefs, values and attitudes otherwise referred to as the "hidden curriculum" (Schön, 1987, p.70) and finally, a surface structure of operational acts of teaching and learning. Based on (Schön, 1987, p.70) views, most academics believe that this 'master-apprentice' studio model which, always followed a face-to-face approach cannot be fully taught online (Fleischmann, 2018a; Fleischmann, 2018b)."However, even before the pandemic struck, educators like Morkel (2011) already started experimenting on the idea of blended learning and digital technology tools in re-shaping the studio space. Since 2014, Morkel conducted feedback and critiques also known as 'crits' (p.8) through a blended approach – with - success (see for example Morkel & Cronje, 2022). Although Morkel's (2011) work - demonstrates that some elements of - studio courses can be taught online, programmes like visual communication design and multimedia technology cannot share similar experiences because of their current structure.

1.1.1 Current Studio

Since the outbreak of COVID - 19, many educators across the globe were forced to work remotely including those teaching studio related courses. Confronted with the new reality of remote learning, without adequate knowledge for online teaching, and insufficient support from educational technology teams – most lecturers experienced work burnouts, fatigue and mental health problems (Hodges et al., 2020). This led to hastily developed and often poorly designed courses (Gachago et al., 2023).

Most lecturers' efforts in shifting from a long-standing traditional studio approach to a partially/fully online studio showed varying results and experiences across design and technology fields. Without generalisations, their efforts and process were largely characterised by the 'herd' or 'tribal' mentality, a way of thinking based on the culture of the disciplines of design and technology fields (Morkel & Cronje, 2022). Other lecturers' efforts were characterised by the 'wait-and-see' attitude based on the practicality of teaching design and technology subjects online, normally perceived as impossible. The majority of lecturers' concerns stemmed from the value of face-to-face interactions, and feedback processes in the form of design critique which are seen as difficult to replicate online (Bender & Vredevoogd, 2006). On the other hand, some lecturers efforts were characterised by 'just-get-it-done' and 'put-it-online' mentality (Morkel & Cronje, 2022; Hodges et al., 2020, p.15). Most lecturers' efforts were primarily focused on how to reconfigure traditional studio spaces to online studio spaces without losing the studio culture (Fleischmann, 2020).

On a fundamental level, there is a growing shift towards long-term transformation of the traditional studio pedagogy to foster digital literacy skills also known 4C's of 21st century learning such as critical thinking, creativity, collaboration and communication (Baggio, 2010; Muganga & Ssenkusu, 2019). As Anderson (2004) puts it, "transformative learning takes place when technology is used to foster high-levels of student-student; student-content; student-teacher interaction" (p.110). From these studio transformation developments, it is clear that online studios are gaining momentum forcing lecturers to rethinking their teaching and learning strategies in studio courses (Fleischmann, 2020). There is a need to transform current studio pedagogies to make them 'digital maker spaces' for students to explore the boundaries of design fields and new emerging technologies in their studio activities. As Francis and Hardman (2018) stated, "an activity should be grounded in the purpose and context in which it is situated" (p.69). In this study, studio activities are described as "a set of activities put together in a systematic format to achieve higher cognitive functions through the use of cultural tools in a process called mediation" (p.69). Furthermore Vygotsky (1978) referred to the mediation process of any activity as only achievable through the use of cultural tools such as language, text and images. Vygotsky (1978) elaborates that the presence of cultural tools benefit the subjects by allowing them to develop higher order thinking skills or creativity skills within a given context or specific environment as a collective.

1.2 Rationale for the study

The motivation for this study is to advance knowledge in the fields of design and technology on online studios and how students' digital literacy skills could be fostered through online studios to prepare them for knowledge production in the design practice. By the same token, developing

and producing highly qualified knowledge graduates with relevant 21st century skills remains a primary goal of many governments, higher education institutions, educators and business leaders across South Africa and many other African countries.

According to Mayisela (2019), there has been an increasing call to focus on the digital literacy practices of university students instead of mastering their technical skills, but there is currently limited theoretical and empirical research on digital literacy skills that are developed in online studios. To cover these knowledge gaps, current traditional studio pedagogy needs to be transformed (Sinfield & Cochrane, 2020). The degree to which this can be achieved depends on teaching and learning strategies in place as well as technological tools in place to promote cognitive development that is shift away from 'master-apprentice' to 'cognitive-apprentice' model. In the cognitive-apprentice model, the emphasis is on how students acquire not only specific skills and knowledge but also the cognitive processes and strategies used by experts in discipline specific settings (Collins et al.,1991). The cognitive-apprentice model is based on the idea that learning is not just about memorising facts or following instructions but involves a deeper understanding of the underlying principles, problem-solving techniques, and decision-making processes used by experts (Collins et al., 1991).

Transformative blended learning approach is one of the key teaching and learning strategies to bring more technology and transformation in the current studio spaces. It offers a "great promise" (OECD,2018, p.77) to help students develop their digital competency skills, promote team work and collaboration among other relevant 21st century skills such as critical thinking and problem-solving skills (Sinfield & Cochrane,2020). The rationale of this study is to make theoretical contributions in the fields of design and technology to guide how digital literacy skills can be fostered by online studios. In addition, the purpose of this study is to contribute towards lecturer interventions where critical thinking, risk taking, imaginative exploration and productive failure are accepted as positive processes of learning and development (Danvers, 2003,p.52). Danvers (2003) argued that "Creativity thrives in an atmosphere that is supportive, receptive to new ideas and activities". He posits that creative literacies are those literacies that bring about a shift from consumption to production of digital content.

1.3 Research Problem

The manner in which some of South Africa's higher education institutions (HEIs) have digitally transformed over the last two-decades has been a great subject of debate and controversy (Ng'ambi et al.,2016). For instance, some fields like design and technology which primarily focus on studio-based pedagogy have seen a rather slow transformation due to pedagogical practices

in those fields (Ng'ambi et al.,2016; Smith & Johnson, 2021). Although the implementation of digital literacy and digital technology in the design and technology fields is not a new phenomenon, the rate at which they are being developed and implemented has been slow (Dreamson, 2020, p.495). As a result, most faculty in design fields and their students struggle to develop and implement curriculum driven by emphasise on digital literacy skills such as communication, collaboration, creativity and critical thinking. During the COVID-19 pandemic, lecturers in design and information technology fields struggled to increase student engagement during online classes.

Although the Department of Higher education and training (DHET) has made efforts to promote educational transformation across the country to foster critical thinking, digital literacy skills as well as problem-solving skills which are considered vital for the country's economic development (Department of Higher Education and Training [DHET], 2013, Partnership for 21st Century Learning, 2015), the progress has been slow. With the COVID-19 pandemic and its enduring legacy still exerting pressure on the effectiveness of the current studio, an investigation is required to explore emerging technologies and their affordances to understand how the current traditional studio can be transformed to an online studio to foster undergraduate students' acquisition of 4Cs: critical thinking, creativity, collaboration and communication (Partnership for 21st Century Learning, 2015) to meet the requirements of the current digital age (Baggio, 2010; Muganga & Ssenkusu, 2019). Currently, there is a dearth of research focusing on the teaching pedagogy employed by instructors in online studios to facilitate the making of instructional decisions in the studio normally characterised by its social nature, collaboration, feedback, and critique sessions. If an investigation is not done, there is a risk that graduate students particularly in the fields of design and technology will fail to meet current demands of the industry — further lagging behind their counterparts in the global north countries. Online studio pedagogy could encourage interactions between students in which: critical thinking is encouraged through activities that stimulate robust problem-solving abilities where risk-taking, imaginative exploration and productive failure are accepted as positive processes of learning (Danvers,2003,p.52).

1.4 Research Questions

The research questions guiding this study are outlined as follows:

1.4.1 Main research question: What digital literacy skills do online studios promote among undergraduate students in a discipline-specific setting of design and information technology fields?

1.4.1.1 Sub-question 1: What were lecturer's pedagogical practices in the studio before and during Covid-19?

1.4.1.2 Sub-question 2: How did these practices influence the development of 21st century 4Cs (critical thinking, creativity, collaboration and communication) skills in students?

1.4.1.3 Sub-question 3: What pedagogical practices are required for online studios to foster digital literacy among undergraduate students in design and technology related fields?

1.5 Aims and Objectives of the study

The study investigates the potential of online studios in design and technology education to foster digital literacy skills also known as the 4Cs (critical thinking, creativity, collaboration and communication) of 21st century learning among design and technology undergraduate students (Muganga & Ssenkusu, 2019). Students drawn from two Design programmes, based across two departments in the Faculty of Informatics and Design: Visual Communication Design (VCD), based in the Applied Design Department and Multimedia (MM), based in the Information Technology Department were chosen for the study. The two departments were of interest to study because they offer design courses and programmes that were listed as part of critical skills currently in need in South Africa, see the Figure 1.2 in chapter 1 and make use of studio pedagogy specifically. The objective is to foster students' acquisition of skills and to promote transformative learning. The study aims and objectives are summarised in table 1 below.

Table 1. 1: *Summary of research questions guiding the methodology*

Research Aim	The aim of this study design and promote pedagogical practices for the online studio to foster undergraduate students' acquisition of 21st century digital literacy skills.	
Main Research Question	What digital literacy skills do online studios promote among undergraduate students in a discipline-specific setting of design and information technology fields?	
Research Sub-questions	**Objectives**	**Research Methods**
What were lecturer's pedagogical practices in the studio before and during the Covid-19?	To understand pedagogical practices in the studio before and during Covid-19.	Interviews, Focus groups, participant observations
How did these practices influence the development of 21st century 4C's (critical thinking, creativity, collaboration and communication) skills in students?	To identify the enablers or contradictions influencing students' digital literacy practices in the studio spaces.	Interviews, focus groups, participant observations

What pedagogical practices are required for (online) studios to foster digital literacy among undergraduate students in design and technology related fields?	To identify pedagogical practices and digital technology tools that can be used in online studios to foster digital literacy skills.	Interviews and focus groups

1.6 Significance of the study

The significance of the study is premised on the rapid rise and prominence of online education within higher education globally and in South Africa accelerated by the COVID-19 pandemic. The study focuses on two programmes within the Faculty of Informatics and Design at a University of Technology in the Western Cape. The study explores pedagogical strategies in which traditional studios can be adapted to online studios and how students can develop their digital literacy skills. As a matter of urgency, current studios must transform to meet the demand and challenges of today's higher education. There is a significant need to transform these spaces to foster student-to-student; student-to-content; student-to-teacher; content-to-student and content-to-teacher high-levels of interaction with emerging technologies in design and technology fields.

1.7 Terminology of the study

21st Century Learning – Focuses on equipping students with the skills and knowledge needed to thrive in a rapidly changing, globally connected, and technology-driven world. This approach emphasises not only academic excellence but also the development of essential skills that prepare students for the complexities of modern life and work (NRC Report,2012, Partnership for 21st Century Learning, 2015).

21st Century skills – Refer to a set of abilities and competencies that are considered essential for success in today's world, particularly in the context of education and the workplace. They are also known as 4Cs of 21st century learning and they include, communication, collaboration, creativity and critical thinking. These skills are geared towards preparing individuals to thrive in a rapidly changing, technologically advanced, and globally interconnected society (NRC Report,2012; Partnership for 21st Century Learning, 2015).

Blended Learning – Is a combination of face-to-face (F2F) classroom instruction with online learning activities and digital resources (Muhuro & Kang'ethe, 2021). It involves the integration of different modes of teaching, models of delivery and deployment of various technologies, and teaching modes to meet specific knowledge sharing, and information needs. The blended learning model leverages the strengths of both in-person and online education to create a more flexible and personalised learning experience for students.

Cognitive-apprenticeship model – Is an instructional approach to teaching and learning that places emphasis on how students acquire not only specific skills and knowledge but also the cognitive processes and strategies used by experts in discipline specific settings (Collins et al.,1991). The cognitive-apprentice model is based on the idea that learning is not just about memorising facts or following instructions but involves a deeper understanding of the underlying principles, problem-solving techniques, and decision-making processes used by experts (Collins et al.,1991).

Collaboration – Collaboration is a key component of 21st-century skills, emphasising the ability to work effectively and efficiently with others (NRC Report,2012, Partnership for 21st Century Learning, 2015).

Creativity – Is one of the fundamental 21st Century Skills, encompassing the ability to generate new ideas, think outside the box, and innovate ideas (NRC Report,2012, Partnership for 21st Century Learning, 2015).

Critical skills – Refers to digital technology skills considered as scare and rare in the South African Labour Market (Department of Home Affairs, 2021).

Critical thinking – Is a core 21st-century skill that involves analysing information, evaluating evidence, and making reasoned decisions (NRC Report,2012; Partnership for 21st Century Learning, 2015; OECD,2018).

Cultural Historic Activity Theory (CHAT) – Is a sociocultural constructivist learning theory rooted in Soviet cultural-historic research. At its core, activity theory revolves around the notion of human activity—a dynamic concept wherein individuals develop their personalities, consciousness, skills, generate novel cultural artefacts and catalyse transformations in social conditions (Engeström ,2001; Sannino et al., 2009).

Design – Refers to a discipline of study in the context of this research. It encompasses other sub fields such as architecture, visual communication design, product design and industrial design and multimedia design (Author,2023).

Design Studio – Is a dynamic, interactive learning environment primarily used in design related courses. It functions as a collaborative space where students engage in hands-on, project-based work to develop their design skills through design exercises, or projects as they are usually called (Goldschmidt et al.,2010).

Digital Literacy – Digital literacy also known as 4Cs of 21st century learning is the ability to navigate the digital world using reading, writing, critical thinking and technical skills. It also involves an individual's ability to find, evaluate and communicate information through digital platforms (Glister,1997).

Expansive learning – Expansive learning, as proposed by Engeström (2001), is a framework rooted in Cultural-Historical Activity Theory (CHAT). It refers to a form of learning that transcends traditional boundaries and involves the collaborative creation of new knowledge and practices (Daniels et al.,2010). Expansive learning is seen as a response to complex, systemic challenges that cannot be addressed by existing knowledge or approaches. This type of learning is particularly relevant in contexts where innovation and transformation are necessary such as online studios (Schnabel & Ham, 2012).

Information Technology – Refers to a discipline of study in the context of the study. It encompasses other sub fields such as application development, communications network, informatics and multimedia design (Author,2023).

Master-apprenticeship model – Is a traditional approach to learning and skill development in which an experienced expert, often referred to as the 'master,' mentors and guides a less experienced individual, known as the 'apprentice,' in a particular craft, trade, or skill.

Online Studios – Refer to virtual learning environments where students can engage in design projects, receive feedback, collaborate with peers, and interact with lecturers in real-time or asynchronously (Schnabel & Ham, 2012; Meyer, 2014). These online studios are designed to replicate the collaborative and hands-on experience of traditional design studios, utilising digital tools and platforms to facilitate learning and creativity (Schnabel & Ham, 2012; Meyer, 2014).

Pedagogical practices – Refers to the methods and strategies used by teachers to facilitate learning. These practices are informed by educational theories and are designed to engage students, promote understanding, and foster critical thinking and problem-solving skills .

Traditional Studios – Traditional studios in design education are physical spaces where students engage in hands-on, experiential learning through direct interaction with instructors, peers, and materials (Schön,1983; Dutton,1987). These studios foster creativity, collaboration, and the development of practical design skills in a controlled environment (Anthony,1991).

1.8 Delineation and limitation of the Study

The study is built on the broad concept of online education in higher education but with a narrow focus on online studios. The study draws inspiration from the studies of Fleischmann (2020) and Sinfield and Cochrane (2020) on studio transformation and online studios. The primary goal of this study is to understand how current traditional studio pedagogy could be transformed to online studios. The goal is to foster undergraduate students' acquisition of 4Cs of 21st century learning: critical thinking, creativity, collaboration and communication to meet the requirements of the current digital age (Muganga & Ssenkusu,2019).

Although the study is focused on the design and Information and technology fields because of the rise in demand to train more knowledgeable graduate in the area of critical skills [1] (i.e, skills considered as scarce and rare in South Africa, see Figure 1.2 below), the findings of this study could be applied to other disciplines and fields that are interested in the concept of the studio and studio-based pedagogy. Findings of this study could be used to transform other disciplines and help them meet their targets and goals since studio-based pedagogy focuses on learning by doing and producing different kinds of artefacts. In the current knowledge economy, we see the rise in the need to produce different kind of artefacts be it text, programming code, sound or images.

6-DIGIT OFO CODE	6-DIGIT OFO DESCRIPTION	MINIMUM QUALIFICATION REQUIRED	PROFESSIONAL OR LICENSE-TO-PRACTICE REQUIREMENTS	PROFESSIONAL BODY
2019-216101	Architect	Bachelor's degree or advanced diploma (NQF Level 7)	Yes	South African Council for the Quantity Surveying Profession
2019-216601	Digital artist	Bachelor honours degree, postgraduate diploma, or bachelor's degree (NQF Level 8)	No	
2019-216603	Multimedia designer	Bachelor's degree or advanced diploma (NQF Level 7)	No	
2019-216604	Web designer	Bachelor's degree or advanced diploma (NQF Level 7)	No	
2019-251203	Developer programmer	Diploma or advanced certificate (NQF Level 6)	No	Membership in the Institute of Information Technology Professionals South Africa will be preferable
2019-251301	Multimedia specialist	Bachelor's degree or advanced Diploma (NQF Level 7)	No	Membership in the Institute of Information Technology Professionals South Africa will be preferable
2019-251302	Web developer	Diploma or advanced certificate (NQF Level 6)	No	Membership in the Institute of Information Technology Professionals South Africa will be preferable
2019-251401	Applications programmer	Diploma or advanced certificate (NQF Level 6)	No	Membership in the Institute of Information Technology Professionals South Africa will be preferable
2019-251901	Computers quality assurance analyst*	Diploma or advanced certificate (NQF Level 6)	No	Membership in the Institute of Information Technology Professionals South Africa will be preferable

Figure 1. 2: *Government Gazette Critical Skills List Draft 2021; Source: http://www.gpwonline.co.za/*

[1] Newly updated critical skills list: https://www.dha.gov.za/index.php/notices/1512-critical-skills-list-checklist

1.9 Structure of Dissertation

The study is made up of six chapters aimed at informing each other to produce a coherent and logical argument for the research. At the end of these chapters is a list of references followed by a list of appendices. The dissertation chapters are outlined as follows:

Chapter one lays the foundations and key arguments in the field of study by outlining the problem statement, research questions, as well as aims and objectives of the study.

Chapter two presents an in-depth literature review of the studio phenomenon in the field of design and technology education. It provide a brief historical account of the origins of the studio, how it developed as well as how it continues to evolve to what it is today. The chapter also discus about digital literacies, how they have evolved as well as 21st century key literacy skills known as 4Cs of 21st century learning: critical thinking, creativity, collaboration and communication.

Chapter three looks at theoretical underpinnings and conceptual frameworks that guide the study as well as justification why these theories and frameworks are adopted in the study. The third generation Cultural Historic Activity Theory (CHAT) framework is also used as parts of the methods used to collect and analyse the data on the current study. To formulate chapter three correctly, CHAT theoretical underpinnings form the basis to which this chapter is built upon.

Chapter four present the research approach, methodology and data collection methods suitable for an empirical study. Data collection methods including advantages and disadvantages associated with each method in an empirical study are covered in this chapter.

Chapter five presents the findings of the study on the dynamics of online studio activities and their impact on digital literacy skills of undergraduate students. The chapter provides valuable insights into the complex interplay between lecturers, students, tools and socio-cultural context within face to face, blended and online studio environments and conditions required for these to foster students' acquisition of 4Cs.

Chapter six is the discussion, conclusions and recommendations for the study. It highlights further research in the field as well as contributions made and the significance of these contributions in developing the field. The figure 1.3, below, provides a detailed diagram of the structure of the dissertation.

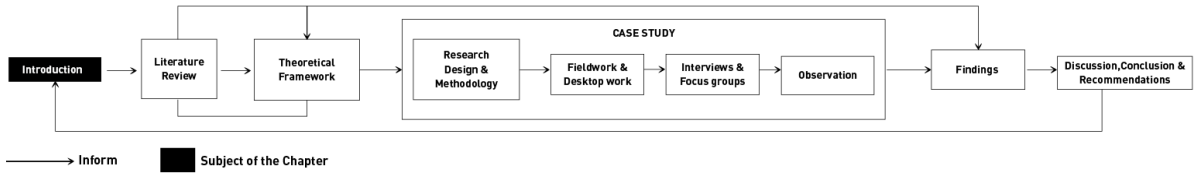

Figure 1. 3: *Diagrammatic summary of Dissertation outline*

1.10 Summary

Chapter presented the introduction and background of the study, followed by a detailed account of current debates in the field of design when it comes to transforming the current studio space. The chapter also included aims and objectives as well as the study's delineation and limitations. A brief rationale outlining the importance of the study was also presented in this chapter to guide the readers understand the significance of the study. The following chapter is a literature review chapter which provides major highlights on the educational studio concept and how it has developed over the years. Lastly, the chapter presents literature on digital literacy and how it has evolved.

CHAPTER 2: LITERATURE REVIEW

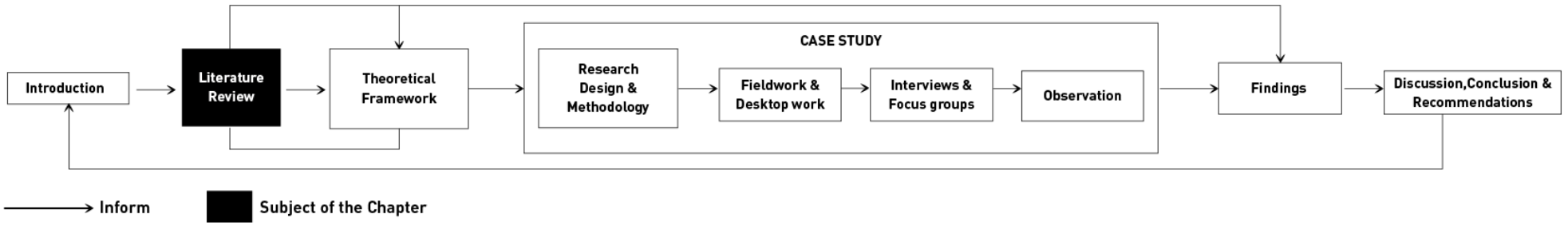

Figure 2. 1: *Outline of Chapter 2*

2.1 Introduction

The notion that online education and emerging technology systems have the potential to transform traditional pedagogies in higher education is no longer disputed in academia since the outbreak of the COVID-19 pandemic a few years ago. In effect, the question is no longer whether it is possible to teach certain courses online, but how these courses can be taught in fields like design and technology education. These circumstances keep raising significant pedagogical concerns regarding the creation of effective online learning environments within the complexities of today's online education landscape. Literature available shows that online teaching gained substantial popularity in higher education institutions globally but there is a dearth of research focusing on the teaching pedagogies employed by instructors in online classes to facilitate online studio teaching and learning (Fleischmann, 2021). This chapter provides a discourse on the studio phenomenon, its origins, meaning and actual activities taking place in the studio.

The studio phenomenon is elaborated in section 2.2, below, with key debates of the studio environment presented in sub-section 2.2.1. Nevertheless, subsequent sections (2.3 and beyond) outline the concept of digital literacy as well as key digital literacy skills known as 4Cs of 21st century learning: critical thinking, creativity, collaboration and communication (Muganga & Ssenkusu, 2019) in the field. This is followed by section 2.4 which looks at pedagogical strategies to foster digital literacy in online studios in design and technology disciplines. Finally, the chapter concludes with a brief summary on the influence of digital literacy in higher education and their relevance to the fields of design and technology.

2.2 Studio-based pedagogy

The studio-based pedagogy is one of the pedagogical practices synonymous with the academic fields of architecture, visual communication design, photography, and industrial design as well as multimedia technology. Researchers like Schön (1987) claimed that studio-based education has the potential to be used for students in other disciplines in order to learn the practices of the field. As Schön (1987) pointed out, design guidance is carried out by the 'master-apprentice' model which contributes to students acquiring knowledge to solve complex problems. The Master Apprentice model is a traditional approach to learning and skill development in which an experienced expert, often referred to as the "master," mentors and guides a less experienced individual, known as the "apprentice," in a particular craft, trade, or skill. Recently, some lecturers in have attempted to redesign their studio-based pedagogy from the master-apprenticeship model to cognitive apprenticeship model. In the cognitive apprentice model, the emphasis is on how students acquire not only specific skills and knowledge but also the cognitive processes and

strategies used by experts in discipline specific settings (Collins et al., 1991). The cognitive-apprentice model is based on the idea that learning is not just about memorising facts or following instructions but involves a deeper understanding of the underlying principles, problem-solving techniques, and decision-making processes used by experts (Collins et al., 1991).

This means that the studio-based learning now allows students to participate in active learning by fostering collaboration, communication, critical thinking and creativity in the learning process. Design studios are considered spaces where creativity and subjective knowledge dominate (Ramaraj, 2017).

2.2.1 Studio-based teaching and learning process: pre-COVID-19 pandemic

Studio-based teaching and learning pre-COVID-19 pandemic predominantly focused on theory lectures, studio sessions and digital software-training tutorials where teaching and learning activities included direct lectures where cooperative learning, group work and collaboration were key characteristics of studio (Obeidat & Al-Share, 2012). Other activities were designed to provide students with technical, theoretical and practical skills required in the industry. In terms of the relative proportion of time spent in the classroom setting, fifty-percent was spent on practice through projects, whilst the other fifty-percent was based on skills-oriented tasks and lectures (Obeidat & Al-Share, 2012). The fundamental design of courses in the studio primarily focused on theory aimed at developing students' technological skills by fostering digital literacy as a basis of design knowledge creation relative to the design industry (Kim, 2016). In this phase, students were given assessment tasks through project briefs with clear and detailed instructions to foster students' 4Cs of 21st century learning: (critical thinking, creativity, collaboration and communication). Other activities included fostering artistic or practical skills, including technical drawing, design programming, model making, ideation and visualisation process with the aim of expressing and visualising or executing ideas, a process known as ideation (see Figure 2.2, 2.3 & 2.4).

Figure 2. 2: *Ideation process from concept to final digital execution*

Figure 2. 3: *Power of colour, Magazine project Ideation process from concept to final digital execution*

Figure 2. 4: *Power of colour, Magazine project Ideation process from concept to final digital execution*

Source: *A collection of student work showcasing ideation and visualisation process in the studio (2022-2023)*

As the above iterations proceed, students gained access to a broader range of ideas and content in their knowledge creation process. Central to the studio activities as the above illustrations have shown was the positioning of work as never complete but always on a pathway towards better iterations (Brocatto, 2009). Students were required to showcase their work in diverse representational modes such as sketching known as scamping on paper or drawing with digital software at their disposal (Cennamo et al., 2011).

2.2.2 Studio-Based Learning during the COVID-19 pandemic

During the outbreak of COVID-19, lecturers globally were forced to work remotely, compelling everyone, including staff in in design and technology fields, to rethink their teaching strategies. Before the COVID-19 pandemic, online learning was adopted in limited ways in design and technology courses and other arts related courses, as such, shifting from the long-standing traditional studio approach to a partially/fully online studio showed varying results and experiences across design and technology fields (Morkel & Cronje, 2022). Both novice and experienced lecturers unfamiliar with online teaching mostly adopted a 'just-get-it-done' and 'put-it-online' approach (Hodges et al., 2020). This raised significant pedagogical concerns regarding the

creation of effective online learning environments within the complexities of today's online education landscape.

However, some studio-based learning activities shifted online even though some lecturers were doubtful about teaching design remotely online. The lecturers were concerned about losing the value of face-to-face interactions, iterative processes and studio critique sessions (Fleischmann, 2020). For contextual framing, while some lecturers in South Africa's higher education were willing to go an extra mile to get technological training to teach with technology, some over exerted themselves and experienced work fatigue resulting in fast-tracked and/or poorly designed courses (Hodges et al., 2020). Less attention was given to the relevance of online learning in artistic disciplines and their pedagogical frameworks. This raised some fundamental questions regarding the feasibility of teaching design related courses online. Some even questioned whether the quality of teaching and learning would remain the same when compared to traditional teaching methods often carried out in the studio (Fleischmann, 2020). To date, academia seems to be clearly divided on the notion of teaching design related courses and subjects online.

2.2.2 Traditional studios vs Online studios

The historical development of the traditional studio and online studio shows that for a long time, there has been ongoing misgivings about online studios interfering with the traditional studio creative process. In addition, most critics remain doubtful whether online studios are of any value to the design and technology curriculum. For example, critics like Yorgancıoğlu (2020,p. 34), argued that digital tools can limit the "hands-on experimental process of design learning that are embedded in design education". In addition, scholars like Fleischmann (2020), highlighted that the traditional studio pedagogy is based on a concept coined by Schön, (1987) called "learning-by-doing" through the experiential learning model developed by Kolb (1984). Learning by doing as Schön, (1987) highlighted is about acquiring knowledge through discovering, observing and experience which, "often involve doing," making and reflective thinking" (Marshalsey & Sclater, 2018 *in* Fleischmann, 2020). Most lecturers remained doubtful that the same could be achieved in an online studio.

Moreover, a study by Fleischmann (2020) also stated that physical studios which often include workshops and laboratories, are collaborative spaces that facilitate peer interaction and a type of 'camaraderie' which cannot be found online. In support of this argument, scholars such as, Shreeve et al., (2010) and Morkel (2011), further argued that the studio has an important social dimension in traditional studio pedagogy which takes time and careful consideration to implement

online. The study of Wragg (2020, p.2288) further pointed that the studio pedagogy is still portrayed as a space where "inexplicable magic" takes place.

Although the traditional studio pedagogy has proven to be successful over the years, it has recently seen a shift as we transitioned to online and remote learning during the COVID-19 pandemic (Sinfield & Cochrane, 2020). In the online and remote learning model also known as digital learning model, emphasis is on courses that explore design media (digital software, technologies, and associated technical processes). Learning is further augmented with digital technology tools such as online learning management systems, digital tools and some use of social media (Sinfield & Cochrane, 2020). Furthermore, scholars like Sinfield and Cochrane (2020) based at the centre for the Study of Higher Education at the University of Melbourne, Australia championed for the re-design of current studio curriculum towards fostering digital literacy skills in the current digital age.

The existing traditional studio pedagogy with its expert-centred approach requires transformation to accommodate other forms of knowledge creation in the current digital age. Regarding the on-going debates about traditional studios and online studios, Sinfield and Cochrane (2020) suggest redesigning alternative models to the current traditional studio pedagogy to foster critical thinking, creativity, collaboration and communication considered a key requirement in the current digital world. In addition, the studies of Morkel and Cronje (2022) highlight that traditional studio activities like critique sessions can be carried out online, if carefully designed and facilitated. Their study suggests that doing online crits is beneficial to the students as it is learner centred and encourages negotiations on power relations which are often difficult to obtain in a physical studio.

Parallel to this discourse, the study of Cochrane et al., (2020) states that newer teaching and learning methods are urgently required as the current digital age is witnessing rapid rise of service design and systems design globally. For instance, the design sector alone contributes over $1.431 billion to the New Zealand economy - and $2.811 billion to South Africa's economy (Design Co & PwC, 2017 *in* Sinfield & Cochrane, 2020). Although South Africa and New Zealand share many similarities in their economy and culture, New Zealand has performed better economically compared to South Africa over the years and as such it is seen as a good example South Africa could emulate.

In addition, South Africa and New Zealand have also experienced a steady decline in physical print platforms in favour of digital and interactive media platforms through digital technology. This shift in focus of their economic production is rapidly creating new business opportunities for

design and technology fields. On the other hand, Australia too has been on a similar trajectory to New Zealand and South Africa, in Australia for instance, the Ministry of Education and the Ministry of Labour developed a Digital Technology policy strategy aimed at strengthening Australia's graduate digital literacy skills Cochrane, 2020). Since then, there has been a growing call in South Africa to increase graduates in the areas of critical skills which consist of web design, digital design and multimedia design to contribute to the growth of the country's economy (Sinfield & Cochrane, 2020) similar to what they have in New Zealand and Australia .

In the same token, South Africa's technological needs are becoming more pertinent, the studio pedagogy cannot be ignored as it is. The growth of media industries such as online marketing, e-books, online learning, data visualization, interactive storytelling, web design and motion graphics will ultimately cause current traditional studio pedagogy to move online. Furthermore, lack of funding has forced design and information technology programs to consider online studios to expand class size, and consequently reduce dedicated workspaces for students in the studio (Fleischmann, 2020; Jones, Lotz & Holden, 2021). Studies show that the use of computers and emerging digital technology tools in the design fields for instance is enhancing the overall creative process outcomes as well as designer's experience with digital literacy skills.

2.3 Digital Literacy

Following the aftermath of the COVID-19 pandemic, it became clear that digital literacy is a critical competence for empowering citizens in a digital world. Digital literacy has become a key element in teaching and learning across different educational fields. However, confusion remains surrounding its definition and its application in educational settings (Marín & Castaneda, 2023). For instance, some scholars like Zamista and Azmi (2023) define digital literacy as 'the skill to understand and use information in the digital era and how to process this information which will influence interaction patterns in society' (p.7189). In addition, scholars like Hague and Payton (2011), Naufal (2021), Rizal et al., (2022) define digital literacy as an individual's ability to utilise information and communication technology to find relevant information, evaluate it critically, and work based on the information they have obtained. On the other hand, Gilster (1997, p.1) defined digital literacy as the ability to understand and use information and communication technology (ICT) to find, evaluate, utilise, create and communicate content/ information, with cognitive and technical skills.

Furthermore, scholars such as Kalantzis and Cope (1997), Pangrazio et al., (2020) connect digital literacy with new literacies, considering it as a system of cognitive, social and technical skills essential to navigation in the information environment. Similarly, Rizal et al., (2022) consider digital

literacy as important because it enables us to (i) solve problem, (ii) think critically, creatively and innovatively, (iii) collaborate with more people and (iv) communicate more fluently. Researchers Naufal (2021) view digital literacy as a more complex concept which consists of several complex components, such as;

(i) Computer literacy, the ability to effectively use electronic devices and software;
(ii) Information literacy, the ability to independently search, analyse and critically understand information data;
(iii) Technical skills, competent use of social media and use of network technologies with an understanding of the basics of network security and ethical standards.

According to Van Deursen and Van Dijk (2014), digital literacy depends on the development of three types of skills:

(i) Ability to interact with software, which implies the knowledge and skills to work with the content;
(ii) Ability to interact efficiently with electronic device, go online and create digital artefacts;
(iii) Universal skills in working with digital technologies, including design, development of a digital online or offline environment.

In today's rapidly evolving digital landscape, digital literacy competence is paramount. Digital literacy is a critical competence for empowering citizenship in a digital world (Marin & Castańeda, 2023). Students are no longer mere consumers, but also authors of content and can share their ideas worldwide (Dumitru, 2023). Studies by Leguina et al., (2021) and Yin and Choi (2022) demonstrate that digital literacy and access to online education contributes to reducing inequality by providing individualised and personalised learning paths in online settings.

2.3.1 Digital skills required for digitally literate students

There are certain digital literacy skills required for digitally literate students for participation in the online studio as well as information for students about course explanations and procedures. A related and important issue is students' ability to communicate and collaborate with their peers, that is a student's ability to use digital technology to communicate with other students and collaborate in various contexts. A digitally literate student learning in an online studio should be able to "access course content, participate in online class activities and collaborate with other students to achieve deeper levels of knowledge generation through the creation of shared goals, shared exploration, and shared process of meaning-making" (Pallof & Pratt, 2000,p.5).

The literature available suggests that digitally literate students should be critical and creative enough to solve different problems or challenges. Being creative can be described as any " act or process that occurs when the key elements of novelty, appropriateness, and a receptive audience in a given filed comes together to solve a given problem" (Pallof & Pratt, 2000,p.5). Lecturers must also be willing to engage in and facilitate collaboration by promoting creativity, critical thinking and communication through dialogue.

2.3.2 Digital competencies required for digitally literate lecturers

Digital teacher competencies are " the set of skills, knowledge and attitude required by lecturers to support student learning in technologically rich learning spaces and support their own professional development" (Esteve – Mon et al., 2020,p.1). Similarly, Pérez and Fernández (2018) identified several digital competencies that university lecturers need to develop to meet the current needs in their educational contexts: (i) development and implementation of collaborative learning experiences; (ii) teaching planning and design in online environments, (iii) research, development, and pedagogical innovation with the use of information technology, (iv) orientation, guidance, and evaluation, and (v) management of the growth and professional development with information technology.

In addition, other digital competencies required for university lecturers to fully teach online include, (1) information and data literacy, (2) communication and collaboration, (3) digital content creation, and, (4) problem-solving. Marín and Castañeda (2023, p.30) study suggest that mastery of these digital literacy competencies results in (i) empowered individual, (ii), digital citizen, (iii) knowledge constructor, (iv) creative communicator and, (v) global collaborator. In addition, lecturers and higher education administrators must explore alternative pedagogical strategies to current ones through novel educational techniques by developing tools to support students' interaction in the institutional learning spaces.

2.4 Pedagogical Strategies to foster 4Cs digital in online studios

Research on pedagogical strategies required to foster digital literacy among undergraduate students showcase that developing the delivery of online studios in the design and technology fields is possible. Fostering digital literacy in online studios can be successfully achieved by ensuring access to and familiarity with emerging technology tools in use and careful design of learning activities. The process requires establishing guidelines and procedures which are relatively loose and free-flowing, and generated with significant input from the participants (the students through evaluations). Lecturers need to promote collaborative learning by creating a double loop in the learning process to enable students to reflect on their learning process (Pallof

& Pratt, 2000). Some studies show that majority of online learning is done without instructional design principles in mind (Vučić et al., 2021). There is also a difference between preparing to teach in the classroom and preparing to teach online. Following design principles for online courses delivery ensures the focus is on student learning and not on the technology or platform (Vučić et al., 2021).

According to Vučić et al. (2021), studio-based learning can be highly engaging for students, enabling them to develop holistic and authentic capabilities such as critical thinking, creativity, collaboration and communication. In addition, lecturers can incorporate these related capabilities, along with the development of discipline-based knowledge and technical skills by redesigning their courses to meet their current teaching and learning goals.

Since teaching in online studios involves more than simply taking old pedagogy models and simply transferring them to a different medium. It requires the development of new online communities and how students and lecturers relate with each other in those communities. According to Pallof & Pratt (2000, p.3), online education and asynchronous learning strategies such as blended learning can be used as alternative teaching strategies to online studios in which new practices and new relationships can make significant contributions to learning. The study of Pallof & Pratt (2000, p.4), suggests that lecturers must be trained to not only use technology, but also to shift the ways in which they organise and deliver material to successfully navigate the ways of teaching in online studios. This shift can maximise the potential for students to take charge of their own learning process and can facilitate the development of a sense of community among students (Pallof & Pratt, 2000, p.4-5).

2.4.1 Strategies for achieving the 4Cs in Online Studio Pedagogy

To understand how the goal of the studio pedagogy to develop digital literacy skills, also known as the 4Cs of 21st-century learning (collaboration, creativity, communication, and critical thinking), could be achieved in online studio pedagogy, the literature suggest the following key strategies:

2.4.1.1 Collaboration

The literature shows that collaboration is a crucial component of studio pedagogy. Collaboration helps foster an environment where students can share ideas, work together on projects and receive feedback. In an online setting, effective collaboration requires leveraging digital tools and creating structured activities that promote interaction and teamwork. Lecturers can foster student collaboration by assigning group projects where students work together as a team. Group

projects help students develop collaboration skills as they navigate project planning, role allocation and conflict resolution. Digital platforms such as Google Workspace, Microsoft Teams, help to ensure accountability and balanced participation (Johnson et al.,2014). In addition, use of collaborative design tools like Figma, Adobe XD enable collaborative design work. These tools support simultaneous brainstorming, commenting and editing, making it easier for students to collaborate effectively (Sawyer,2007).

2.4.1.2 Creativity

Creativity is a vital skill in design education, fostering innovation and the ability to develop unique solutions to complex problems. In an online studio setting, lecturers can employ various strategies to nurture and enhance students' creative abilities. Through open-ended projects, students can develop out-of-the-box thinking. Such projects with flexible briefs encourage students to define their own goals and outcomes within the framework of the project (Beghetto & Kaufman,2010). In addition, lecturers can also foster creativity in online studios by introducing multimedia assignments by encouraging students to use various media formats. Encouraging the use of various media formats allows students to express their creativity through different channels and develop a wide range of skills. For instance, lecturers can assign projects that require students to create animation or videos to convey their ideas. Tools like Adobe Premier Pro, After Effects, and Canva can be used for these purposes (Jenkins et al., 2009). Other digital brainstorming tools like Miro, Padlet and mapping tools such as MindMeister help students to organise their thoughts and explore different branches of an idea.

2.4.1.3 Communication

Effective communication is crucial in online studio pedagogy, ensuring that students can articulate their ideas clearly, receive and provide feedback, and collaborate effectively with peers and instructors. For instance, lecturers can use video conferencing tools to help maintain a sense of community and real-time communication among students and lecturers. Lecturers can schedule regular synchronous meetings using tools like Microsoft Teams, ZOOM, and Google Meet to discuss project progress, hold interactive sessions and conduct critiques (Hrastinski,2008; Lowenthal & Snelson,2017).

In addition, lecturers can encourage their students to develop the communication skill through digital portfolios. Digital portfolios allow students to document and showcase their work, facilitating ongoing feedback and reflection on their design process. Lecturers should encourage students to create and maintain digital portfolio tools using platforms like Behance, Adobe Portfolio, or Wordpress. These platforms encourage students to update their portfolios regularly,

including reflections on their design choice and feedback received (Chang,2001; Barret,2007). Lastly, real-time collaborative tools like Google Workspace, MicrosoftOneDrive enable students to work together on documents, designs, and projects, facilitating continuous communication and collaboration (Granic et al.,2009; Sawyer,2012). By integrating the above digital communication tools into online studio pedagogy, lecturers can enhance the effectiveness of student interactions, improve the quality of feedback, and foster a collaborative learning environment. These approaches, supported by recent research and best practices, ensure that students develop strong communication skills necessary for success in the design field.

2.4.1.4 Critical thinking

Critical thinking is essential in design education because it enables students to develop seasoned arguments, analyse information and evaluate different perspectives. In an online studio setting, fostering critical thinking involves presenting students with complex, real-world problems to solve through studio-based (PBL) and problem-based learning (PBL), encouraging them to think critically and develop practical solutions (Hmelo-Silver,2004). In addition, reflective journals encourage students to document their learning process, reflect on their experiences, and critically evaluate their design decisions. Digital journal tools like WordPress or educational tools like Seesaw allow students to reflect on their learning progress and challenges helping them to critically analyse their work and though processes (Schön,1983; Moon,2004). Digital concept mapping tools like MindMeister, Coggle, and Lucidchart help students to organise and represent knowledge, making connections between concepts and ideas, which is essential for critical thinking. Collaborative mapping encourage students to work in pairs or groups to create collaborative concept maps (Nesbit & Adesope, 2006; Novak & Cañas,2008). Implementing the above critical thinking strategies in online studio pedagogy helps students develop the ability to evaluate, analyse, and create new knowledge. These approaches ensure that students are well-equipped to tackle complex design challenges and contribute to innovative solutions. By integrating studio-based learning, problem-based learning , digital reflective journals, and concept mapping into the curriculum, lecturers can foster a rich environment for critical thinking and intellectual growth.

2.4.2 Alternatives to Online Studio: Blended Learning approach

Blended learning (BL), or the combination of face-to-face and online instruction (Graham, 2013), is widely adopted across higher education. Interestingly, some scholars refer to blended learning as the “new traditional model” (Ross & Gage, 2006, p.167) or the “new normal” in course delivery (Norberg et al., 2011, p.207). Blended learning has the potential to enhance teaching and

learning in terms of autonomous learning, self-paced learning opportunities and differentiated learning provision. Opportunely, blended learning is associated with improving teaching practices by enabling lecturers to provide a wide variety of teaching modalities, thus allowing the students to gain the core competencies required (Ehrmann, 1998). In addition, lecturers have an opportunity to give personalised attention to students who may be falling behind (Muhuro & Kang'ethe, 2021). This can be done through a combination of face-to-face and online sessions (Stein & Graham, 2020).

Furthermore, some advantages of blended learning over other delivery modes of learning includes its ease in facilitating collaborative communication and problem solving, coupled with flexibility and personalised learning (Cleverland-Innes & Wilton, 2018), thus enhancing pedagogical practices. Enhanced pedagogical practice occurs when students develop competencies to master their acquisition of 4Cs of 21st century learning by working with various technologies such as digital technologies and 3-dimensional printing technologies when they engage in projects that solve real-life problems (Muhuro & Kang'ethe, 2021). Literature shows that when lecturers use blended learning successfully and offer learning opportunities for augmented realities, or problem-based activities to solve authentic problems, students increase the repertoire of competencies to solve ill-defined problems and use various sources of knowledge in twenty-first century learning (Binkley et al., 2012, Scoffel, 2016). Furthermore, given the importance of preparing students for professional roles after graduation, the online component of blended learning provides students with 'learnability', or the ability to unlearn, learn and relearn (Sungsup et al., 2019 *in* Muhuro & Kang'ethe, 2021). It is therefore important that higher education institutions in South Africa also ensure that their students, lecturers and other stakeholders do not fall behind in embracing blended learning. Fortunately, according to Tsabalala et al., (2017) *in* Muhuro & Kang'ethe (2021), the current generation of students is incrementally motivated to use technology in their learning thereby prompting institutions to embark on blended learning.

2.4.3 Blended Learning in Higher Education Institutions

South African universities are feeling the pressure to control costs, improve quality and respond to current power cuts and disruptions that have become a recurring phenomenon. Many universities in South Africa are now experiencing brain drain and staffing shortages as many qualified professionals prefer to work in overseas universities with better employment prospects and benefits where social amenities are readily available (Ndebele et al., 2017). Blended learning (BL) has the potential to solve many of these problems through various emerging technology tools and learning management systems (Muhuro & Kang'ethe, 2021).

However, this can only succeed when the lecturers provide appropriate learning opportunities and have the requisite resources and capacity to facilitate such learning (Rugube et al., 2020). Lecturers who plan to reconfigure their curricula require essential understanding of learning theories and different education frameworks available to develop such curricula (Muhuro & Kang'ethe, 2021). Reconfiguring the studio curriculum also require other essential ingredients such as clear learning outcomes, continuous learner support and feedback as well as careful design of teaching and learning activities (Stein & Graham, 2020). Furthermore, blended learning requires specialised personnel to support information and communication technology (ICT) literacy and learning designers to support lecturers develop their curriculum with clear teaching and learning goals as well as learning theories relevant to their disciplines.

2.5 Summary

To understand the significance of online studios and digital literacy, we should understand that studio-based learning as an activity system. At its core, the studio revolves around the notion of human activity—a dynamic concept wherein individuals develop their personalities, consciousness, skills, generate novel cultural artefacts and catalyse transformations in social conditions (Sannino et al., 2009). These activities involve a complex interplay of physical, digital, human and social resources and relationships. This chapter provided key discussions on the studio phenomenon with consideration given to content, language, literacy, education as well as community and institutional structures. It also focused on the impact of digital literacy for online studios within the broader socio-cultural, economic, and political contexts of the study. The chapter also identified some gaps in fostering of digital literacy skills known as 4Cs of 21st century learning in design and technology educational fields. In summary, this chapter highlights the need to explore the significance of online studios and digital literacy in the fields of design and technology. The next chapter provides a discussion of the theoretical framework underpinning this study.

CHAPTER 3: THEORETICAL FRAMEWORK

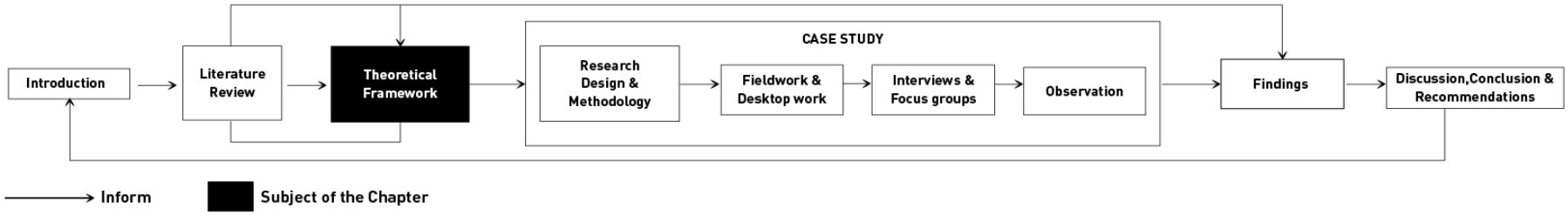

Figure 3. 1: *Outline of Chapter 3*

3.1 Introduction

Theoretical frameworks are made up of interconnected constructs or nodes and propositions that offer a systematic perspective on the phenomenon under investigation (Mlitwa, 2010). They serve to guide researchers in formulating pertinent questions in a study or serve as analytical tools for data analysis. The objective of this study is to investigate the potential of online studios as a mediating tool to foster undergraduate students' acquisition of 21st century skills as an outcome. Although the interest in online studios is on the rise, in particular since COVID-19, the majority of educators in the context of this study have not fully integrated technology in the current studio environment. There exists some gaps regarding the potential of online studios to prepare design students for current design practices. Therefore a theoretical framework that considers this context is useful to guide the study. Cultural Historical Activity Theory (CHAT) was adopted to provide a practical and conceptual model for implementing the research approach and methodology (Anfara & Mertz, 2014). Since CHAT consists of an organised set of principles that helps explain real-world events, it guided the researcher to ask appropriate questions as the study develops.

3.2 Cultural Historic Activity Theory (CHAT)

Activity theory is situated within the social constructivist theories of learning, rooted in Soviet cultural-historic research. At its core, activity theory revolves around the notion of human activity—a dynamic concept wherein individuals develop their personalities, consciousness, skills, generate novel cultural artefacts and catalyse transformations in social conditions (Sannino et al., 2009). Scholars like Engeström (2001) argue that through these activities, humans reshape learning environments, paving the way for expansive learning opportunities. Expansive learning, rooted in cultural-historical activity theory, provides a framework for understanding how individuals and groups can transform their practices, knowledge, and understanding in complex and evolving environments (Engeström, 2001). Similarly, researchers such as Rogoff (2003) contend that human development is fundamentally a cultural process, exerting a profound influence on learning.

The objective of this study is to investigate the potential of online studios in fostering undergraduate students' acquisition of 4Cs of 21st century learning: critical thinking, creativity, collaboration, and communication to meet the requirements of the current digital age. Cultural historic activity theory (CHAT) serves as a framework for analysing online studio activities in design and technology courses.

Francis and Hardman (2018) emphasised that "activities must be rooted in their purpose and context they are situated" (p.69). In this study, studio activities are described as "structured set of tasks aimed at enhancing cognitive functions through mediation with cultural tools" (p.69). Vygotsky (1978) referred to the mediation process of any activity as only achievable through the use of cultural tools such as language, text and images.

Vygotsky (1978) elaborated that the presence of these cultural tools benefits the subjects by allowing them to develop higher-order thinking skills within a given context or specific environment as a collective. The relationship between the subject and object is mediated by intermediary term known as the "artefact", encapsulating the historical trajectory of their relationship (Kuuti, 1996). The transformation of the object yields the resultant outcome, as depicted in Figure 3.2 below.

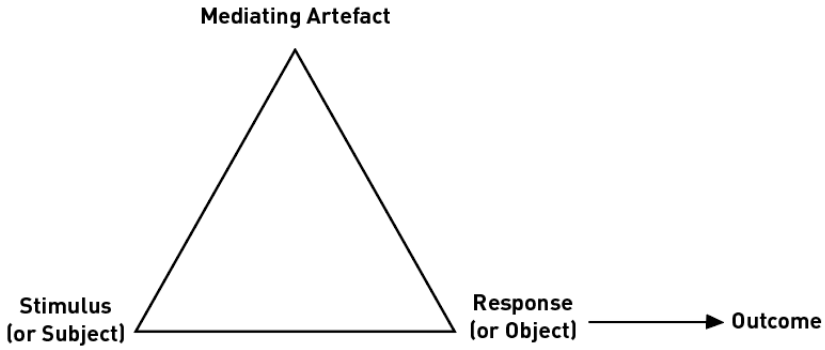

Figure 3. 2: *Vygotsky's Human learning through mediation*

3.2.1 Second Generation Activity Theory

While Figure 3.2 above effectively illustrates the initial iteration of activity theory, it is noteworthy that the transformation process therein pertains exclusively to an individual level, thus overlooking the crucial dimension of collective activity (Engeström, 2001). Since Vygotsky's original theory focused on an individual in an activity system, it lacked detailed explanations regarding activities involving collective action. This limitation prompted Leontiev (1978) to further develop a second-generation activity theory, which focused on activities involving collective action.

To fully explain how a collective system works, Leontiev (1978) in (Francis & Hardman, 2018. p.69), utilised a "primeval collective hunt" analogy (p.69). In this analogy, Leontiev sought to simplify the process of a collective work activity by describing how the hunters would split themselves into groups, each responsible for its own actions in what he termed as the 'division of labor'. Following this logic Leontiev (1978) was able to justify how each group's actions would

lead them towards their 'object' (motive). Refer to Figure 3.3 below, originally adapted from (Francis & Hardman, 2018.p.69).

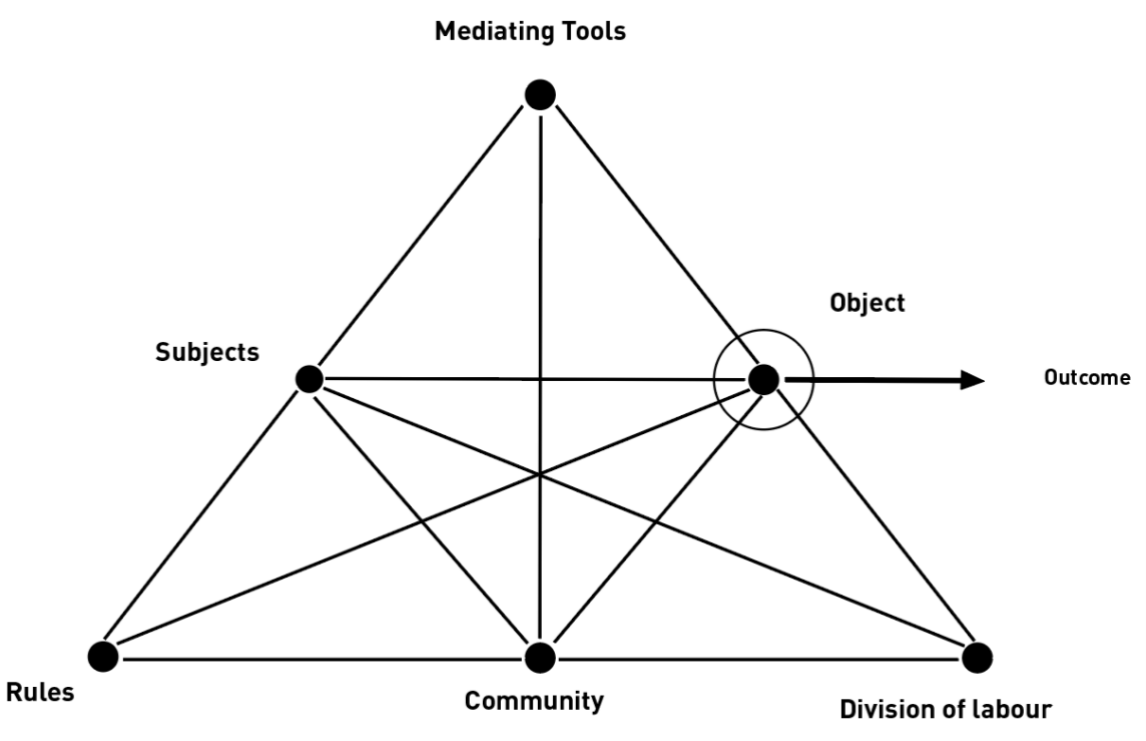

Figure 3. 3: *Leontiev's second generation activity theory*

3.2.2 Third Generation Activity Theory

Third-generation activity theory built on Leontiev's second-generation activity theory, which viewed an activity as a collective effort with division of labour among the subjects. Although Leontiev's work represents an improvement on Vygotsky's original activity theory, his work also had its own limitations. According to Francis and Hardman (2018), the theory "failed to consider the role of context and surrounding communities in the transformation from individual action to collective activity" (p.69). To mitigate the above challenges in Leontiev's second generation activity, Engeström (2001) made improvements to the theory by accounting for lack of contextual understanding identified in the works of Vygotsky and Leontiev.

As demonstrated in the study of Francis and Hardman (2018), Engeström (2001) expanded on Leontiev's *'division of labour'* concept by including the concepts of *'rules'* and the *'community'* (p.70), thus forming what is popularly known as third generation activity theory (3GAT). In Figure 3.4 below, adapted from Francis and Hardman (2018), Engeström (2001) argues that "activities should be comprehended within the power structures that govern them and within their social context " (p.70).

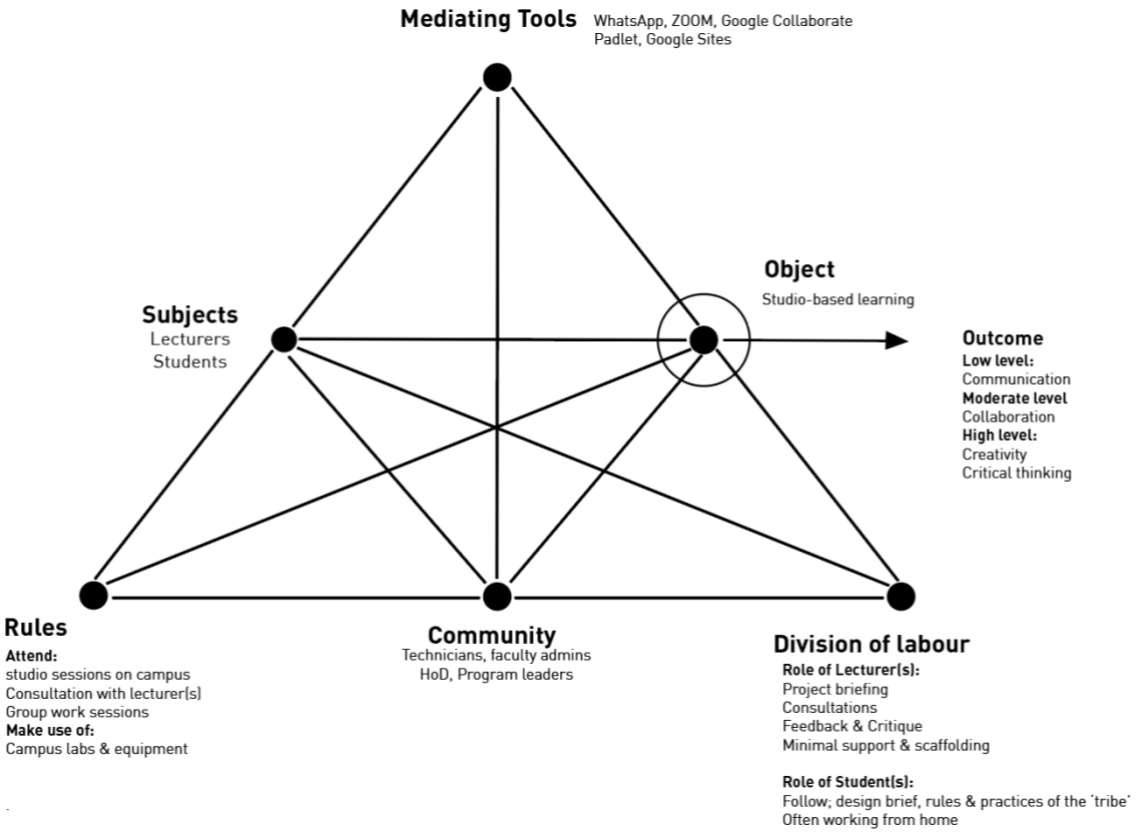

Figure 3. 4: *Engeström's generation activity theory (Conceptualisation of an activity)*

By referring to the above statement, Engeström (2001) suggests that an activity cannot be fully understood by merely observing 'individual actions' or *'collective actions'* without understanding the *'rules'*, *'community'* and *'social-context'* in which the activity occurs. Furthermore, Francis and Hardman (2018) explain that Engeström (2001) third generation activity theory "can be expanded further to include two activity systems by examining one activity system and its relations to a network of other activities within a system" (p.69) as shown in Figure 3.5 below .

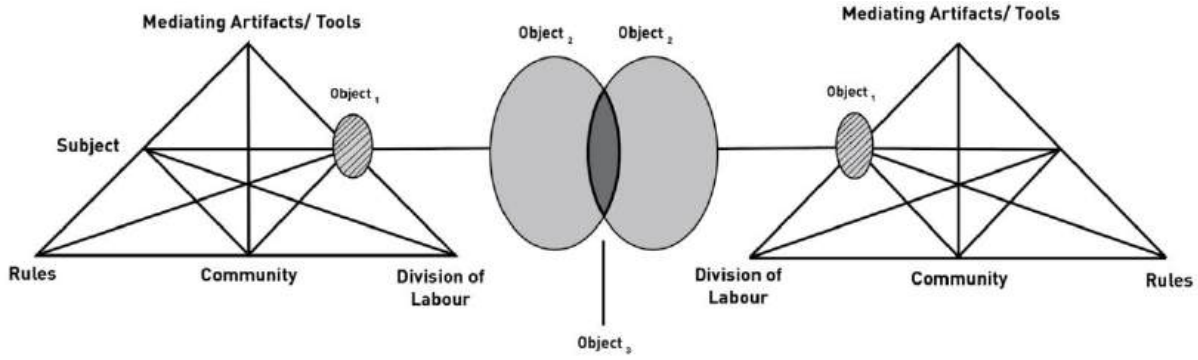

Figure 3. 5: *Engeström's two interacting systems approach as a minimum model for third generation activity theory (3GAT)*

Drawing on the above diagram, third generation activity system developed as a result of internal contradictions or conflicts emerging in the system. Secondly, as Francis and Hardman (2018) argue improvements on Leontiev's second generation activity were largely influenced by the "model's lack of acknowledgement of 'cultural diversities' and 'multiple perspectives' which can be found in an activity leading to multi-voicedness (p.69-72). Francis and Hardman (2018) add that although some scholars may view multi-*voicedness* as a primary source of conflict and contradiction, Engeström (2001) actually multi-*voicedness* as a catalyst for change and transformation.

3.3 The Use of Cultural Historic Activity Theory in the study

The application of CHAT in this study allowed the researcher to observe and analyse students and lecturers engaging in studio practices to achieve their objectives. By examining the tools used and the mediation of rules and community history, insights were gained (Burwell, 2012). CHAT provides a clearer understanding of interactions among students, lecturers, and other subjects in studio practices involving digital technologies.

A key attribute of activity theory in the context of this study is its emphasis on dialectical analysis of interactions between humans (students and lecturers) and mediated tools or artifacts (technical elements) shaped by human activity (purpose) (Svensson & Goldberg, 2015). Since the goal of this study is to explore the potential of online studios to foster undergraduate students' acquisition of 4Cs of 21st century learning, CHAT was used to help the researcher understand how students learn and lecturers teach and learn in the complex environment of a design studio. In addition, the theory was used to examine the experiences and perceptions of students and lecturers regarding the transformation of their current studio spaces. CHAT's fitness for this research is based on the fact that factors that influence the use of blended learning in studio practices cannot be adequately understood outside the social, technical and institutional environment in which the practices of e-learning are rooted (Lu & Churchill, 2014). CHAT also allows for a comparison of systems and the impact on the outcomes (i.e. development of 4Cs) when changing tools, such as moving from a traditional studio setting to an online studio setting (see for example figures 5.5 and 5.6 for a comparison of the multimedia (MM) activity system before and during COVID-19.

In that regard, CHAT is used to understand and analyse the factors affecting the transformation of studios from an activity-based and multi-stakeholder perspective. The CHAT concepts of work activity are used to present the potential of online studios as a system of activities. These concepts include actors, motives/goals, mediators, activities/actions, transformations and outcomes . From

the point of view of the work activity system, an actor is an individual or a group of people (Engeström,1987). The motives/goals refer to the objectives that must be achieved by the various actors within the activity system. Mediators are factors and tools that can allow or inhibit the successful achievement of a goal (Vygotsky, 1978). Activities/actions are tasks that must be carried out by the various actors within the work system . The transformation process combines enabling factors, tools and activities to achieve a positive result known as the outcome. These CHAT work activity concepts were used to present studio-based teaching and learning as an activity system in Figure 3.6, below.

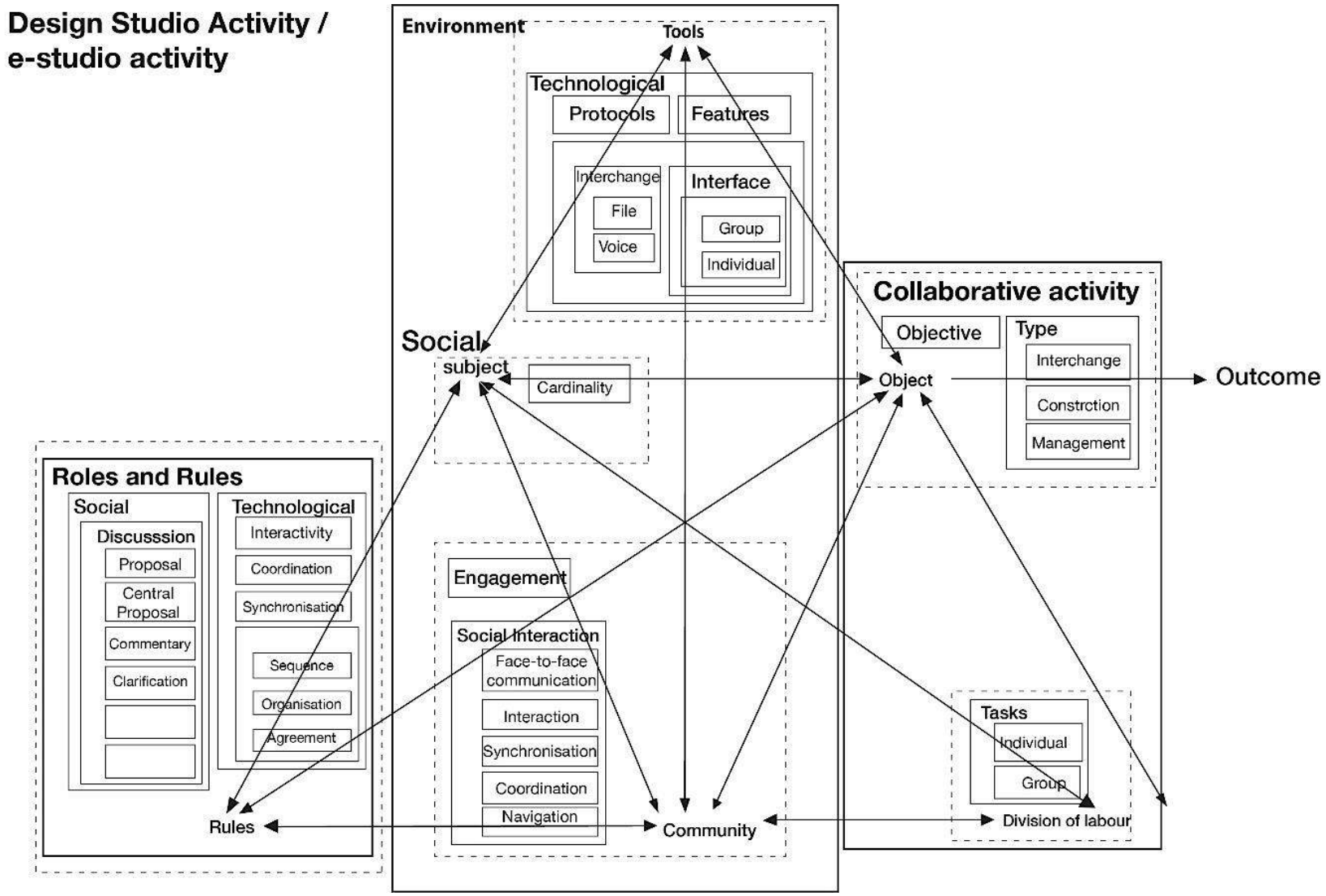

Figure 3. 6: *Online Studio Activity Framework*

Cultural historic activity theory (CHAT) in this study considered studio practices as a system of activities in which collective work is carried out by individual and group actors in pursuit of a common goal. In other words, teaching and learning activities are not a series of isolated individual exercises, but parts of a common and collective effort. It was pointed out that elements in this system of activities – the context, the rules, the tools and the environment – are all mediators, potentially promoting smooth interaction among activities. Success in transforming the studio to prepare undergraduate student's for future design practices and foster their acquisition of 4C's of 21st century learning is context- and mediator-dependant.

3.4 Expansive Learning

Expansive learning, as proposed by Engeström (2001), is a framework rooted in Cultural-Historical Activity Theory (CHAT). It emphasises the idea of learning as a transformative process that occurs within complex and evolving social environments such as online studios. Primarily, expansive learning manifests as alterations in the object of the collective activity. In successful expansive learning, this leads to qualitative transformation of all components of the activity system as outlined in the diagram below (Engeström, 2001).

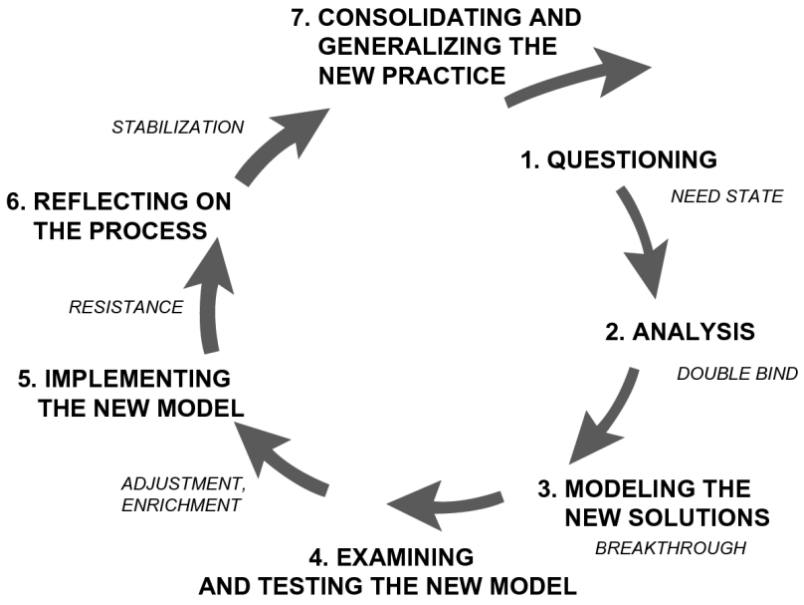

Figure 3.7: *Sequence of learning actions in an expansive learning cycle*

As outlined in Figure 3.7 above, the first action towards expanded outcomes of a traditional studio activity system could require lecturers and curriculum developers in higher education to start by: (i) questioning, criticising or rejecting some aspects of the traditional teaching and learning practices currently dominant in their practices (Engeström, 2001). Such questioning should lead to (ii) analysing their activity systems in order to find out causes or explanatory mechanisms

behind the prolonged transformation of their studios, achieved by tracing the cultural and historical context of their teaching and learning environment (Engeström, 2001). Additionally, this process may require the lecturers to, (iii) model the newly found explanatory relationships in online studios. For effective execution, lecturers must (iv) examine the new model by testing it in order to grasp its dynamics, potentials and limitations. Upon completion of this process, lecturers must (v) implement the model through practical applications, and conceptual extensions and finally, (vi) reflect on and (vii) evaluate the process, consolidating its outcomes into a new stable form of practice (Engeström, 2001). In this context, it is imperative that the model of expansive learning be employed to transform the current activity systems in visual communication design programmes and multimedia programmes.

3.5 Summary

CHAT in this study considers studio practices as a system of activities in which collective work is carried out by individual and group actors in pursuit of a common goal. In other words, teaching and learning activities are not a series of isolated individual exercises, but parts of a common and collective effort. The application of expansive learning principles in online studios could foster active engagement, critical thinking, and collaborative learning, ultimately enhancing students' ability to tackle complex design problems and contribute meaningfully to the fields of design and technology. The research methodology is presented in the next section.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

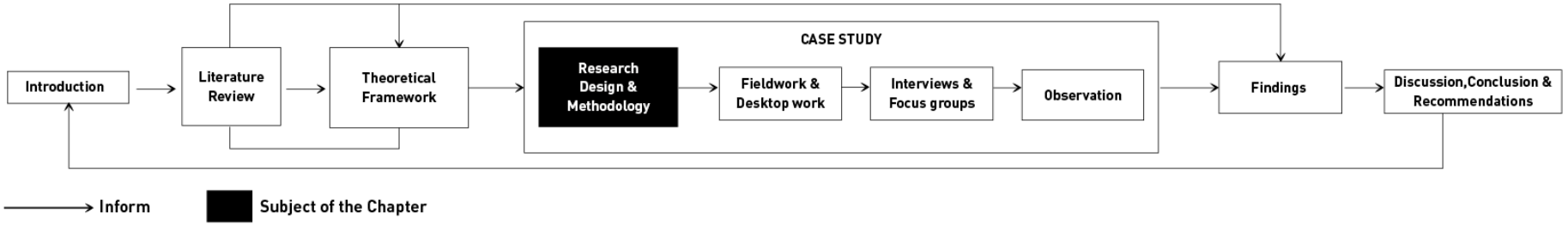

Figure 4. 1: *Outline of Chapter 4*

4.1 Introduction

The aim of the study is to investigate the potential of online studios within design and information technology disciplines to foster digital literacy skills in South Africa's higher education landscape. The goal of the study was to identify digital literacy skills that are fostered by online studios in design and information technology disciplines. The current methodology chapter presents the research design, approach, population and sampling techniques that were used to identify study participants. The methodology adopted in this study followed a qualitative approach in the form of a multi-site case study. Interviews, focus groups and participant observations were used as data collection instruments.

4.2 Research Design

The current study adopts Saunders's et al (2016; 2018) research onion as a strategy for developing a research methodology that aligns with the aims and orientations of the study. Regarding this, the methodology section of this study adopted an interpretivism approach on the outside layer of the onion followed by a multimethod qualitative approach as a methodological choice in the form of a multi-site case study.

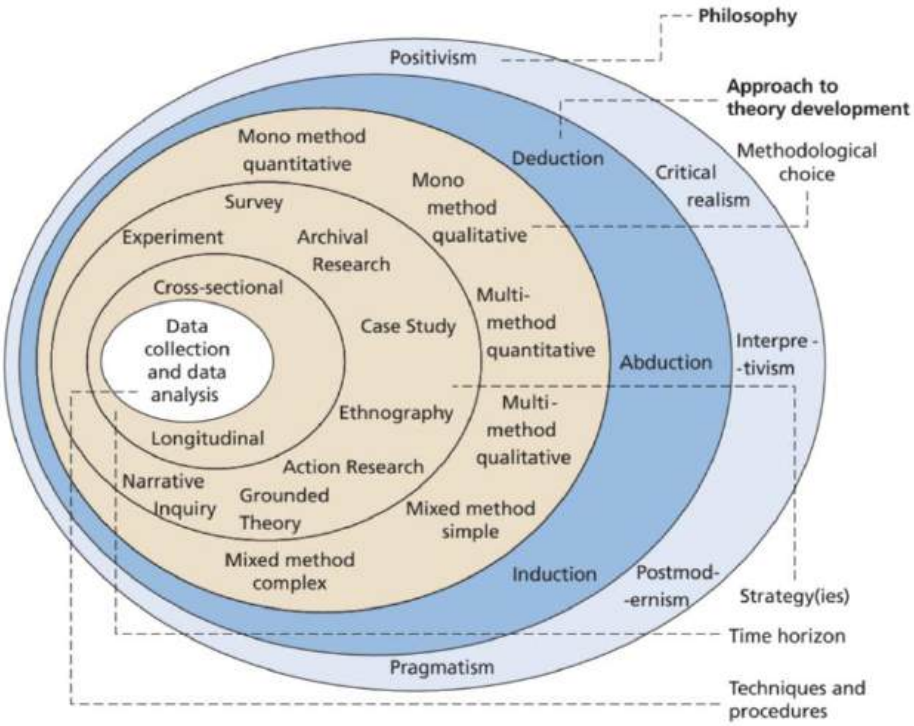

Figure 4. 2: *The 'research onion' propounded by Saunders et at., (2018)*

4.2.1 Ontological dimension of the research: Social Constructivism

Ontology is a philosophical enquiry concerned with questions such as "what is reality, and how do we recognise what is real?" (Bezuidenhout et al., 2014, p.64). The word 'Ontology' originates from the Greek language, 'ontos' meaning "being, or that, which is", and logos meaning "the study of" (Bezuidenhout et al., 2014, p.64). Ontology thus denotes the study of being, reality or existence (p.64). According to Bezuidenhout et al (2014), the dominant contemporary trend in ontology is the notion that humans create their own reality by defining or naming constructs. This is known as the social construction of reality, in terms of which reality is created inter-subjectively as it happens in human consciousness (Mchunu, 2013). A social constructivism perspective aligns logically with the interpretivist epistemological paradigm of knowing about reality followed in this study.

Social constructivism is a social theory that deals with the construction of reality (Chandler, 2011). It focuses on human awareness or perception and its position in the world. This study investigated the potential of online studios in design and information technology disciplines to foster digital literacy skills among South Africa's undergraduate students for 21st century design practice. The researcher believes that reality is constructed through human activity (design activities inside design practices). As Kim (2001) stated, "social constructivists believe that reality is not something that can be discovered: it does not exist until it has been invented/co-constructed in society" (p.54).

4.2.2 Epistemological foundations of the study: Interpretivism

The term 'Epistemology' is derived from the Greek word *episteme* meaning 'knowledge', and *logia* or *logos* meaning 'the study, science or theory of' (Bezuidenhout et al., 2014, p.86). Epistemology then denotes the study of knowledge or the science of knowing, and beyond that, the nature of knowledge (Bezuidenhout et al., 2014). Epistemology is concerned with questions such as "what counts as knowledge and how do we know what we know?". Three main trends in epistemology as it relates to research have been identified as: realism, interpretivism and positivism (Bezuidenhout et al., 2014). Each profoundly influenced the way the researcher thought about research processes, not only in terms of assumptions and concepts but also regarding which research problems seem important.

The interpretivist paradigm views knowledge as based on observable events, personal beliefs, values, reasons and understanding (Ojong & Muthuki, 2010). Interpretivism is used to understand the phenomena of online studios in design and information technology disciplines to foster digital literacy skills among undergraduates by reviewing meanings that participants ascribe to the studio

in those disciplines. The researcher critically reflected on the social and historical background of the field and his role in the study to ensure a good interpretation of participants' views (Walsham, 2006, p.326). Details of the research methodology and data collection tools that were used in the interpretative research paradigm appear in Table 4.1 below.

Table 4. 1: *Research Design Summary*

Theoretical Orientation	Approach	Justification for the research
Ontology	Social Constructivism	The context and people shape truth; the effect of the potential of online studios to prepare students for 21st century design practice is rather contextual and personal.
Epistemology	Interpretivism	The researcher shapes the perception of the social context under study; researcher must be familiar with the context.
Methodology	Explorative qualitative, multiple case study	Effectiveness of a new and evolving phenomena is studied, researcher's role inside the context; has effect to the validity of the results.
Methods	In-depth-interviews, Focus groups, Participant observation	Qualitative data collection instruments will provide more insight on the potential of online studios to prepare students for 21st century design practice.

4.3 Research Approach (Qualitative research)

A research approach is the process of discovering what is known about a particular field of study. The manner of discovery of this information, is known as a research methodology (Babbie, 2013). The research approaches that resonate within the interpretivist paradigm include participatory action research, quantitative research and qualitative research. Traditionally, natural science focuses on hard or quantitative (i.e., positivist) analysis; the social sciences followed this route until its limitations became obvious as researchers noticed that subjective human feelings were difficult to quantify (Babbie, 2013). This led to the evolution of qualitative (anti-positivist) analytical methods, which took more account of "soft", personal data (Walliman, 2011, p.270-271).

While quantitative methodology makes use of statistical analysis and scholars work with figures (Mchunu, 2013), qualitative deals with the qualities of subjective experience and the meanings people attach to these (Bezuidenhout et al., 2014). The study aligns itself with a qualitative approach which is elaborated below to investigate the potential of online studios in design and information technology fields to foster digital literacy skills among undergraduate students in those fields. The use of qualitative research approach and qualitative data collection techniques made it possible for the researcher to study the participants in their natural environment (Babbie, 2013).

4.4 Research Strategy

A research strategy refers to the sequence of the steps in a plan researchers develop to guide the collection of data in a study (Yin, 2011). In this study, research questions and the nature of

the problem underpinning the study also informed the choice of adopting a multiple case study for that study (Creswell, 2011). This study followed the case study approach as elaborated in section 4.4.1 below.

4.4.1 Case Study: Multi-site

This study follows a case study approach involving multiple-sites to be studied and using multiple methods to analyse the collected data. The investigation of the phenomenon was conducted within the study's real world-context in real time (Yin, 2003); this strategy is used because the boundaries between the phenomenon and the context were not clearly defined (Yazan, 2015; Yin ,2017). Yin 2017 (p.35) emphasises that the choice of whether to carry out a case study should be determined during the assessment of contextual conditions, in order to obtain meaningful answers to the "how" and "why" questions concerning the phenomenon under investigation.

Based on the above logical reasoning, this study caries out a multiple-case study at a university of technology with students, lecturers and learning designers, to explore the potential of online studios to foster digital literacy skills among South Africa's undergraduate students for 21st century design practice. Another reason for adopting a multiple case study approach was based on the logical reasoning of a studio and its pedagogy as a collective activity for both students and lecturers, carried out by multiple stakeholders also known as actors, using tools, rules and procedures to negotiate the transformation of the current traditional studio to an online studio. The actors who participate in this teaching and learning activity are categorised as: the entity (institution); the group(s) (departments and their communities of practice); and individual actors (lecturers, students and network administrators). The case study format influences participant selection as well as data collection methods – such as in-depth interviews, focus groups and participant observation (Yin, 2017).

4.5 Description of the participants

The study participants were students and lecturers at the university of technology under study . They were drawn from two Design programmes, based across two departments -the Faculty of Informatics and Design: Visual Communication Design (VCD) , based in the Applied Design Department and Multimedia (MM), based in the Information Technology Department. The two departments were of interest to study because they offer design courses and programmes that were listed as part of critical skills currently in need in South Africa, see the Figure 1.2 in chapter 1 and make use of studio pedagogy.

The study targeted undergraduate students from first to third year and lecturers. These groups were of interest to the study because of their demographic composition and educational experience with design and information and technology fields. The second year students had completed more than four terms and the transition of face-to-face studio systems during COVID-19 to an online studio system was fresh in their memory, while third year students had a better chance to reflect on the changes that emerged in the traditional studio during the COVID –19 pandemic over the course of nearly three years.

Drawing on activity theory, the subjects were categorised into: VCD and MM lecturers and students, as well as programme coordinators. The logic of activity theory is then embedded into the analysis and interpretation of the data as presented in section 4.7 of this chapter. In this process, the researcher focuses on relationships between the data and elements of activity theory as a type of qualitative content analysis (Ritchie et al., 2013).

4.5.1 Participant selection and study site

The site of study is a university of technology (UoT) which was established in 2005. This is where the researcher was based at for seven years as a student and three years as a lecturer, making a total of ten years of on-site experience within the institution. This means that the researcher and undergraduate lecturers have already built a relationship, which allows the researcher to access the research participants. This also helps the researcher to devise a strategy to select a research sample that was representative of the target participants (Hennick, Hutter, & Bailey, 2011).

However, the researcher still required permission and *buy-in* from the heads of department and programme coordinators in the VCD and MM courses. Working closely with these participants allows the researcher to collect rich qualitative data by asking for clarification of issues depending on their responses. Furthermore, the researcher had access to students from diverse demographic and study levels (1st-3rd year students) allowing for findings representative of the participants in VCD and MM programmes. Available and willing students- and lecturer-participants were purposefully selected.

4.6 Data Collection

Data were collected and gathered using primary and secondary data collection methods. Primary data were collected using semi-structured interviews and focus groups. Secondary data constituted internal publications provided by participants to the researcher and publicly available data which was relevant to the topic under investigation (Wahyuni, 2012). Primary and secondary data collection methods were predominantly used to address the primary research questions by

employing qualitative data collection methods such as interviews, participant observations and focus groups with students and lecturers from the VCD and MM programmes.

4.6.2 Semi-structured Interviews

There are different interview structures and philosophical orientations researchers adopt when conducting a qualitative study (Merriam & Tisdell, 2015). By structure, this study adopts a semi-structured interview format with open-ended questions guided by a constructionist philosophy. Interview questions for this constructionist approach are flexibly worded with a mix of structured and unstructured questions. The flexibility offered is guided by a list of issues to be explored, and neither the exact wording nor the order of the questions was determined ahead of time (Merriam & Tisdel, 2015). The greatest advantage with this format was that it "allows the researcher to respond to the situation at hand, to the emerging worldview of the respondents, and to new ideas on the topic" (Merriam & Tisdel, 2015, p.110). A constructionist interview approach helped the researcher understand meaning-making activities from the interview context, the 'studio' as a 'signature pedagogy' and online studio teaching experiences as they are shaped by the perceptions of the persons who experience them.

In addition, students and lecturers' experience in this study was used to make meaning through their perceptions and lived experiences. Constructionist interviews focused on the emergent, socially constructed character of the "data" that were produced through the interviews (Gubrium & Holstein, 2008). During the semi-structured interviews, individual lecturers and students from the VCD and MM programmes in the Faculty of Informatics and Design at a university of technology were interviewed to get deeper insight into their perception on the potential of online studios in design and information technology education.

Constructionist semi-structured interviews helped the researcher develop insights into participants' subjective beliefs, opinions, perceptions, and attitudes concerning the potential of online studios to foster digital literacy skills among undergraduate students and prepare them for 21st century practices. An interview guide was designed to follow a semi-structured approach with predominantly open-ended questions and close-ended questions were kept at a minimum (See appendix C), a sample of the interview guide. In addition, the interview guide's open-ended questions also allowed the researcher to probe for additional information and to ask interviewees to clarify their responses if they appear to be either ambiguous or lacking detail.

Table 4. 2: *Interview schedule*

Organisation*	Department**	Participant***	Interviews	
			Date: June- 2023- July -2023	Time
* University of Technology	**Applied Design	*** 9	20-Jn – 8-Jul	90 mins
	** Information & Technology	*** 6	10-Jul – 25-Jul	60 mins

**University of Technology*
*** Departments*
****Participants*

The researcher started off the interview by briefly explaining the aim of the interview and emphasising the confidentiality, anonymity and voluntary nature of the study. The interviewees were then given a consent form which was signed off by both the interviewee and the interviewer. With the participant's permission, the interviews were recorded. The interviews were conducted in the English language face-to-face and online via ZOOM or MS Teams, in accordance with the preferences of each interviewee. The interviews had an average duration of 60 to 90 minutes. Each interview was recorded and the recording was made available upon request[2].

4.6.2 Focus groups

Focus groups are used to obtain the perceptions of the students and lecturers in VCD and MM programs at a university of technology. According to Mlitwa (2010), focus groups can be conducted in different formats, including participation in participant activities, using mood boards or collages or just "focus group discussions". Researchers often adopt focus group discussions with students to enable the interviewing of several students at one time, thus saving time and human resources.

The focus group participants were drawn from VCD course and MM course in the Faculty of Informatics and Design within the Applied Design and IT departments at a university of technology. A briefing session of 5 – 10 minutes was conducted with the participants to ensure their familiarity with the discussions that were taking place. Different types of focus groups exist: the mini groups (between 4-6) participants, over 90-120 minutes), or telephone groups (using telephone conference systems such Ms. Teams, ZOOM and WhatsApp, over 30-120 minutes), and full groups. A full group normally consist of eight to ten participants, and runs between 90

[2] https://drive.google.com/drive/folders/11GnpFDdH8w_I06jioC0DGiq4EQLWGkZn?usp=sharing

and 120 minutes. In this study, a mini focus group was chosen as the most suitable format because it allows the researcher to engage with participants within a reasonable length of time.

Table 4. 3: *Focus group participants*

Institution

Faculty: Informatics & Design (FID), Undergraduate students (1st-3rd) year students, 2023

Date, time, venue: (1) Jun, 2023; 10am-12h00; Room 3.10
(2) Jul, 2023; 10am-12h00; Online and Face-to-face

Total Students at University	Total Students in the Faculty of Informatics & Design	Gender	Level of Study: Y1- 1st yr, Y2-2nd yr, Y3 3rd yr, ECP-Extended Curriculum				
			Y1	Y2	ECP	Y3	Participants
Design Department	1275	Male	1	1	0	1	3
		Female	2	1	0	0	3
IT Department	3745	Male	1	2	0	0	3
		Female	2	1	0	0	3
Total		Male	1	1	0	1	6
		Female	4	2	0	0	6

Explanatory notes:

- The undergraduate classes (ECP, 1st-3rd year) students in the Faculty of Informatics and Design at the District six campus draw students from different departments, Applied Design and Information Technology.
- Being in second and third years, they have experienced Covid-19 to have an adequate background and experience with the studio formats during the pandemic
- Department, level of study and number of years a student has been at university were important criteria for the selection of focus-group participants.

As shown in table 4.3 above, twelve students were selected from VCD and MM programs to participate in the focus group discussions. The students participants were selected according to level of study, number of years registered in the programme and across academic departments in the Faculty of Informatics and Design (FID). Furthermore, to ensure an effective focus group, the researcher created a "brave space environment" (Arao & Clemens,2013). A brave space environment refers to a setting, often in educational or professional contexts, where individuals are encouraged to engage in open, honest, and respectful dialogue about difficult or sensitive topics (Arao & Clemens,2013; Cook-Sather,2016).

Unlike a "safe space," which emphasizes comfort and avoiding discomfort, a brave space acknowledges that discomfort and conflict are part of growth and learning. The researcher encouraged focus group participants to respect each other by valuing each participant's perspective (Sensoy & DiAngelo,2017). Furthermore, the researcher also encouraged focus group participants to speak openly and freely by providing support to navigate challenging conversations during the focus group discussion.

In addition, focus group participants were notified ahead of time before the discussions took place. The study and its aims were explained to the participants and how the group discussion was expected to run. The researcher started the discussion by posing questions to the group and the group participants were asked to respond to these questions. There were 5 – 10-minute water breaks in between the sessions to allow the participants an opportunity to reflect on the on-going discussions.

4.6.3 Participant observation

Participant observation technique is used as a triangulation strategy to corroborate the information from interviews and focus group discussions (Hancock et al., 2009). During participant observation of the physical studios' spaces, a simple observation that includes viewing of on-going lectures, actual students' activities inside the studio was recorded upon consent. Being a participant observer in the study allows the researcher to spend sufficient time with the participants to gain much deeper, richer and more accurate information of the phenomenon. The only disadvantage was that of researcher bias and interfering with classroom dynamics (Kumar, 2011), but this was handled by practicing reflexivity which is elaborated in detail in section 4.7.2 below. However, a triangulation method is used to tackle the issue of researcher positionality by ensuring trustworthiness and credibility of data is maintained throughout the study.

4.7 Data Analysis

Thematic data analysis was used to analyse data from interviews, focus groups and observations for meaning making. Data were analysed through the lenses of Cultural Historic Activity theory to identify patterns from the data, any similarities or contradictions that emerged from the collected data (Wahyuni, 2012). An important step that was followed in data analysis was the management of raw data; data was managed as follows: (i) data storage – since this study used multiple sources of data (interviews, focus groups and observations), the researcher developed an archive on the cloud to store the data privately.

Considering the ethics requirement for conducting field research, data were stored electronically on the researcher's password protected computer and in online platforms such as Google Drive to allow easy retrieval and safe keeping (Wahyuni, 2012). During data analysis, the researcher transcribed all interviews by focusing on the content of the interviews and focus groups, so checking the accuracy of the transcript's content was considered to be crucial (Miles & Huberman, 2013).

4.7.1 Deductive Thematic analysis using CHAT as analytical framework

The procedures below were used as part of thematic analysis of primary data collected through interviews, focus groups and participant observations. The procedures below as summarised in the study of Braun and Clark (2006) were used to perform thematic analysis follows:

- ***Become familiar with the data –*** the researcher became familiar with all collected qualitative data to identify impressions of the possible significance of details that appeared to be particularly striking.
- ***Generate initial codes –*** during this step, the researcher assigned codes to each fragment of data that appeared to be relevant to any of the research questions and CHAT activity system.
- ***Search for themes –*** this step involved grouping together coded pieces of data that appeared to suggest possible themes pertaining to the research questions and CHAT through a qualitative data analysis software MAXQDA22. The researcher accomplished this step by organising and sorting relevant extracts of data, before combining or splitting them according to the overarching themes to which they belong to. At this stage, the researcher carefully took note of any relationships or contradictions that were evident among the codes, themes, and sub-themes. The themes were identified with reference to the research questions and the theoretical framework. The theory was used to analyse

students and lecturers pursuing their activities and objectives within studio practices, by examining their tools and the mediation of the rules and history of the communities in which they are operating (Burwell, 2012).

- ***Review themes –*** at this stage, data analysis required the researcher to make decisions concerning whether to combine, divide, or discard any of the themes that were identified in the previous steps.
- ***Define and name themes –*** the researcher had to refine the themes further, through continuous analysis, and to identify any subthemes that might be generated from main themes before assigning appropriate names to them and concise descriptions of their exact importance. Responses classified in terms of these themes were then analysed with the help of qualitative data analysis software, MAXQDA. Specific responses in each transcript were colour coded according to the theme see Table 4.4 below.

Table 4. 4: *Images Used in Data Visualisation in MAXQDA*

	Themes	The meaningful whole of the categories			(Strong) coexistence and/or conflicts between categories, codes, or subcodes
	Categories (in different colors	Meaningful structures formed by the combination of codes			(Weak) coexistence and/or conflicts between categories, codes or subcodes
	Codes (in different colors)	Meaningful structures formed by combining subcodes			Themes main subject and the themes
	Subcodes	Subcodes that make up the codes			

* *Different colors used in categories and codes have been used to visualise different categories and codes.*

Thereafter answers that fell within the same theme (in other words, answers that shared the same colour) were grouped together. The identified themes, categories, codes, and subcodes as a result of data analysis based on the questions used in interviews and focus groups (which are the primary data sources) about students and lecturers' perceptions on the potential of online studios in design and technology education to foster digital literacy skills in design and technology fields.

- ***Write the report*** – in this final step of data analysis, the researcher transformed the analysis into a readable and compelling account that successfully aligned with the goals of the study. CHAT constructs together with the study's research questions were used in the writeup of the report to give the study a credible orientation in the field.

To avoid researcher bias during the analysis and write up of the study's findings, other steps such as reflexivity and triangulation were taken into consideration. These measures were taken into account to increase data dependability, conformability and transferability for further studies of similar contexts see section 4.7.3 below.

4.7.2 Self Reflexivity and Triangulation

Researcher bias is common throughout qualitative studies. However Burke-Johnson and Christessen (2014) suggested that researchers can adopt self-reflexivity and triangulation to minimise researcher bias from their study. It is true that the problem of researcher bias is frequently a problem in qualitative research because qualitative research studies tend to be exploratory, open-ended and less structured than quantitative studies (Burke-Johnson & Christessen, 2014.p429). Since the researcher played a vital role in the study, it was important to be aware of researcher bias. The researcher's positionality in the study (that is insider researcher) required reflexivity to be considered to minimise researcher bias. As a valuable tool, it allowed the researcher on-going self-awareness and inner reflection during the data collection process in order to produce more accurate analysis of the research" (Pillow, 2003,p.78). It was anticipated that participants in this study shared views and experiences that were different from the researcher, and thus, the researcher attempted to understand participants' accounts from within their frame of reference. Research memos and journal writing were used to document and identify and name any preconceived ideas and biases before and after each interview or focus group session with the participants (Pillow,2003).

Alongside the reflexivity technique highlighted above, the study adopted a triangulation technique called triangulation of measure to minimise researcher bias and to identify a converging point of the data collected. Triangulation in general is a validation approach of using multiple investigators, methods, data sources or theoretical perspectives in the search for convergence of results (Pillow,2003). As an outcome, "triangulation of measure" in the study occurred when the results converged on the same conclusion.

4.7.3 Trustworthiness

The study used Guba and Lincoln's (1981) four constructs of credibility, transferability, conformability and dependability to determine trustworthiness of the study as follows: (i) *credibility* of the study was demonstrated by ensuring that the study was conducted within the parameters set by the research design and data collection procedures (Schurink, Fouché & De Vos,2011; Shenton, 2004). To increase the authenticity of data for the study, persistent and prolonged observations of different methods of data collection were adopted by the researcher; (ii)

transferability in this study was achieved by aligning research questions and data collection methods consistent and in line with the aim and objectives of the study (Schurink et al., 2011).

Contextual information was given for the study so that the reader can decide if the described situation is similar to the one they would like to transfer the findings to (Shenton, 2004); (iii) *dependability* was achieved by keeping the findings consistent and reliable throughout the study – the details of how the researcher would document research proceedings, which would allow anyone outside the research discipline to audit, follow and critique the research procedures was followed (Moon et al., 2016); lastly *conformability* for this study was achieved by providing clarity to the concept of reflexivity, which is the awareness of the researcher's role in doing the research, as well as the procedures and consequences of research (Haynes, 2012). Reflexivity gave the researcher the ability to formulate an understanding of an individual's cognitive world, especially the individual's influence as a researcher and that of participants.

4.8 Ethical Considerations

Researching one's own practice is always a challenge; therefore, careful ethical considerations were adopted to avoid researcher bias. The study was guided by the ethical procedure set out by the School of Education Ethics Department of UCT. The first step involved gaining ethical approval from the University of Cape Town. Secondly, the researcher sought additional permission and ethics clearance from a second institution's ethics department. Lastly, the researcher also informed and got permission from the Head of Department and programme coordinator in the VCD and MM programme in the Faculty of Informatics and Design to contact and interact with the students. Data collection only commenced when such clearance was granted (See appendix A and B). Confidentiality in the study was maintained by using pseudonyms to represent the research participants (students and lecturers) and all collected and analysed data was kept strictly confidential in line with the UCT data management plan attached to this dissertation (See appendix C).

The participants were informed about the purpose of the study before they agreed to participate in the study. Only after they agreed to participate in the study where they invited to the interviews (Rubin & Babbie, 2001). Therefore, an information sheet and consent form were designed to provide participants with needed information (See appendix A and B). Participants were also informed that they could withdraw from the study at any or refuse to answer any questions they were not comfortable with, and that confidentiality and anonymity would be maintained in the publication report and any additional publications that might arise from the study see appendix (A-C).

4.9 Summary

This chapter covers the research approach, data collection methods, and instruments that were used to collect data from the participants. The introductory section links the research instrument (sub-questions in table 4.1) with the process of answering the research questions. There is a direct correspondence between the theoretical approach described in chapter 3 and the research methodology adopted for the study. The theoretical framework in chapter 3 assists in conceptualising and understanding the research problem at hand, at the same time suggesting appropriate research methods and techniques to carry out the investigation. Lastly, ethical considerations and how these were followed and adhered to is also provided in this chapter. The next chapter is a presentation of the study's findings on the potential of online studios in design and technology education to foster digital literacy skills among undergraduate students in the VCD and MM programmes.

CHAPTER 5 : FINDINGS

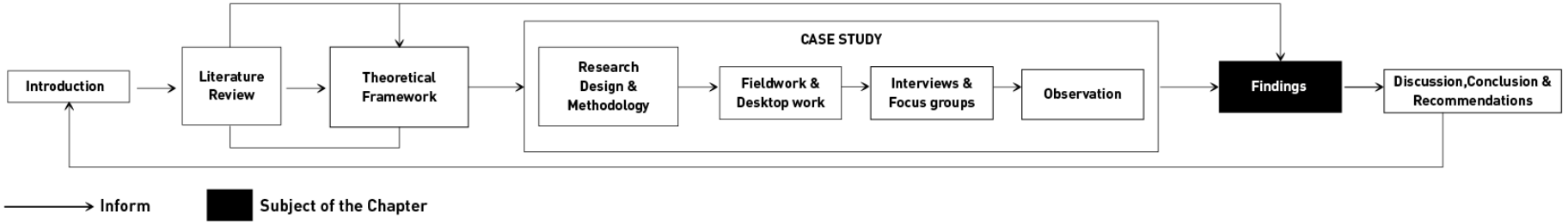

Figure 5.1: *Outline of Chapter 5*

5.1 Introduction

The study investigates the potential of online studios in design and Information Technology (IT) education to foster digital literacy skills also known as the "Super Skills" or the 4C's of 21st century learning among design and Information Technology (IT) education undergraduate students. These skills are: critical thinking, creativity, collaboration and communication. It focuses on pedagogical strategies in which traditional studios can be adapted to online studios and the ways in which these online studios can foster students' acquisition of digital literacy skills. As a matter of urgency, current studios must transform to meet the demand and challenges of today's higher education to foster high levels of interaction with emerging technologies in design and technology fields, as this constitutes transformative learning.

This chapter presents the findings of the study on the dynamics of online studio activities and their impact on digital literacy skills of undergraduate students, guided by Cultural Historic Activity Theory. The chapter provides valuable insights into the complex interplay between lecturers, students, tools and socio-cultural context within online studio environments and conditions required for these to foster students' acquisition of 4Cs of 21st century learning. The research question posed was: "What digital literacy skills do online studios promote among undergraduate students in a discipline-specific setting such design and information technology fields?" This question was divided into the following sub-questions:

(i) What were lecturers' pedagogical practices in the studio before and during Covid-19?
(ii) How did these practices impact the development of 21st century 4C's (critical thinking, creativity, collaboration and communication) skills in students?
(iii) What pedagogical practices are required for (online) studios to foster digital literacy among undergraduate students in design and technology related fields?

In reference to the aim of the study and the nature of problem at hand, the researcher identified individuals who could assist with relevant information to help answer the above questions. The participants were selected from two programmes VCD and MM in the Faculty of Informatics and Design of a university of technology.

5.2 Thematic presentation of findings

This section presents the coded data obtained from interviews and focus groups according to the themes and subthemes determined after classification in section 4.7 of the previous chapter. The following themes emerged after data analysis:

(i) Studio as a signature pedagogy: activity systems in the studio; before and during the COVID-19 pandemic.
(ii) Contradictions, technical limitations, mediator tensions and impact on digital literacy skills acquisition (collaboration, communication, critical thinking, creativity);
(iii) Online studio transformation.

Sub-themes such as students and lecturers' experiences and perceptions with online studios (attendance, participation and interaction); and integration of online studios and digital literacies are also presented in this findings section. The above themes are then linked to CHAT constructs and corresponding categories, with the categories representing the aggregation and concatenation of codes with specific shared characteristics during the analysis phase. CHAT was used to understand how students, lecturers and other stakeholders interact in studio practices with digital technologies. The categories and themes presented here mostly emerged from analysis of the interview data, interview questions, activity theory constructs and a theoretical understanding of the phenomenon being studied. The use of CHAT in the findings was to explore how studio spaces can be transformed through emerging technology tools to support 21st century skills development exploring the factors that influence students' participation in these online communities. The findings are discussed under two headings because the study is an embedded multiple-case study in which data was gathered independently from students and staff members across two departments to obtain clear insights and achieve the objectives of the study.

5.3 Studio as a signature pedagogy

As discussed in the literature review the studio pedagogy is characterised by its social nature, supporting collaboration, feedback, critique, students learning from more knowledgeable other as well as structured process of problem-solving through the help and support of lecturers and tutors. The studio as a 'signature pedagogy' theme presented in the findings below is presented along an analytical framework based on third generation activity theory. Based on this logical reasoning, the findings focus on the two activity systems (visual communication and multimedia) before and during COVID-19 pandemic and then tensions and/or contradiction that emerged across these two systems.

5.3.1 Visual communication design programme Activity System before the COVID-19 Pandemic

The visual communication design programme is part of the design department within the faculty of informatics and design at a university of technology. The students who participated in the study from the visual communication department were undergraduate students from first year to third

year level of study from different socio-cultural backgrounds. They were enrolled full-time and some had already completed internships in the design industry to gain work integrated learning (WIL) experience - Given that the focus of studio activities in the visual communication design module is media studies and user interface design, there is a strong emphasis on developing the 4Cs of 21st century learning in students, before they complete their studies at a university of technology.

A typical studio activity in the VCD programme before the COVID-19 pandemic was seen by lecturers as an activity system within a community of practice. One key informant with experience of the design department described the studio as a dynamic and interactive activity system that fosters a sense of 'active engagement' and 'mastery' among students. The key participant mentioned this situation as follows,

> … So, studio is both a physical space and a methodology. It's a living setting, it's a methodology. […] It's kind of an attitude of students learning through mastery. So, they get set a problem or a challenge. And then they go through that whole process of solving that problem, but through a tutor's support. (K-P_2).

One of the key participants (K-P_1) who followed the 'studio model' in her teaching described the studio space as… "a 'tribe', a 'heard' or 'community' characterised by students interacting with each other or students interacting with their lecturer". Regarding this finding, the terms 'tribe', 'heard' or 'community', represent an identity students and lecturers assume by being part of the community and a general acceptable way of socially engaging with one another to achieve a common purpose, goal or outcome based on their objectives as students and lecturers participating in studio learning. In this case it means that there is a clear leader or lecturer who assigns project assignments and assess them at the end of a given time frame for students to develop digital literacy skills also known as 4Cs of 21st century learning (collaboration, creativity, communication and critical thinking).

Consequently, the VCD programme activities before the COVID-19 pandemic are described as *collective studio activities*. According to K-P_2, students and lecturers engage in various activities as a 'community'. K-P_2 also stated that students and lecturers known as 'subjects' were motivated by a purpose or towards the solution of a problem (object), which was mediated by tools and/or signs (artefacts or instruments) used to achieve the goal (outcome). For example, the goals and outcomes of studio activities required students to develop mastery of Adobe software package for logo design, illustration, animation or user experience (UX) and user interface design (UI). K-P_2 also - emphasised that students were encouraged to socialise,

collaborate, attend feedback and critique sessions, learn from more knowledgeable others as well as to embark on a structured process of problem-solving through the help and support of their tutors, making it a signature pedagogy. While describing the main activities that occurred in the visual communication design department before COVID-19, K-P_1 underscored that student interactions with their peers as well as their lecturers were encouraged because design is considered a social activity.

Another dimension related to the social nature of the studio is the use of social media technology tools to foster teacher-student interactions; student-student interactions and student-content interactions. The findings in this study show that a majority of studio activities in the visual communication design department before the Covid-19 pandemic were constrained by cultural factors including conventions (rules) and social organization (division of labour) within the immediate context and framed by broader social patterns (production, consumption, distribution and exchange). For instance, findings revealed that majority of students were from historically underserved communities and could not afford some of the equipment and software required to execute certain projects like photography.

Of importance, findings show that most students were unable to purchase expensive Nikon or Canon D650S cameras that were recommended by their lecturers. From the visual communication design department activity system, as highlighted by K-I_1 and K-I_2, it can be understood that the inter-relationship between activities, actions, operations and artefacts, subjects' motives and goals, and aspects of the social, organisational and societal contexts within which these activities were framed see Figure 5.2 overleaf.

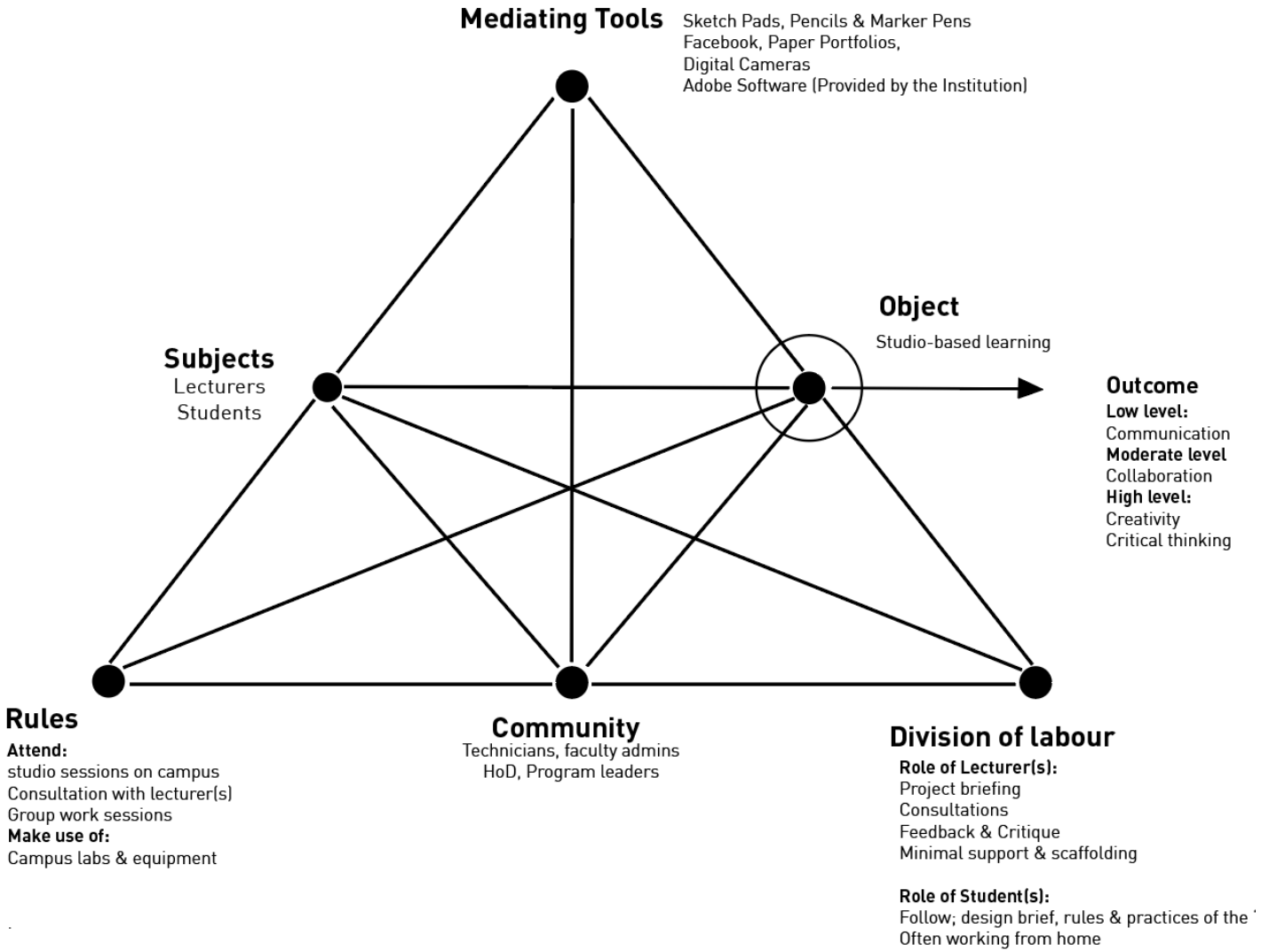

Figure 5.2: *Visual communication department activity system before the COVID-19 pandemic*

While there was much emphasis on viewing the VCD programme's learning environment as a practice-oriented place, where social engagements were encouraged, studio activities in the VCD programme also included theory subjects such as history of arts or business studies, which were taught in lecture-style formats. However, even in those subjects' students were given studio-type assessment tasks through project briefs with clear and detailed instructions to foster the 4Cs of 21st century learning, either working as individuals or sometimes as part of a collaborative project. Artistic or creative skills were for example encouraged through a process called ideation or visualization. During this learning activity, students used different tools like drawing pens, marker pens and artistic paper to sketch or visualise their design solutions inside the studio, or sometimes outside the studio see Figure 5.3 below.

Figure 5.3: *ideation process from concept to final digital execution*

Students were also expected to develop their collaborative skills by deeply engaging with their lecturers or project leaders. However, the reality is that students were often left on their own to figure it out by themselves. Regarding this, L-1 stated that:

> … And you would not see that lecturer until the following week, Monday… He would say "What am I supposed to do? So, you spend the whole week frozen. And you can't move forward? Until somebody explained it to you in a way that you understand.

The above statement shows how lack of support or scaffolding severely impacts students' acquisition of digital literacy skills such as creativity, communication and collaboration in a studio setting. The word 'frozen' in the except above, indicates a culture of fear was experienced in the studio by some students, as it prompted students to 'just figure it out' on their own without lecturer's support and guidance. The studio culture ceased to exist over time because of this lack of support, as students who participated in a focus group indicated, as they became less motivated to participate and collaborate in the studio, resorted to working alone from home and only submitted a final project on the final deadline day. ST_1 from F-G_1 had this to say:

> … If you look at what happens in the design department, we learn by making and we're supposed to learn by making it home as individuals, we only come to school for two days then we go home and work from home until the due date.

Expectations were not clear, students reported to not be comfortable in participating in the studio activities preferring to work from home instead. In the visual communication department, the instructors did not serve as guides or mentors. Regarding the students' statements above, one key informant in the faculty of informatics and design supported this apparent lack of studio-culture,

> … So, I think we sometimes lie to ourselves when we think that we've got a studio culture." […] "I've walked into empty studios, […] and I never, hardly ever saw a full studio...The studio was full on the day when the brief happens maybe on the day when feedback happens, the rest of the rooms are always empty…And I think having worked in the design department yourself, honestly, you have to agree with me – do you remember any studio culture? (K-P_1).

From the findings, it seemed that there was a distinct tension between how lecturers and students perceive the studio culture in this department. Lecturers in the visual communication design department did not fully engage students in directing their own learning.

5.3.2 Visual communication design programme Activity System during the COVID-19 Pandemic

As discussed above, most participating lecturers in the visual communication department revealed that they had not used digital technology often before 2019. However, there are exceptions, with some lecturers making use of digital tools, such as social media to foster communication and collaboration. K-P_2 and a selected lecturers in the visual communication department started embedding different types of social media tools to promote social interaction, which became a key component of the studio activities. Regarding this finding, K-P_2 underlined the following,

> So later on, we adopted Facebook group in our courses because it has a social, almost like the cafeteria space, you know… the informal learning space took on in the other courses, and subject as well.

Some colleagues also used an ePortfolio, which helped them in the transition to online learning as highlighted by, L2:

> …But I think by then 2019, I was already starting to explore some online options, because one of the teaching methods that me and my former colleague were introducing at the time was e-

> portfolios. […] So, one of those things was to tell students that they can upload their portfolios on their website. So, look at it as your printed portfolio online. We were starting to explore these platforms on our own you know.

In the case of the above online activity system of developing e-portfolios, some lecturers perceived this transition as a benefit for their assessment activities because online portfolio submissions proved to be cheaper and cost effective, as there was no need to print portfolios anymore.

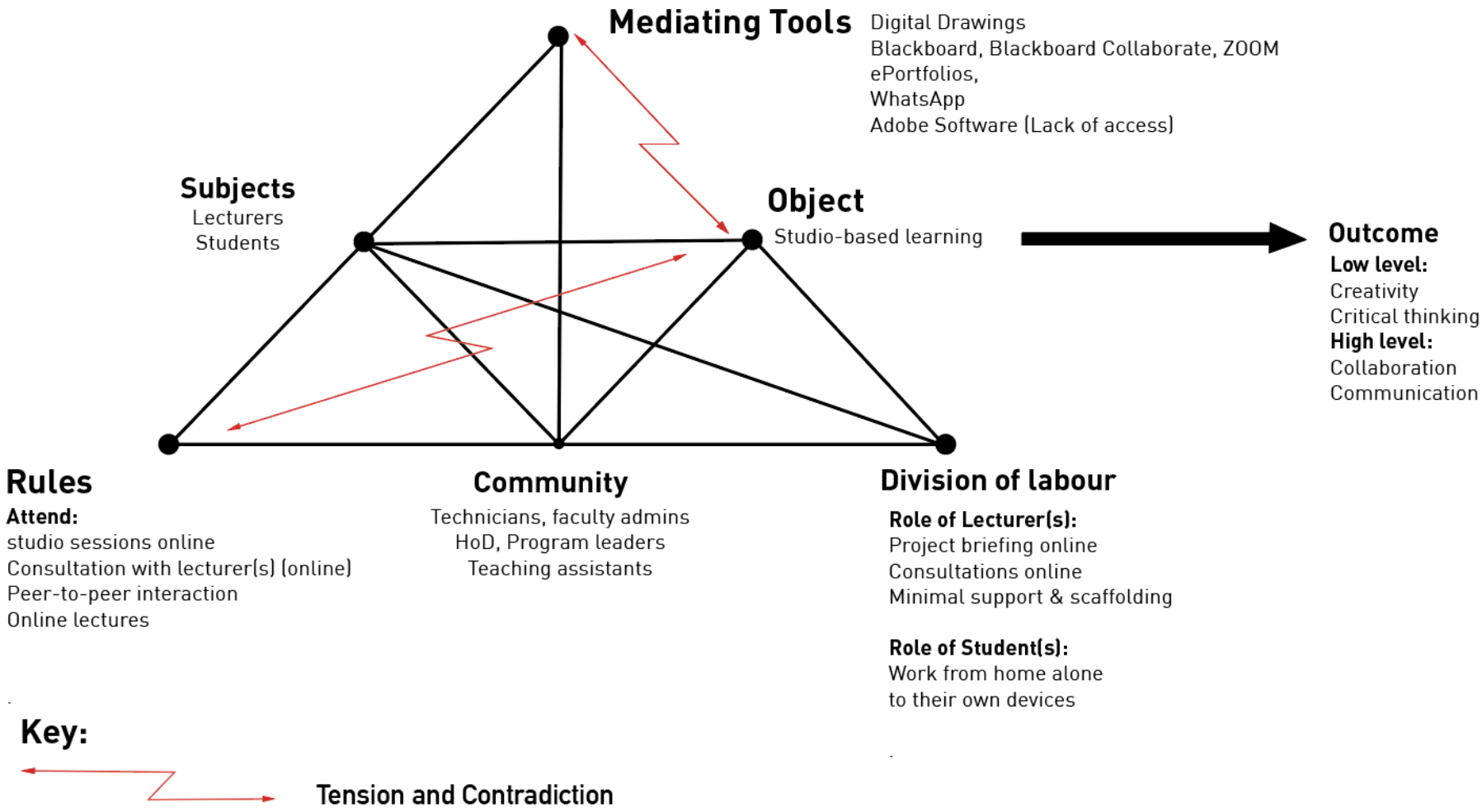

Figure 5 4:*Visual communication design programme activity system during COVID-19.*

During the pandemic, portfolio submission requirements were different but the goals remained the same; new online digital tools such as Behànce and Google Sites were adopted as e-portfolio showcasing tools – saving the students time and money. According to L3, L4 and L5, e-portfolios improved their assessments as they could easily request students to share a link to their e-portfolio for evaluation. This allowed both students and lecturers the flexibility to collaborate anytime and at anyplace, both students and lecturers no longer needed to come to the physical campus as everything could be done online, saving them time and money. Therefore, by encompassing and unifying various lecturers' perspectives above, some other lecturers agreed that some subjects were well suited for online learning and benefitted students more. Regarding this perspective, L6 said:

> … I do think that that some, some subjects and some course material lend itself very easily to being an online situation (L6).

However, some lecturers in the visual communication department were adamant that the value of in-person interaction, including the ability to read body language, socio-cultural interactions and interconnectedness that comes with physical presence cannot easily be replicated online and they would prefer face-to-face interactions over online interactions. A participant who was very familiar with traditional face-to-face interactions said,

> … You could read the body language, you know, you can easily tell what is going on. Online, we don't have enough time, time is limited, we have to live according to a schedule (K-P_2).

In general, while some of the findings above indicate that online studios and online teaching offered certain advantages such as adaptability and efficiency to online teaching, these findings also uncover complex and multifaceted experiences of lecturers as they navigated online teaching. These findings underscore the ongoing perceived value of in-person interactions as part of the studio activities giving the studio its 'signature' status.

5.3.3 Multimedia programme Activity System before the COVID-19 Pandemic

The multimedia programme is made up of more than 500 undergraduate students from first year to third year level of study. In the Multimedia programme, subjects such as Multimedia Foundations, Multimedia Design and Technology and Multimedia Projects are taught. This study draws mostly on the Multimedia Foundations course which is one of the core subjects taught in the multimedia department. This subject focuses on the production of various digital artifacts such as websites, videos as well as mobile applications by learning through reflection within a community of practice. The Multimedia Project subject is also one of the core subjects taught

from first year to honors level where students work in groups through reflection within their community of practice. The process of teaching and learning in the multimedia department follows a different approach to the visual communications department. Teaching is predominantly focused on teacher-centered and problem-based instructional practices with minimum student engagement and technology use.

Within the multimedia department activity system as illustrated in Figure 5.5 below, students and lecturers are portrayed as subjects interacting with tools to attain the desired outcomes of a web-design related project. The object of this activity system is the goal (functional website) and the interaction was mediated through the use of various digital technology tools like Gimp, Adobe Photoshop, Adobe XD and Adobe illustrator software. Other collaboration and communication tools like Blackboard Collaborate and WhatsApp were minimally used to facilitate communication in the activity system before the COVID-19 pandemic. Similarly, the relationship between the subjects (students and lecturers) and community (other departments) was mediated through rules. The rules in this activity were described as any formal or informal regulations pertaining to teaching and learning or the rules related to assessments which had an effect on the activity. For instance, new rules were established within the activity system, the subjects known as students were required to formulate their own working groups of 4 to 6 individuals for the web-design project.

The findings also show that inside the multimedia design department activity system, the affiliation between community and object was mediated through the division of labour, which refers to how the tasks were socially distributed between the students and sometimes between the lecturers. In general, the findings also reveal that the activities in the multimedia department were mostly undertaken in the information technology community of practice. In this community, students and lecturers (subjects) were motivated by a purpose towards a web-design project which required them to gain programming and coding skills (object). The task was mediated by digital technology tools like Adobe software and other collaboration and communication tools like WhatsApp (artefacts or instruments) in order to achieve the goal (outcome) refer to Figure 5.5 overleaf. Their activities were mostly constrained by cultural factors including conventions (rules) and social organization (division of labour) within the information technology context and framed by broader institutional social patterns (production, consumption, distribution and exchange) see Figure 5.5 overleaf.

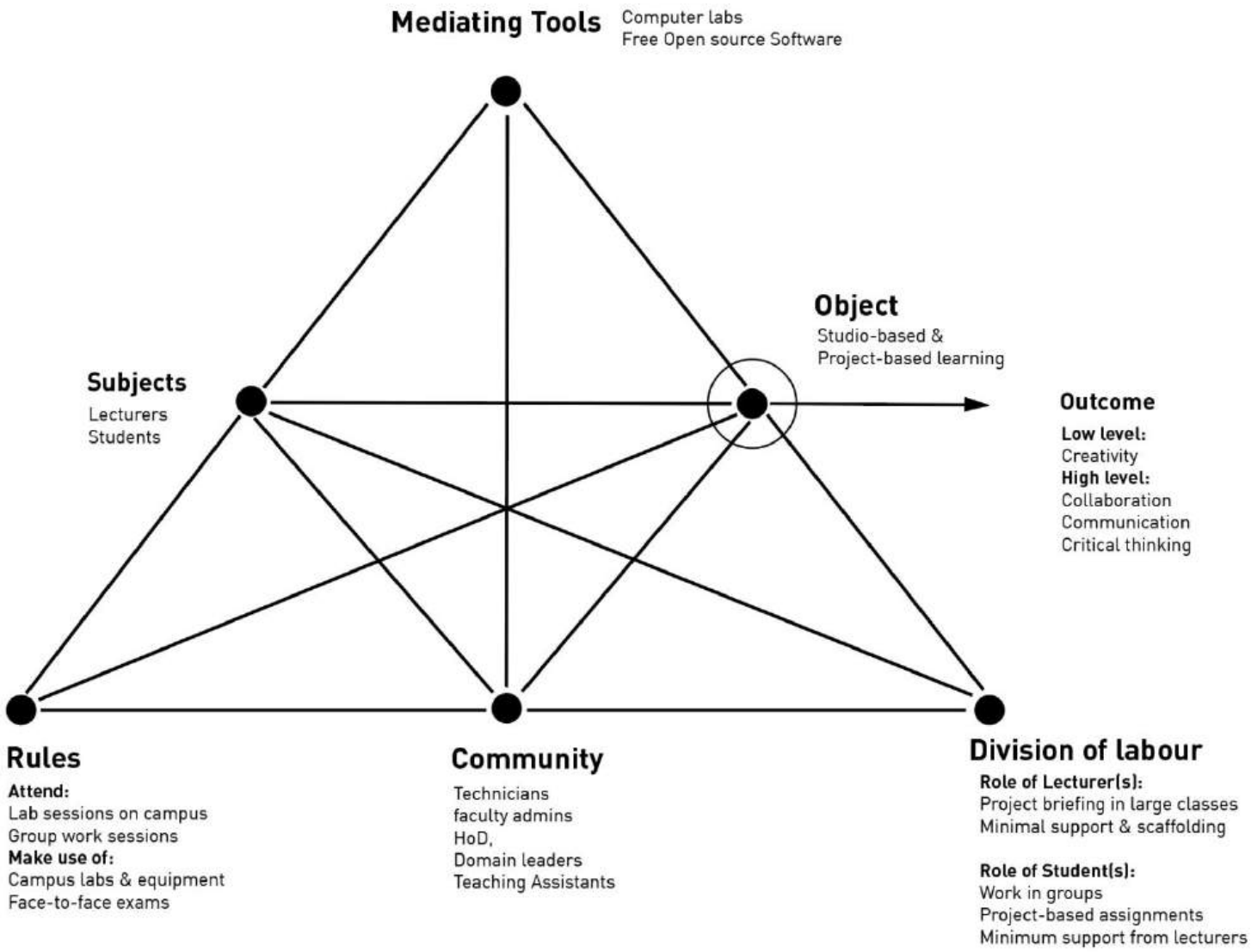

Figure 5.5: *Multimedia programme activity system before COVID-19.*

As a typical design studio project, before the pandemic, multimedia applications foundation (MAF) students were tasked to create an e-portfolio website as part of the Multimedia Projects subject. The 'subjects' were first- and second-year undergraduate students and lecturers in the multimedia design domain who were part of a larger collective system in the information technology department. As part of their activities, they participated in a web design activity that required them to develop a brand-guide and a website using various tools that were available to them. In this activity, they used both physical and psychological tools to achieve their task goals. Physical tools like computers and other hardware were used in the activity. These tools thus extended students' abilities to achieve targeted goals and satisfy the course objectives. Digital technology tools were used intermittently to communicate, collaborate and to influence behavior in one way or another. L6 from the multimedia department said that:

> …as an institution, or maybe as a department we used technology inconsistently in our activities. We simply used blackboard [the institutional LMS] as a dumping ground for information (L6).

This finding reveals that lecturers did not foster student-tool interaction with technology in their activities, but rather used technology tools as a 'dumping ground' for content before the COVID -19 pandemic. Within the framework of this activity, findings show the 'object' component of this activity system portrayed the purposeful nature of designing a website, which allowed the students to control their motives and behavior when they carried out the activity. This entailed students understanding their 'community' as well as other stakeholders within the information and technology department who shared the same overall objective of the activity. The website design activity was part of a larger project carried out in the information technology department, thus the community component put the web-design task into the social and cultural context of the information technology environment which is part of the larger institution in which the subjects operated. However, the 'division' of labour in this activity as the findings show, was not always a smooth process. One lecturer dealt with close to 500 students alone and shared that,

> …there was no real understanding what one lecturer is dealing with, you know, maybe a class of 500 or collectively 500 or two 250 students because it felt individualised.

The 'rules' of this activity were heavily influenced by the social-cultural settings of the environment in which the web-design activity was carried out. Based on this finding, it was challenging for the lecturers in the MM programme activity system to fully apply the studio pedagogy in their activities because their class sizes were too big to carryout online without the support of teaching assistance (TA). The lack of teaching assistance support made it difficult to carry out the activities.

5.3.4 Multimedia programme Activity System during the COVID-19 Pandemic

The transition to online studios during the COVID-19 global pandemic, brought in its wake a plethora of educational challenges in the multimedia department. The two programmes experienced online learning very differently. While in the VCD programme, there was some experience with online portfolios and social media, that helped the transition to online learning the MM programme was thrown into the deep end as the COVID-19 pandemic forced lecturers in the design and information technology departments to adopt online teaching, which proved challenging for some lecturers. The findings show that this rushed transition to online learning resulted in poorly developed courses that were poorly attended. Since students were not allowed to meet face to face, activities were done remotely online. For example, students were asked to design an e-portfolio website online by collaborating with each other. As part of the online activity, the rules, tools and social interactions changed compared to a period before the COVID-19 pandemic. The task required students to work remotely by collaborating with one another using various technology tools because they had minimal access to software and tools on campus since it was a lock-down.

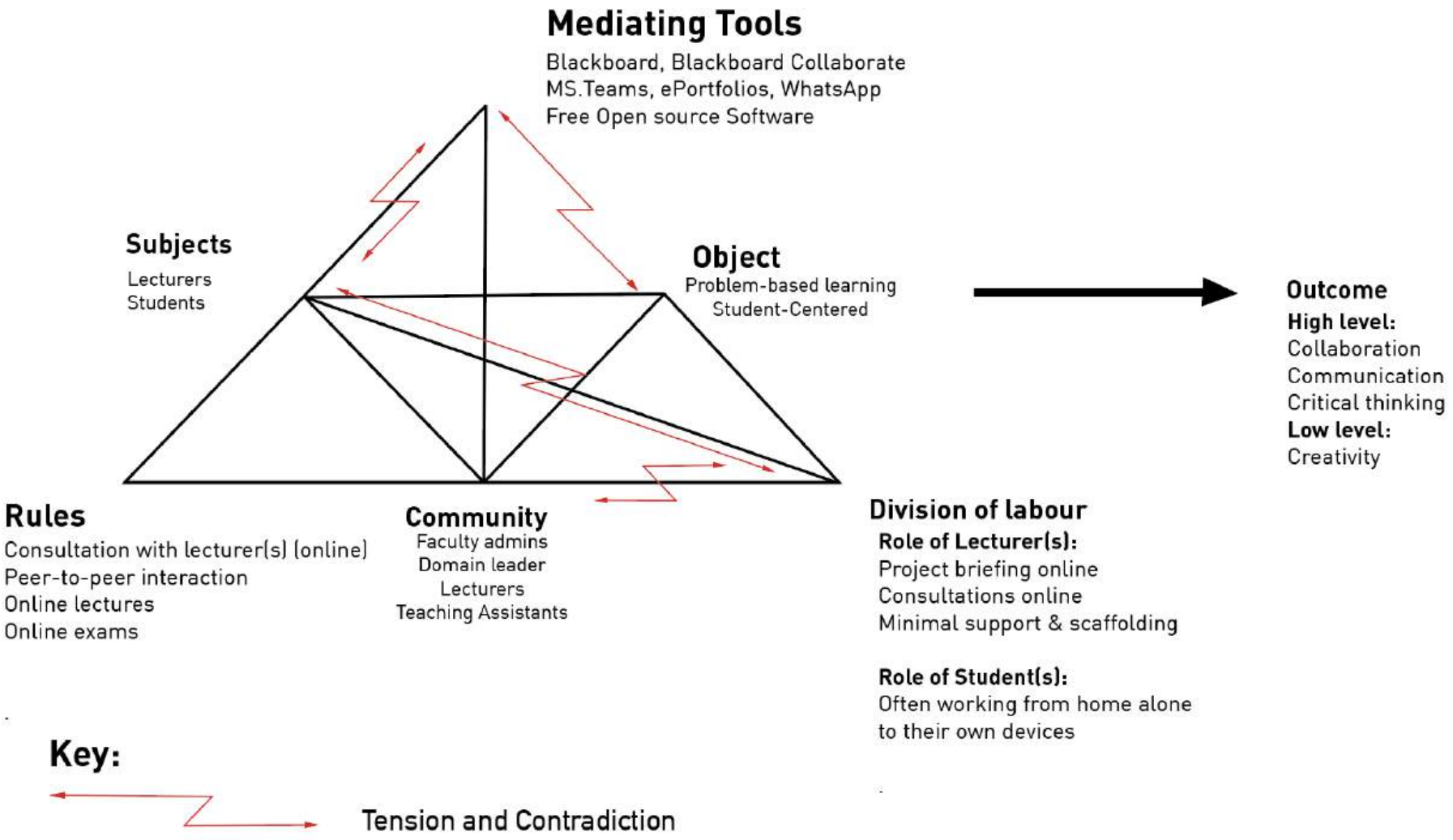

Figure 5 6: *Multimedia programme activity system during the COVID-19 pandemic.*

However, despite these challenges, some lecturers were positive and optimistic about changing the activity from a traditional approach to an online approach, in particular regarding the benefits of designing the e-portfolio website through online collaboration. One of the lecturers, L7, in the multimedia programme for example found that some subjects are well suited for online learning and would benefit students:

> …I do think that that some, some subjects and some course material lend itself very easily to being an online situation.

When the web-design task was shifted to online, the students known as the subjects in this activity were requested to use multimedia tools such as Adobe Photoshop, Adobe Illustrator, Adobe XD and other relevant open-source design software tools. Lecturers reported that this activity was project-based and required students to formulate their own working groups. L8, a lecturer who had experience with online learning explained that:

> …We had to make students come up with their own groups or we would put them into groups, sometimes the workload was just too much, we did not have time to organise them to groups so we gave them instructions how to do it.

While students were able to form groups, tensions and contradictions emerged affecting the activity system. Findings show that some students struggled to use technology tools to communicate with each other. Some lecturers ended up instructing the students to form groups using various digital communication tools, such as WhatsApp, as well as emerging technologies like Google Classroom, Google Keep, and My-Space. These tools were employed to facilitate real-time online collaboration, as L9 explained:

> … I told students they can use any free online tool available to communicate and stay in touch with each other throughout the project.

Similarly, lecturer, L7 shared that: “I am not much into technology, so I told students to use anything they can find online to get the job done”.

As part of this collaborative effort, students became responsible for selecting a group leader and assigning specific tasks to each member. In one particular web-design project, students in focus group two reported that they were put in four groups, each comprising six students. A student from F-G_2 explained that,

> “ we gave each other some tasks to design a particular section of their website once we were put in groups”.

Another student in F-G_2, added that:

" we got a project brief from our lecturer via Blackboard, basically the brief gave us instructions on what to do but the brief was too confusing, […] me and my friends we didn't know what to do so we were stuck.

Asked to elaborate on what they did when they got stuck, another student from F-G 2 interrupted the conversation and said,

> … our lecturer invited us to a Blackboard Collaborate meeting where she explained the brief and project specifications, basically it was a consultation because we were confused.

Figure 5.7: *Multimedia students attending an Online ZOOM consultation meeting*

Regarding the finding above, another student, ST_3 reported that " basically she showed us some examples of the project and it was much easier to understand". When asked to identify the tools that were used, one enthusiastic student who seemed to like online learning argued that " everything basically took place on Blackboard Collaborate, I think it was really cool because I could see what the lecturer was doing". When asked how they completed the web-design task, ST_4 in F-G 2 explained that,

> …" basically our lecturer told us to put everything together and submit the finals."

Upon project completion, students were instructed to consolidate all sections of their e-portfolio into a unified portfolio and submit the completed work on Blackboard. Regarding this activity, L6, who was one of the lecturers responsible for assessing the project said,

> … The e-portfolio website design project aims to assess students' design skills and creative thinking, with a focus on understanding Adobe Photoshop, a preferred mock-up design tool in web design and front-end development.

Asked how they achieve the goals of this activity, L6 said,

> … We leverage the capabilities of Adobe Photoshop and Gimp as design tools because they are easy to use,

when probed to elaborate, L6, responded as follows,

> …"we encouraged students to watch LinkedIn training videos, so that's basically how students were able to create digital mock-ups of their selected websites.

L5, L6, L8 and L7 all agreed that this online activity was of benefit compared to the traditional web design activity, as the online activity eliminated the need for paper drawings and sketches students came up with during the design process before the COVID - 19 pandemic. While the findings in the above activity systems indicate some benefits of incorporating online learning in traditional studios through online communication and collaboration with technology tools like Blackboard Collaborate and Microsoft Teams, several contradictions including technical limitations and mediator tensions emerged as shown in the findings below.

5.4 Contradictions, technical limitations, mediator tensions in Traditional and Online Studio

The above findings show that both visual communication design and multimedia department activity systems shared some similarities in technical limitations, a feeling of disempowerments as well as lecturers' resistance to change their traditional practices. In both activity systems, lecturers' resistance to change hindered the studio transformation to online studio practices. The findings show that there were some communication challenges in the multimedia activity system due to poor division of labour as a result of lecturer shortages caused by short term contracts. This resulted in tensions and contradictions in the activity system.

In addition, lack of technical support and frustrated network administrators in charge of the IT system at the university further worsened the situation in both activity systems by making the transformation goal almost difficult or impossible to achieve see Figure 5.8. Regarding this finding, it is clear that too much bureaucracy, poor communication, resistance to change, poor academic planning, lack of cooperation between departments and domains and institutional 'rules' may further handicap the 'subjects' (actors) from achieving their common 'goals'. The findings also

show that the above activity systems in the VCD programme and the MM programme before and during the COVID - 19 pandemic were riddled with internal contradictions. These contradictions emerged as a result of interaction by different components of the activity system and they can be seen as a source of development of new pedagogical strategies within the studio environment. Figure 5.8 overleaf depicts contradictions that emerged in the activity systems of the VCD programme and the MM programme.

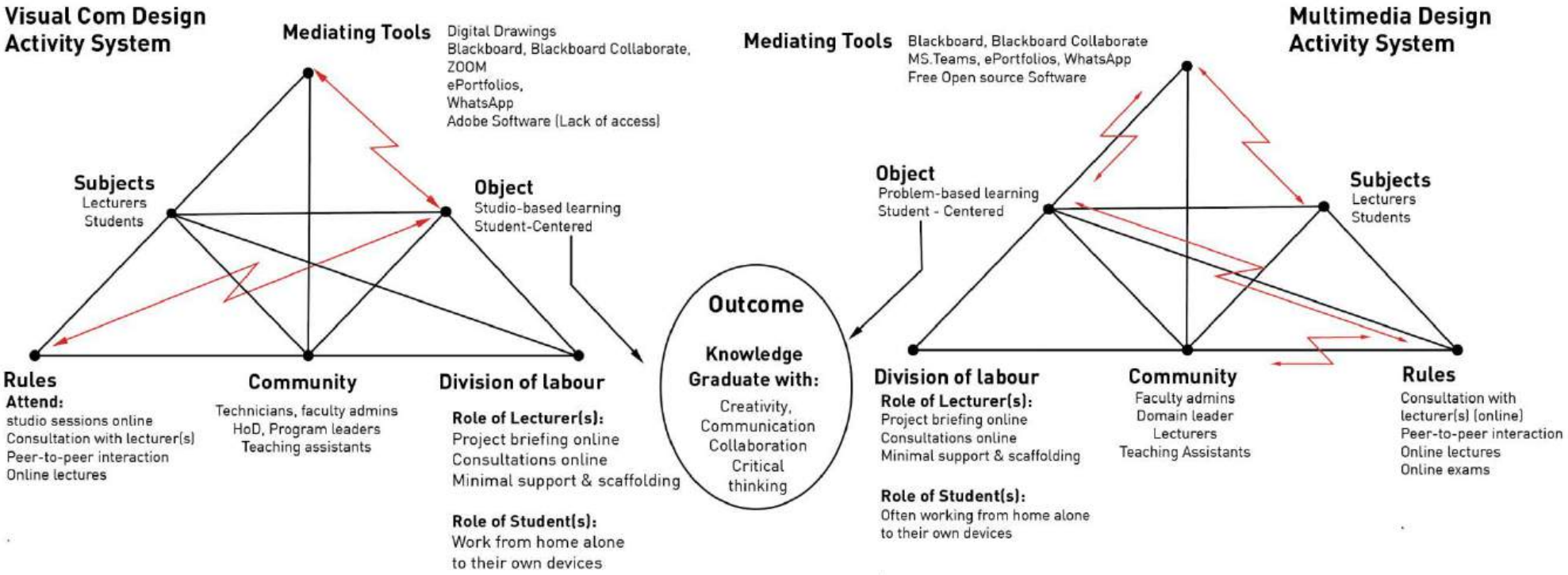

Figure 5.8: *Contradictions in Departmental Activity systems*

Based on the contradictions within the departmental activity systems in Figure 5.8 above, the analytical framework for identifying constraints when moving to online studios to foster 4Cs of 21st century learning in the design and technology field can be seen in table 5.1 below.

Table 5. 1: *Key of Contradictions from visual communication department and multimedia department activity systems*

Theoretical components: Activity system	Research component
Subject-Rules-Object (Rules)	Pedagogy / pedagogical rules
Subject-Tools-Object (Tools)	Technology, Tools affordances and constraints
Subject-Division of labour-Object (Division of Labour)	Socially shared roles and responsibilities

The findings in this study reveal that there were some contradictions and mediator tensions within the visual communication design department and multimedia department activity systems. Their transition to online environment meant that the lecturers had to reconfigure their teaching and learning to accommodate this change; students on the other hand had to get used to the new online learning environment. The findings show that these tensions and contradictions in the visual communication design and multimedia department activity systems emerged as a result of the change in rules, tools usage and division of labour amongst the subjects in their newly reconfigured activity systems. These tensions and contradictions can be summarised as (i) Subject-Rules-Object (Rules); (ii) Subject-Tools-Object (Tools); (iii) Subject-Division of labour-Object (Division of Labour). As a matter of fact, findings show that some of the contradictions emerged as a result of changes in assessments and how students were receiving feedback on their projects. The rest of findings below present these contradictions that emerged from the VCD programme and the MM programme activity systems.

5.4.1 Subject-Rules- Object: Pedagogy rules-related contradictions

In terms of pedagogy rules-related contradictions, the main contradiction reported by lecturers related to assessment strategies for theoretical courses in design and Information Technology (IT) subjects. The findings related to the examination of theory subjects in the multimedia programme show that contradictions emerged due to rote learning, memorisation and lack of proctoring in the online exams within the multimedia department. A majority of the lecturers that were interviewed complained that students cheated by referring to external material during online exams that were written at home, as lecturers could not effectively monitor the students as they wrote their exams remotely. This contradiction in assessment strategies was caused by lack of

clear technological strategies to prevent students from cheating in the exam; under normal circumstances, students in multimedia programme write a portion of their exams on campus in a secured environment, thus eliminating cheating. Regarding this contradiction, L7, said,

> … You know, a lot of our students cheated in their exams during the COVID-19, because a lot of them passed and the system said we should let them pass, […] I mean we were not allowed to fail any students by our bosses, to be honest with you I had to learn to accept this reality, So, I didn't have anything to say, I just went with the flow… (L7).

Regarding this finding, the effectiveness of technology is being questioned and it shows that during the COVID-19 pandemic, assessments were moved online to accommodate all students, which brought into question the reliability of technology for assessing students work in online learning but also lecturers' inability to properly assess the quality of students' work. This finding is one of lecturers' failures to prevent students from cheating in their exams, the contradiction is that failed to redesign the assessments in ways that prevent students from cheating. By referring to the above activity systems, the quality of the learning experience in the VCD programme and the MM programme also depended on the synergy between pedagogy and technology as well as coordination and division of labor among the actors in the activity system. In the activity systems above, there is aggravated tensions and contradictions emerging in all the departments in respect to the faculty of informatics and design and the entire institution. The two programmes in this study and their activity systems are part of the university's wider network. The contradictions above have brought significant tension in both departments leading to lecturers remaining stuck in their teacher-centered practices. All systems ended up blaming each other for example for high student dropout rates, and subject carryovers.

5.4.2 Subject-Tools-Object: Tool / Technology-related contradictions

Regarding the subject-tools-object contradiction, the findings show a contradiction in the use of technology tools in the activity systems in relation to licence fee for software packages needed for students' projects. The findings from the visual communication design department and multimedia department activity systems, show that students from the visual communication department had unlimited access to the licensed version of the Adobe creative software while the majority of the students from the multimedia department had limited access to the licensed version of the Adobe creative suite. This lead to student dissatisfaction: some of the students in the multimedia department reported they should have been given access to all kinds of tools including Adobe creative suite tools for web-design. Based on this contradiction, students from F-G_2 predominantly from the multimedia department expressed their frustration for having

limited access to Adobe creative software. A majority of them were not happy to use free generic open-source software readily found online citing its irrelevance in the design and technology industry. The overall assumption and belief by the multimedia students was that if they had unlimited access to Adobe creative software, their designs were going to improve and they were going to become best designers.

The findings from the visual communication design department activity system show that the majority of lecturers and students were against using free and generic software. They all believed that free generic online tools and Windows related computer hardware systems were not suitable for creating good wireframes. Their assumption was based on their preference for Adobe creative software and Apple operating systems versus Windows related operating system. From this contradiction, it was observed that both departments used different software tools and operating systems to do the same task and to achieve the same goals. The findings for instance show that for web-development related projects, lecturers in the multimedia department activity system preferred a hard coded website using programming language tools like Java, Python and C^{tt} which most visual communication design department students and lecturers were not familiar with in their activity system. Although there were some contradictions and disagreements on the tools of choice to mediate web-design activity as part of studio-based learning in the VCD programme and MM programme activity system, some lecturers were able to use various emerging technology tools to achieve their objective leading to realisation of 4Cs of 21st century learning such as problem-solving skills, critical thinking skills, communication skills and collaboration skills.

5.4.3 Subject-Division of labour-Object: Division of Labour - related contradictions

5.4.3.1 Unequal division of tasks: Collaboration

All lecturers raised the importance of institutional support for developing online learning environments because the task requires a lot of time and effort. At the time of the study, lecturers complained about lack of institutional support as they had to work alone in developing and redesigning online courses. Regarding this finding, L6, said:

> … I felt lonely during the Covid-19 pandemic, no one knew what I was going through, I had to deal with all the students alone and I reached a mental breakdown, I couldn't take it anymore (L6).

Suggestions and insights for further improvements were also shared by all students who participated in the study. The students in the focus groups raised the importance of having clear project guidelines before starting on a project, others in F-G_1, predominantly from the visual communication design department stressed the importance of effective communication and clear

guidelines for online collaborative learning. Students in F-G_1 and F-G_2, raised the importance of clear course outline and structure to foster more collaborations and online discussions. Some students suggested that a clear course structure and outline can help students access course material and locate information on discussion boards. ST_1 from F-G_2 stressed,

> … As students we were familiar with online learning, me and my friends we really struggled, and we noticed the lecturers struggled too… "Maybe I'm wrong but I think we need to practice online learning culture by being active in class."

ST_3, in the same focus group said,

> … Me too, I think maybe we should really be taught how to learn online, I mean because I switched my camera off the whole time, and I never participated on anything.

During online class observations and a few class sessions after the COVID-19 pandemic, findings from these observations also indicate a strong presence of teacher-centered teaching culture in the visual communication department and the multimedia department. During the observation, it was found out that the teacher-centered approach further prevented the studio from being a creative or social space where students share ideas and collaborate with one another. Equally so, the studio culture ceased to exist – ST_2 and ST_3 who participated in F-G_1 indicated that they became less motivated to participate and collaborate in the studio and resorted to working alone from home and only submit a final project on the final deadline day. Regarding this finding, the students in F-G_1 had this to say,

> … If you look at what happens in the design department, we learn by making and we're supposed to learn by making it at home as individuals, we only come to school for two days then we go home and work from home until the due date (F-G_1).

Based on their experience, it is evident that most lecturers in the study site followed teacher-centered instructional practices focusing on one way communication during the pandemic leaving students to figure it out on their own. Similarly, students from the multimedia department ended up figuring out their own learning because there was no direct support from their lecturers. According to one lecturer who was interviewed, this experience helped some of the students to develop their own critical thinking, communication and collaboration skills. That is, the unavailability of lecturers most of the time and pressure to submit quality work at the end of the semester inescapably forced them to develop those skills out of necessity than their counterparts in the visual communication design department. ST_1 from F-G_2 stated,

> … I mean, our lecturers did not respond on time to our emails, so we would WhatsApp each other in our group […] sometimes we googled the answers ourselves, my friend would ask where can I find information on this and that, and then I quickly google it, and I send it to them, then I sort of realised that, I probably know better what question to ask Google.

In the absence of lecturers, students from the information technology department performed most tasks on their own by consulting one another.

5.4.3.2 Online Presence in forum discussions: Communication and Collaboration

During the presentation of findings on visual communication design department and multimedia departments' activity systems, technology related contradictions also emerged. Regarding this finding, most lecturers did not use digital tools effectively at managing online discussion forums. Findings from both activity systems show that there was a strong desire from the students for synchronous responses in forum discussions and lecturer presence in online spaces. Some students felt that the lack of instructor presence in their online discussions and instructors reading from their PowerPoint slides during online learning did not fulfill their desire to participate in online discussions. This tension is revealed through ST_4 from focus group 2, who said,

> … I didn't like our online classes that much because most lecturers were not there to guide us" […] We really felt that our lecturers were never present at all and this made us confused because we didn't know what to do next (ST_4).

Another student, ST_5 said,

> … Sometimes when we asked questions in the forum discussion, there was no one person to answer, no one wanted to reply to the post. We ended up chatting to ourselves on WhatsApp.

Regarding this finding, ST_3 from FG_1 added that a consequence of not having lecturers communicate with them on Blackboard Learning Management System was that students ended up being confused about project requirements, and this contradicts the communication and reflective nature of forum discussions and the social nature of the studio pedagogy. Based on this tension, several students in F-G_1 and F-G_2 expressed their preference for WhatsApp discussion over forum discussion on Blackboard to compensate for its constraint. ST_6 from F-G_2 reported,

> …. For me, communication is very important because I can easily reach my friends on WhatsApp because I have their number and we are in the same class, but if we try to ask a question via email or Blackboard, we only get responses to our questions from our lecturer or classmates when they

log-in. […] we have to wait for some time and wait for other people's responses. So, we end up communicating on WhatsApp.

5.5 Summary of findings

In summary, the findings of this chapter suggest that the shift to remote instruction during the COVID -19 pandemic offered an opportunity for lecturers to explore online education in the form of online studios. The use of online studios during the pandemic holds considerable promise for integrating technology into studio spaces, enhancing student capabilities in digital literacy, collaboration, critical thinking, and problem-solving.

The above findings demonstrates that teaching and learning in online studios is achievable when the purpose and goals of the learning activity are re-envisioned to encompass a broader spectrum of possibilities than previously conceived. The findings show that to achieve the 4Cs of 21st century learning in studio pedagogy, lecturers need to develop collaborative group projects focused on developing students' collaboration skills. Lecturers need to assign students to work in teams on design projects, promoting collaborative problem-solving and idea sharing. Lecturers are also encouraged to make use of digital collaborative tools like shared online work spaces, discussion forums, and project management software to facilitate continuous collaboration.

Moreover, the study reveals that lecturers should shift from current teacher centered instructional practices in favour of student centered instructional practices grounded in social constructivist theories. Lecturers are encouraged to provide regular presentation and critique sessions to help students articulate their design processes and defend their ideas. Findings show that lecturers should make use of digital communication tools more frequently to communicate ideas clearly and effectively with their students.

In addition, the study identifies the 'contradictions' of an activity system as both a potential source of conflict and a driver of innovation, which requires ongoing translation and negotiation efforts. The tensions and contradictions that emerged were a result of lecturers not being used to regular use of digital communication tools to communicate ideas clearly with their students. The findings underscore that the evolution of activity systems is a gradual process, informed by their social historical context and the development of theoretical frameworks that have historically shaped them. A further significant insight from the study is the role of systematic contradictions, technical limitations, and mediator tensions within the VCD and MM programmes' activity systems. The study notes that the introduction of new elements (such as technology) into activity system often

exacerbates secondary contradictions when these new elements conflict with existing structures, leading to disturbances and innovative attempts at system transformation.

The next chapter concludes the study by offering recommendations for future research into online studios and digital literacy. It recapitulates the key problem investigated and outlines some notable challenges encountered. The final chapter also summarises the strategic recommendations aimed at providing guidance for lecturers in redesigning their courses to effectively integrate online studios with traditional, studio-based learning methods.

CHAPTER 6: DISCUSSION, CONCLUSION & RECOMMENDATIONS

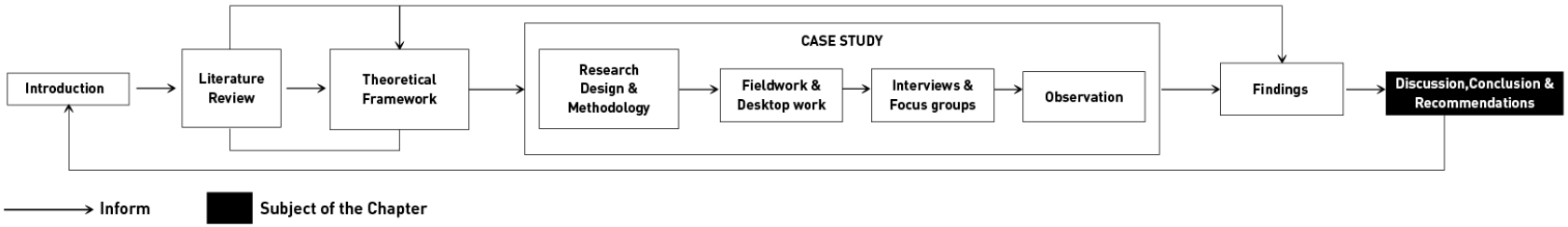

Figure 6. 1: *Outline of Chapter 6*

6.1 Introduction

The focal point of this study was to investigate the potential of online studios in design and Information Technology (IT) education to foster digital literacy skills also known as the "Super Skills" or the 4Cs of 21st century learning among design and technology undergraduate students. The objective of this investigation was to identify pedagogical strategies that bolster the students' acquisition of digital literacy skills — communication, creativity, collaboration, and critical thinking — among design and technology undergraduate students, thereby catalysing transformative learning experiences in online studio contexts. In addressing the study's aim and objective, this chapter concludes the research by addressing the main research question and sub-questions established in chapter one in the form of a discussion in section 6.3 below. In addition, a summary of key findings on online studios and digital literacies are presented in section 6.4 below. Finally, the chapter concludes by describing the research's contribution to the body of knowledge, the study's limitations, and recommendations for further research on curriculum design mechanisms for lecturers to adopt when redesigning their courses for online studios to supplement the traditional studio-based learning approaches.

6.2 Revisiting the theoretical framework and its use in the dissertation and the development of digital literacies

To understand how the goal of online studio pedagogy to develop digital literacy skills, also known as the 4Cs of 21st century learning (collaboration, creativity, communication, and critical thinking), was achieved in the study, CHAT was used as the analytical lens through which the studio activities conducted before and during the COVID -19 were examined as they pertain to students' acquisition of 4Cs in design and technology courses. Echoing Vygotsky's, (1978) seminal perspective, as discussed by Francis and Hardman (2018), " both visual communication and multimedia activity systems were grounded in the purpose and context in which they were situated" (p.69). In this study, studio activities were described as "a set of activities put together in a systematic format to achieve higher cognitive functions through the use of cultural tools in a process called mediation" (p.69). In addition, the presence of these cultural tools benefits the subjects by allowing them to develop higher level skills within a given context or specific environment as a collective. Within this study's framework, the aforementioned skills were recognised as 4Cs: critical thinking, creativity, collaboration and communication -CHAT was used to observe and analyse the engagement of students and lecturers pursuing their activities within studio practices, focusing on their tool's usage and the mediating influence of the rules and historical context of communities in which they operated. For instance, students in multimedia course were given open-ended projects with broad guidelines, allowing them to explore creative

solutions and innovative designs. Emphasis was given on prototyping and ideation to foster a creative mindset. The use of digital tools like video conferencing, chat platforms and discussion forums also encouraged students to communicate their ideas clearly and effectively. In addition, projects were designed to address real-world problems, requiring students to apply critical thinking to devise practical solutions.

CHAT offered a nuanced understanding of the dynamics among students, lecturers, and other stakeholders as they interacted with digital technologies in studio settings. The integration of digital tools in the studio during the COVID-19 pandemic likely enhanced communication and collaboration among students, providing them with hands-on experience using technology for design. A principal aspect of activity theory, pertinent to this study was its emphasis on dialectical analysis of the interactions between students and lecturers (subjects) and the mediated tools or artifacts (technical elements) which are inextricably shaped by their intended use and purpose .As mentioned earlier, use of tools like video conferencing, chat platforms, and other collaborative digital tools likely encouraged students to communicate their ideas clearly.

In addition, CHAT provided the analytical foundation for an in-depth analysis of online studio activities to help the researcher understand how students and lecturers engage in the complex environment of a design studio. In this analysis, CHAT was used to examine the experiences and perceptions of students and lecturers in the current studio spaces as they pursue their activities. An observation of their tools and the mediation of the rules and history of the communities in which they were operating was also made. This observation approach helped the researcher to gain a clearer sense of how students, lecturers and other stakeholder interact in studio practices with digital technologies. Accordingly, CHAT was used to understand and analyse the factors that drive the transformation of studio environments from an activity-based and multi-stakeholder perspective. The CHAT framework delineates online studios as systems of activity, encompassing concepts such as actors, motives/goals, mediators, activities/actions, transformations, and outcomes. From the point of view of the two activity systems, an actor was defined as an individual or a group of people engaged in the activity system - Motives/goals pertain to the objectives sought by the actors within the activity system. Mediators represented the elements and tools that facilitated or impede the achievement of these objectives.

6.3 Discussion of Findings

The study highlighted that studio-based learning remains the main teaching method used in many design related courses and other arts fields, so does multimedia technology. However, research on the implementation of online education for educational purposes in design and technology

related fields remains limited and inconclusive. The key findings as discussed in section 6.3.1 below highlight the need to transform current studio pedagogies to make them 'digital maker spaces' for students to explore the boundaries of design fields and new emerging technologies. In addition, some of the findings discussed in this section suggest that the shift to remote instruction during the COVID -19 pandemic offered an opportunity for lecturers to explore alternative pedagogies. Pertinent to these pedagogies is the need to foster students' acquisition of digital literacies . Following the aftermath of the COVID -19 pandemic, digital literacy has become a key element in teaching and learning across different educational fields.

6.3.1 Contradictions in activity systems and their impact on digital literacies

Drawing from the visual communication design and multimedia design programmes' activity systems, the study identified some contradictions. Tensions and contradictions identified were both a potential source of conflict and a driver of innovation. The tension and contradictions that emerged helped both students and lecturers to develop a more comprehensive understanding of design principles and practices. They also created opportunities for students and lecturers to reflect on their own teaching and learning processes by evaluating their progress and identify areas for growth.

In addition, the findings underscore that the evolution of activity systems is a gradual process, informed by their social historical contexts that historically shaped them. As a result, the findings show that it will take time for both students and lecturers to develop key digital literacy competencies to fully adapt in online studios and online education. Although there were some instances of digital literacy use in online studios in design and Information Technology (IT) education, the study found that the students' and lecturers' ability to develop these competencies could have been affected by the 'contradictions' of an activity system as a result of tensions and multi-*voicedness* that emerge."

Noteworthy is the distinction made between contradictions — viewed as accumulating structural tensions within and between activity systems —and problems or conflicts. For example, the study noted that the introduction of new elements (such as technology) into activity systems often exacerbated secondary contradictions when these new elements conflict with existing structures, leading to disturbances and innovative attempts at system transformation. When moving online, interesting shifts happened across the two contexts. While in some instances individual 4Cs improved, in others they remained the same or even decreased (Gilster, 1997). Reasons for these contradictions in the MM activity system and the VCD activity system are varied, but include

students having to work more independently, collaborate more because of lack of lecturers' support (Naufal, 2021).

In addition, some students struggled to access course content, participate in online class activities and collaborate with other students. Communication and collaboration in the MM activity system was better compared to the VCD activity system. The students from the MM activity system during the COVID-19 pandemic were able to achieve deeper levels of knowledge generation through the creation of shared goals, shared exploration, and shared process of meaning-making. Although some lecturers were able to create learning environments that foster the development of 4Cs in online studios, some lecturers needed thorough guidance on how to develop their curricula. The study findings suggest that the delivery of online studios to foster students' acquisition of 4Cs of 21 st century learning also known as digital literacy skills, can be successfully achieved if attention is devoted to the following key areas:

(i) Ensuring access to and familiarity with emerging technology tools in use;
(ii) Establishing guidelines and procedures which are relatively loose and free-flowing, and generated with significant input from the participants (the students through evaluations);
(iii) Promoting collaborative learning; and creating a double loop in the learning process to enable students to reflect on their learning process (Pallof & Pratt, 2000).

Furthermore, the study also found some contradiction in the teaching strategies that were employed in the visual communication design and multimedia activity systems. The findings from these two activity systems during the COVID-19 pandemic show that the majority of online learning is done without instructional design principles in mind. There is also a big difference between preparing to teach in the classroom and preparing to teach online. Following design principles for online courses delivery ensures the focus is on student learning and not on the technology or platform. Although studio-based learning is normally conducted in traditional face-to-face format in the studio, it can also be socially constructed in a digital space through various social media tools and emerging technologies (Morkel & Cronje, 2022).

6.3.2 Contradictions related to Teaching and learning in the studio

In terms of contradictions related to teaching and learning in the studio, the study found out that one of the key challenges to develop any kind digital literacy skills is implementation of teaching and learning strategies that are not aligned to the overall course goals and objectives. The literature available to date shows that online learning requires sound knowledge of different pedagogical strategies to foster students' acquisition of 4Cs.

In addition, the effective design of enabling learning conditions is central to the transformation of goals and activities into positive outcomes. Furthermore, the study noted that one of the problems of poorly developed teaching strategies and teacher centred instructional practices was disengaged students, a culture of fear and lack of institutional support. The emergence of this contradiction was based on lecturers feeling undervalued and overworked by the institution. The majority of lecturers felt undervalued for their hard work and being overworked for minimum pay. It emerged that lecturers often feel less motivated to do their best because there are no incentives to recognise their efforts and hard work. Lack of instructional design was the primary reason why some tensions and contradictions emerged in the two activity systems.

6.3.3 Technology-related contradictions

Regarding the subject-tools-object or technology contradiction, the findings show a contradiction in the use of technology tools in the activity systems. The findings from the visual communication design department and multimedia department activity systems, show that most online courses were poorly structured, limited use of emerging technology tools and inadequate digital literacy skills. The study found out that these were some of the major drawbacks on the potential of online studios to foster digital literacy skills. The study submits that lecturers should be well versed with teaching and learning strategies that foster student's acquisition of 4Cs of 21st century learning by turning to other alternative instructional practices such as student-centred learning .

Furthermore, the findings show that lecturers could foster student-centeredness in the studio by redesigning their courses and studio activities to promote collaboration and communication. The study identified that the units responsible for developing new teaching and learning strategies at the institutions could work closely with the lecturers from the visual communication design programme and multimedia programme. For instance, the instructional designers at the institution could work closely with lecturers to develop sound and effective teaching and learning strategies for online studios. In relation to the process of developing and redesigning effective teaching strategies to deliver blended learning and online studios, literature suggest the following key strategies:

(i) Ensuring access to and familiarity with emerging technology tools in use;
(ii) Establishing guidelines and procedures which are relatively loose and free-flowing, and generated with significant input from the participants (the students through evaluations);
(iii) Promoting collaborative learning; and creating a double loop in the learning process to enable students to reflect on their learning process .

Following this, lecturers could redesign their courses to meet their current teaching and learning goals; this includes tools, subject matter analysis, content, lesson planning, assessment instruments used and media selection. When lecturers are trained properly to redesign their online studio courses, they can easily move the entire traditional studio to online studio. Without consideration and implementation of the above points, online studios or blended learning may not foster students' acquisition of 4Cs of 21 century learning (collaboration, communication, creativity, critical thinking), in an effective manner, which could lead to lower acquisition of the above literacies.

6.4 Summary of findings

The findings from the two cases involving the visual communication department and the multimedia design department showed that both the visual communication design and multimedia department activity systems shared some similarities. For instance, the findings showed that both departments' activity systems shared some similarities in technical limitations, feelings of disempowerments as well as lecturers' resistance to change their traditional practices. Lecturers' resistance to change hindered the studio transformation to online studio practices — affecting students' acquisition of digital literacy skills such as communication, creativity and collaboration. The findings show that both activity systems experienced communication challenges due to unavailability of lecturers attributed to staff shortages as a result of short-term contracts. The findings in both activity systems show that lack of communication and institutional politics caused by bureaucracy between the departments and the management caused tensions in the activity systems. A detailed summary of the study's findings is presented in the sections below.

6.4.1 Lack of Instructional design

During participant observation, it was observed that most lecturers simply replicated their face-to-face teaching strategies onto an online environment. They simply uploaded their content onto Blackboard without proper course structure in place. As one lecturer stated,

> … "we simply used Blackboard as a dumping ground for our course material" (L_6).

In addition, lecturers could also develop online studios by setting their goals where the instructional problem is well defined and the instructional goals and objectives are established. Following this, they could redesign their courses to meet their current teaching and learning goals; this includes tools, subject matter analysis, content, lesson planning, assessment instruments used and media selection. It was found out the reason why most lecturers 'just get things done', get paid and go home is because of being undervalued for their efforts and being overworked for

minimum pay. Lecturers feel less motivated to do their best because there are no incentives to recognise their efforts and hard work.

6.4.2 Lack of Institutional support

All lecturers raised the importance of institutional support for developing online learning environments because the task requires a lot of time and effort. At the time of the study, most lecturers indicated they were willing to adopt student-centred practices but lack of institutional support and lack of resources forced them to keep teaching in their old ways. The lack of adequate infrastructure such as finance and human resources forced most lecturers to resist any change. During the pandemic, most lecturers felt burnout and undervalued for their efforts leading to a lack of interest and/or unwillingness to adopt online studios. Regarding this finding, L6, said:

> … I felt lonely during the COVID -19 pandemic, no one knew what I was going through, I had to deal with all the students alone and I reached a mental breakdown, I couldn't take it anymore (L6).

In addition to the above findings, the study also showed that students developed a culture of figuring it out on their own by not consulting (asking for feedback during their ideation process) with their lecturers. Most lecturers in the visual communication design department complained about low class attendance below average as the students preferred to work from home, as a result, the studios were always empty before the COVID-19 pandemic . Low attendance may have been indicative of current teacher-centred pedagogical strategies currently in place. The study reveals the necessity for faculty to evolve their cultural pedagogical paradigms towards learner-centred practices grounded in social constructivist theories.

6.4.3 Impact on students' digital literacy skills

A further significant insight from the study is the role of systematic contradictions, technical limitations, and mediator tensions within the visual communication and multimedia department's activity systems. The study noted that the introduction of new elements (such as technology) into an activity system often exacerbates secondary contradictions when these new elements conflict with existing structures, leading to disturbances and innovative attempts at system transformation. In addition, lecturers are advised to transform their pedagogical approaches towards learner-centric practices. Such a transformation is conducive to nurturing the 4Cs of 21st century learning. Therefore, the study offers recommendations in section 6.5 aimed at providing guidance for lecturers in redesigning their courses to effectively integrate online studios with traditional, studio-based learning methods.

6.5 Recommendations: Learning intervention for the studio practices

The recommendations presented in this study are aimed at encouraging lecturers and course planners to explore alternative pedagogies, most of which involve digital modalities of content delivery . The significance of these teaching strategies is significant to students developing their capabilities in digital literacy, collaboration, critical thinking, and problem-solving . A detailed summary of the study's recommendations is presented in the sections 6.5.1 to 6.5.4 below.

6.5.1 Implement Instructional design for the studio: Expansive Learning

The study found gaps in the implementation of instructional design principles in the online studio during the COVID-19 pandemic. This resulted in lecturers simply uploading course material online with the assumption that students would engage with the learning material. Although the study found that some lecturers in the VCD programme and MM programme were not ready for full online studio learning, the study recommends implementing instructional design principles rooted in a blended learning approach enriched with expansive learning. This approach provides the necessary flexibility in pedagogy to cater to diverse learning preferences and styles in the VCD and MM programs. Expansive learning as a theoretical model involves the creation of new knowledge and new practices for a newly emerging activity: that is, learning embedded in and constitutive of qualitative transformation of the entire activity system. In this regard, students and lecturers are recommended to learn new forms of activity (full online studio) which are not yet there.

In the study, the researcher expected that studio transformation to manifest as changes in the subjects, i.e., in the behavior and cognition of students and lecturers in the activity systems. However, the study submits that expansive learning can be manifested primarily as changes in the object of the collective activity. Since the process of adopting an online studio approach to foster students' acquisition of 4Cs for 21st century learning is not an easy process — lecturers are recommended to be ready to handle the tension and contradiction when it occurs during expansive learning. Although some of the findings show that some members of the faculty strongly feel the need to maintain current practices regardless of student drop-out rates and subject carry-overs. Lecturers are recommended to adopt expansive learning since the COVID-19 pandemic has offered an opportunity for lecturers to explore alternative pedagogies, most of which involve digital modalities of content delivery. When implementing expansive learning in their studio curriculum, lecturers are recommended to spend more time planning and organising their studio courses for online delivery. Transforming the current practices, also requires lecturers to start questioning the system without fear of losing their job.

6.5.2 Implement Institutional support

Lecturers further need institutional support and guidance when using technology to foster these 4Cs of 21st century learning. The study recommends that the questioning of current practices and advocating for selection of appropriate technology tools plays a crucial role in nurturing 4Cs of 21st century learning. In addition, findings related to the above notion also demonstrate that top-down commands and guidelines are of little value when the management does not know what studio-based teaching is and how it can be leveraged to foster 4Cs of 21st century learning. Regarding this view, one lecturer recommended that management should focus their attention on incorporating more tools in the activity system and should focus more on centers of coordination in these activity systems. To achieve this goal, the institution, the management and lecturers should follow the expansive learning actions outlined below.

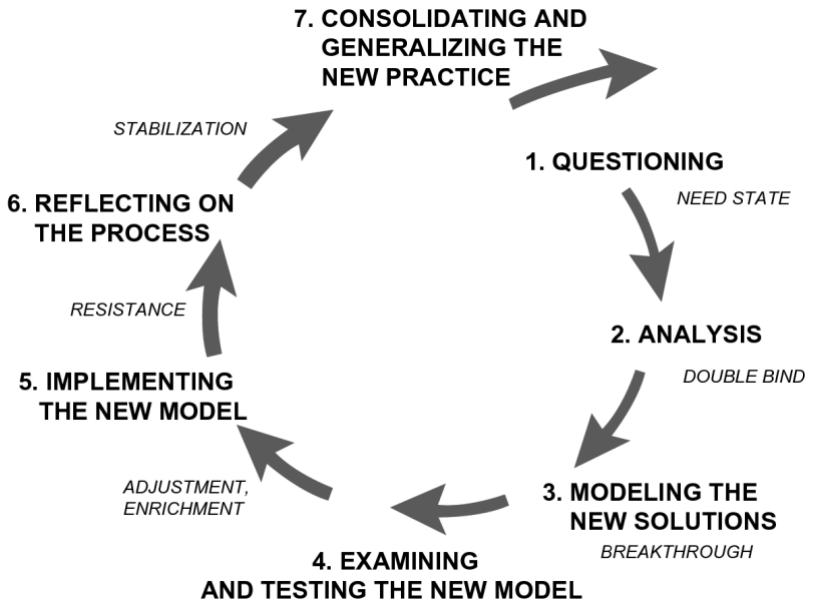

Figure 6. 2: *Sequence of learning actions in an expansive learning cycle (adapted from Engeström & Sannino,2010,p.8)*

As outlined in Figure 6.2 above, the first action towards expanded outcomes of a traditional studio activity system, requires lecturers and curriculum developers at university of technology to start by;

(i) questioning, criticising or rejecting some aspects of the traditional teaching and learning practices currently dominant in their practices. Questioning will lead to
(ii) analysing their activity systems in order to find out causes or explanatory mechanisms to explain why their studios have taken longer to transform by tracing the cultural and

historical context of their teaching and learning environment. This process may also require the lecturers to,

(iii) model the newly found explanatory relationships in online studios. As the findings show, this may include constructing simplified online studio learning models that explain and offer a solution to the problematic situation. To teach in online studios, lecturers must,

(iv) examine the new studio model by testing it in order to grasp its dynamics, potentials and limitations. When this process is done and complete, lecturers must

(iv) implement the model by means of practical applications, and conceptual extensions and finally,

(v) reflect and ,

(vi) evaluate the process and consolidate its outcomes into a new stable form of practice.

In light of this, it is recommended that the model of expansive learning be used to transform the current activity systems in the VCD and MM programmes to a blended learning approach. An important but often ignored consideration is that if online studios are to foster digital literacy, then lecturers must have sound pedagogical knowledge to redesign their courses and make them engaging. Weighing on that notion, instructional designers should help lecturers develop online studios to foster students' mastery of 4Cs. Instructional designers can help lecturers set their goals where the instructional problem is defined and the instructional goals and objectives are clearly established.

6.5.3 Implement Blended Learning approach to foster digital literacy skills

Although some of the findings in this study revealed that most lecturers in visual communication design and multimedia department favoured the traditional approach, the study recommends implementing a blended learning approach in the studio. In this regard, blended learning could potentially enhance teaching and learning by offering autonomous learning, self-paced learning opportunities and differentiated learning provision. Opportunely, blended learning could be associated with improving teaching practices by enabling lecturers to provide a wide variety of teaching modalities, thus allowing the students to gain the core competencies required thus improving on their digital literacies.

Reaching a blended learning approach for online studios could require a shift from the current 'master-apprentice' model premised in "learning-by-doing" through experiential learning in their current studio curriculum. Whilst some lecturers and some critics, argued that digital tools can limit the "hands-on experimental process of design learning that are embedded in design education" and that online studios interfere with the traditional studio creative process — a

blended learning approach aimed at balancing the traditional studio with an online studio is thus recommended. Some of the traditional values of the traditional studio could be replicated in online studios through a blended learning approach. For instance, the COVID-19 pandemic proved that traditional studios can be taught online, fostering students' acquisition of 4Cs of 21st century learning. In addition, as in Sinfield and Cochrane (2020) study, this study recommends the re-design of current 'master-apprentice' model in studio in favor of 'cognitive' models. This study concludes that cognitive-apprentice models could foster digital literacy skills such as critical thinking, creativity, collaboration and communication.

In the same token, the study recommends a new studio curriculum that takes advantage of digital technology tools designed to stimulate blended learning environments intended to promote student-centered learning by supporting high student engagements through collaboration. Regarding this view, a blended learning approach is recommended to transform the studio because it provides access to a wide range of educational resources and limiting alienation associated with purely online education delivery. In addition, a blended learning approach is recommended because it could offer students and lecturers the opportunities to collaborate with their peers and reduce isolation as they are able to share resources from various sources. Furthermore, blended learning could offer more flexible teaching and learning where students and lecturers could alternate between the traditional face-to-face and online learning regardless of time and space. In addition, as in the study of Cochrane et al., (2020), this study is of the view that transforming current tradition studio model to newer models could foster curriculum development that is more student-centered thus shifting away from teacher-centered practices.

Parallel to these recommendations, the study recommends that newer teaching and learning methods are urgently required in the current studio as the current digital age is witnessing rapid rise of service design and systems design all which contribute billions globally. The study also identified that the growth of artificial intelligence (Ai), media industries such as online marketing, e-books, online learning, data visualization, interactive storytelling, web design and motion graphics is gradually causing the current traditional studio pedagogy to move online. In the same token, the study further recommends visual communication design and multimedia lecturers to readdress their current teaching practices through transformative blended learning by embracing more technology use to support students' acquisition of digital literacy skills.

6.5.4 Implement technical support and professional staff training programmes to foster digital literacy skills

To accomplish a greater change of curriculum in the studio through transformative blended learning approach, the study recommends lecturers to be more competent in their digital literacy skills. To foster digital literacy skills, as in Pérez and Fernández (2018) study, this study identified several digital competencies that university lecturers could develop to meet the current needs in their educational contexts:

(i) development and implementation of collaborative learning experiences;
(ii) teaching planning and design in online environments,
(iii) research, development, and pedagogical innovation with the use of information technology
(iv) orientation, guidance, and evaluation, and,
(v) management of the growth and professional development with information technology.

Other digital competencies required for university lecturers to fully teach online include,

(i) information and data literacy,
(ii) communication and collaboration,
(iii) digital content creation, and,
(iv) problem-solving.

Mastery of these digital literacy competencies could result in (i) empowered individual, (ii), digital citizen, (iii) knowledge constructor, (iv) creative communicator and, (v) global collaborator. It is therefore recommended that higher education institutions in South Africa must ensure that their students, lecturers and other stakeholders do not fall behind in developing their digital literacy skills by embracing blended learning.

6.6 Research contributions

The field of design and technology theoretically remains stagnant and sometimes changes at a snail pace. These slow changes make it difficult to convince current design and technology lecturers that transformation is need in the field. lack of successful examples and practical empirical studies on how traditional studios can be taught online fostering students' acquisition of 4Cs of 21st century learning further cause more doubt in lecturers to change and they thus choose to remain stuck with what they know and has proven to meet their goals and needs. More

practical changes are required — therefore, the theoretical and practical contributions of this research are presented and discussed below.

6.6.1 Theoretical contribution: Expanding the field

The study's theoretical contribution is confined to the field of design and information technology fields which are constantly witnessing increased demand for digitally literate graduates who can contribute to the functioning of South Africa's economy by their expert field knowledge and skills. Literature on the potential of online studios to foster digital literacy skills among undergraduate students in the above fields is somewhat scanty and apparently not expanding fast enough. Some of the literature referred to in this study was borrowed from other empirical studies from other fields where the work on online learning has been conducted. The literature available in the field of the study is often characterised by gaps in knowledge, inadequate information, and focusing on contexts that are historically different from South Africa. It is hoped that some of the findings in this study could contribute to the growth of the field in South Africa.

6.6.2 Studio-Based Curriculum Policy change

The study also contributes to the overall field of study by offering suggestions to changes in current educational policies in studio-based settings. The current policies are dated and therefore need to be transformed from the current 'master-apprentice' approach to 'cognitive-apprentice' approach. It appears that not much is done to radically change these policies in the context of the study — these policies only serve the interest of those interested in the traditional studio approach ignoring the interests of those in favour of an online or blended approach. Policy makers should capitalise on the promises offered by remote instruction during the COVID-19 pandemic.

6.6.3 Practical Contribution

The COVID-19 pandemic demonstrated that alternative pedagogies, most of which involve digital modalities of content delivery can serve as an alternative in the studio . Lecturers should exploit this new insight by adopting expansive learning approach combined with transformative blended learning by integrating more technology into studio spaces. A focus on new instructional models different from the traditional 'master-apprentice' model currently adopted in the above fields might serve as a guide to assist in understanding other modern models based on students' cognitive skills and abilities. A 'cognitive-model' is thus proposed as a new strategy to foster new pedagogies in South Africa.

6.7 Study limitations

One limitation associated with this study was the selection of the site; a site with a more pronounced studio-based learning culture could have yielded more nuanced findings. Secondly, qualitative case studies are susceptible to researcher bias and subjectivity. The researchers' interpretations and perspectives can influence data collection, analysis, and reporting, potentially leading to biased findings. To address this limitation, researchers should uphold reflexivity, transparency, and rigor throughout the research process, acknowledging their own biases and aiming for objectivity in their interpretations.

6.8 Suggestions for further research

The study was based on the perspective of students and lecturers in the faculty of informatics and design at a University of Technology. Thus, the current study suggests further empirical studies to augment our understanding of faculty perceptions on online studios and their potential to foster 4Cs from different universities. There is a pressing need for more empirical scholarly studies to broaden our understanding on why most lecturers in studio related courses perceive the current 'master-apprentice' model better than the 'cognitive-apprentice' model and why they argue that it is difficult to replicate online (Collins et al., 1991). A larger study assessing these perceptions is required to understand how lecturers can be assisted to redesign their courses for online studios in the future.

In addition, future studies should investigate how lecturers can be assisted to develop their digital literacies over and above their current teaching and learning load. Similar to the study of Pérez and Fernández (2018), this study identified several digital competencies that university lecturers should be encouraged to develop to meet the current needs in their educational contexts:

(i) development and implementation of collaborative learning experiences;
(ii) teaching planning and design in online environments,
(iii) research, development, and pedagogical innovation with the use of information technology,
(iv) orientation, guidance, and evaluation, and management of the growth and professional development with information technology. Proficiency in these competencies could result in: (i) empowered students and lecturers, (ii), digital citizen, (iii) knowledge constructor(s), (iv) creative communicator(s) and, (v) global collaborator(s).

What remains unaddressed in the above strategies is the methodology through which lecturers may attain mastery in digital literacies. Therefore, this study suggests that future studies should connect lecturers' training needs with the development of their digital literacy capabilities.

6.9 Conclusion

The findings of this study revealed that digital literacy skills were neither fully facilitated in a pre-COVID-19 face-to-face studio nor in the online studio during the COVID-19 pandemic in both visual communication programme and multimedia programme. The study unearthed various contradictions and mediator tensions within the activity systems of these two programmes. When the COVID-19 pandemic struck, many lecturers were forced to work remotely. Lecturers had to reconfigure their teaching and learning to accommodate this change. The students were forced to adjust to the new online learning environment. This impacted some of their digital literacy skills. For example, findings in the multimedia programme activity system successfully developed their communication and critical thinking skills as a result of lecturers not being fully present. Meanwhile the findings from the visual communication design programme activity system showed that lecturers in that programme were always available for consultation but students did not consult with their lecturers. This affected the development of their 4Cs . Moreover, tensions and contradictions emerged in the visual communication design programme and multimedia programme activity systems due to changes in rules, tools usage and division of labour in the newly reconfigured activity systems.

Pedagogical contradictions emerged, particularly regarding online assessments. Unequal access to technological resources and design software compounded disparities, with visual communication design students having better access to licensed software, positively impacting their creativity skills. However, multimedia students, forced to use alternative software, developed critical thinking, collaboration and communication skills much faster, particularly through group-based projects.

In keeping with Muhuro and Kangethe (2021) who stated that "blended learning could be seen as a 'great-promise' for integrating technology in higher education", this study confirms that integrating a blended approach in the current studio spaces could offer significant potential for fostering students' digital competencies, teamwork, collaboration, critical thinking, and problem-solving skills. The subsequent final section of this study illustrated in Figure 6.5 offers a cross sectional analysis of the researcher's experiential journey through the dissertation, highlighting key lessons that were learned and skills that were developed in the course of the study. This introspective process is crucial to any scholarly study as it contributes to the enhancement of

research quality in future studies. The process highlights some of the research's key strengths and weaknesses and how they were handled throughout the study.

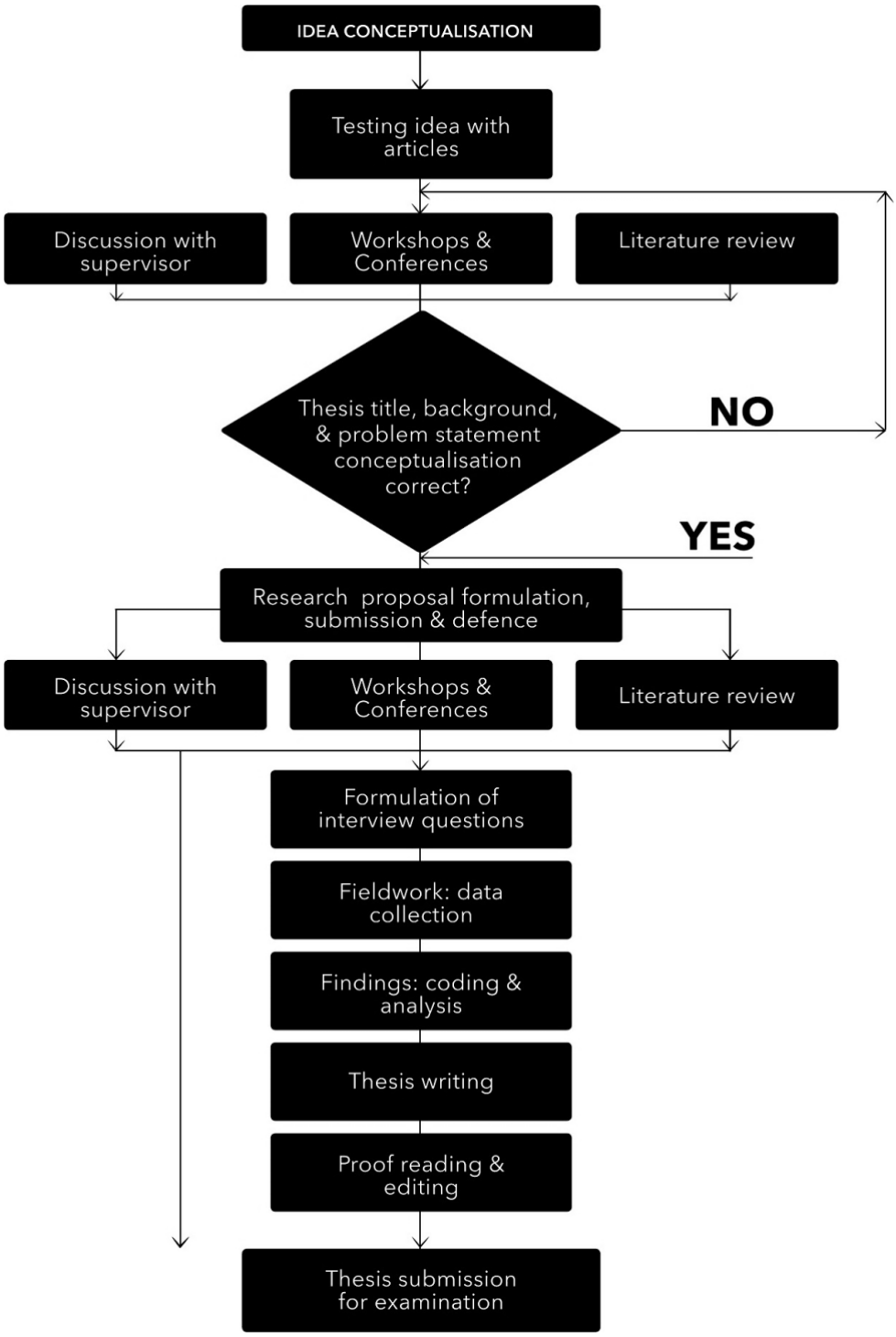

Figure 6. 3: *Flowchart summarising the study process (Author)*

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List of Appendices

Appendix A: Consent and Administrative Documents:

A1 Ethical Clearance Certificate (s)

SCHOOL OF EDUCATION

Dr. Joanne Hardman
Associate Professor: Educational Psychology
Deputy Director School of Education

University of Cape Town, Private Bag X3, Rondebosch, 7701
Physical address: Neville Alexander Building, 6 Lovers walk, Lower Campus
Tel: +27 (0) 21 650 3920 Fax: +27 (0) 21 650 3489
E-mail: Joanne.Hardman@uct.ac.za Internet: www.uct.ac.za/depts/educate

EDNREC20230513

Blessed Mhungu

26 May 2023

mhnble002

Re Ethical clearance

I am pleased to inform you that ethical clearance has been granted by the School of Education Ethics Review Committee of the Faculty of Humanities for your academic project: he use of Online Studios to promote digital literacy skills among undergraduate students in discipline-specific settings: An Activity Theory Perspective. We wish you all the best with your research.

Regards

ASSOCIATE PROFESSOR JOANNE HARDMAN

Cape Peninsula
University of Technology

Directorate Research Development
Office of the Deputy Vice-Chancellor: Research,
Technology Innovation & Partnerships
Bellville Campus
P O Box 1906
Bellville 7535

20 June 2023

Mr Blessed A Mhungu
Student No: Mhnble002
MEd Education Technology
School of Education
University of Cape Town

Dear Mr. Mhungu

RE: SITE PERMISSION TO CONDUCT RESEARCH AT CPUT

Based on the recommendation of APPROVAL from the Faculty of Informatics and Design Research Ethics Committee I am pleased to support your research study **"*The Use of Online Studios to promote Digital literacy skills among Undergraduate students in discipline-specific Settings: An Activity Theory Perspective*"**. Your request to access the Cape Peninsula University of Technology as a research or recruitment site, is granted.

The research study will include: The study's aim is to explore the potential of online studios in discipline specific settings such as applied design and IT to promote digital literacy skills among undergraduate students in both face to face and online studios, as the signature pedagogy of these disciplines. Participation in this study will involve one-on-one interviews with lecturers, focus groups with students, and participant observation during their lecturing sessions at Cape Peninsula University of Technology. Recruitment of students and lecturers at a university of technology in the Western Cape Province. The participants from the faculty of Informatics and Design of that institution are eligible to take part. This includes the departments of Visual Communication Design and the Multimedia of the institution's Faculty of Informatics and Design. The study will target registered undergraduate students and lecturers from first to third year.

This site permission covers the time-period of 19 June 2023 to 19 June 2024.

The CPUT site permission is contingent on research ethics approval as well as adhering to all the relevant CPUT policies and regulations.

The following information has relevance:
Research Ethics Approval Date: 19 June 2023
Research Ethics Approval valid until: 31 December 2024
Research Ethics Approval Reference No: Mhnble002/2023/3

Permission is herewith granted for you to do research at the Cape Peninsula University of Technology.

Wishing you the best in your study.

Sincerely

Prof Dina Burger
Director: Directorate Research Development

A2 UCT Data Management Plan

1. General guidelines

PURPOSE OF THIS TEMPLATE - The purpose of the Outline DMP is to indicate your initial plans for how your data will be collected, shared and stored, and to give you a chance to think about these data-focused aspects of the research process. As your begin doing your research, your data process may change, and it is perfectly acceptable to change your data management plan to accommodate the changes in your research process. Indicate below that you understand the purpose of completing this Outline DMP template.

- I understand the Outline DMP template is a projection of my anticipated data management planning requirements and should be updated as my project develops.

2. Authors and supervisors

PROJECT NAME - Replicate the title of your project, dissertation or thesis exactly as it appears in your proposal document.

The Use of Online Studios to promote digital literacy skills among undergraduate students in discipline-specific Settings: An Activity Theory Perspective

PERSONAL DETAILS - Indicate the name(s) and student number(s) of the student(s) who will be involved in this project, dissertation or thesis.

Blessed Aspinas Mhungu MHNBLE002

SUPERVISOR(S) DETAILS - Indicate who will supervise this project, dissertation or thesis. If you do not yet have a supervisor, leave this section blank.

Associate Professor Daniela Gachago (Main Supervisor) Professor Dick Ng'ambi (Co-Supervisor)

3. Data Collection/Generation

COLLECTION OF ORIGINAL DATA - Indicate whether or not you intend to gather/produce original data for your study, and provide a brief description of the kind of data you think you will collect. If you are unsure at this time, indicate what you think you are most likely to collect. If you are not intending to gather or collect your own data, declare that here.

- I intend to collect original data (described below).

I intend to collect primarily qualitative data in the form of approximately two focus group interviews with students from Applied design and IT disciplines and between five and ten one-on-one interviews with lecturers from the same disciplines of Applied design and IT. The data will be transcribed in MS Word and MS Excel. I anticipate the dataset will be between 100MB and 1GB.

USE OF EXISTING DATA - Indicate if you intend to re-use existing data, either from online searches or from datasets provided by your supervisor, lab, or funder. If you are not intending to re-use existing data, declare that here.

- I intend to reuse existing data in my study (described below).

I intend to use existing theories and frameworks from previous studies I did at UCT to guide the research. I will also make use of a literature review from my previous assignments and studies at UCT.

A3 Turnitin Report

MHNBLE002_Dissertation.pdf

A/Prof Daniela Gachago, 12th of Feb 2024

ORIGINALITY REPORT

13%	11%	7%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	etd.cput.ac.za Internet Source	2%
2	Submitted to University of Cape Town Student Paper	1%
3	journal.eu-jr.eu Internet Source	1%
4	link.springer.com Internet Source	1%
5	Matea Markic Vucic, Jelena Simunovic, Slavomir Stankov. "Studio Based Learning of Instructional Design in an Online Environment", 2021 International Conference on Software, Telecommunications and Computer Networks (SoftCOM), 2021 Publication	1%
6	hdl.handle.net Internet Source	1%
7	researchspace.ukzn.ac.za Internet Source	<1%

Appendix B: Students and Lecturers

B1 Permission Letter

Permission Letter to conduct research at CPUT

Online studios and digital literacy skills among undergraduate students: An Activity Theory Perspective

University of Cape Town School of Education

Dear Sir/Madam

RE: REQUEST TO CONDUCT RESEARCH IN YOUR FACULTY OF INFORMATICS AND DESIGN AT CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

My name is Blessed Mhungu and I am a Postgraduate student studying in the School of Education at the University of Cape Town.

I would like to ask your permission to carry out research on the potential of online studios to promote digital literacy skills among undergraduate students in Design and IT fields. It is part of my research for my Masters in Education Technology at the University of Cape Town (UCT).

The proposed study seeks to investigate current pedagogies within the studio spaces with the aim to investigate the potential of online studios in design and IT education to promote digital literacy skills also known as the "Super Skills" OR 4C's of 21 st century learning among South Africa's undergraduate students. The goal is to strengthen graduate students' acquisition of these skills and to promote transformative learning as Anderson (2004) puts it, "transformative learning takes place when technology is used to foster high-levels of student-student interaction". This research also provides a platform for individual lecturers and key experts who use technology regularly in their teaching to share their views, experiences and provide support for further engagement.

Who is eligible to participate in this study?

If you grant me permission to conduct the study at your institution, I will collect data from undergraduate lecturers and students in the Faculty of Informatics and Design. Any lecturer or student in the departments of Applied Design and IT department is eligible to participate in the study.

Voluntary participation

Participation in this study is strictly voluntary and consensual. This will be confirmed through consent forms, signed by each participant before participating in this research study. Participants are free to withdraw from this study and have their information withdrawn at any time without prejudice.

Research Process

Participation in this study will involve one-on-one interviews with lecturers, focus groups with students and classroom observations during their lecturing sessions at Cape Peninsula University of Technology. During participant observation of the physical studios' spaces, a simple observation that includes viewing of on-going lectures, actual students' activities inside the studio will be recorded upon consent. Participating in these activities will allow the researcher to spend sufficient time with the group or in the situation, to gain much deeper, richer and more accurate information.

In some cases, I will observe their courses on Blackboard regarding their structure and design for online studio learning. I would also like to collect students' on-going assignments and projects produced during their course of study with their permission. During the one-on-one interviews with lecturers, I will start off the interview by explaining the aim of the interview and emphasizing the confidentiality, anonymity and voluntary nature of the study.

The interviewee will then be given a consent form which will be signed off by both the interviewee and the interviewer. With the participant's permission, the interview will be recorded. The interviews will also be conducted in the English language either face-to-face or online via ZOOM or Ms Teams, in accordance with the preferences of each interviewee. The interviews will have an average duration of 30 to 60 minutes. Each interview will be recorded on ZOOM or Ms. Teams and a recording will be available upon request from each interviewee.

For focus groups with students, I will use a mini focus group with 4-6 student participants over 60-90 minutes. The focus groups with the students will also be conducted in the English language either face-to-face or online via ZOOM or Ms. Teams, in accordance with the preferences of each participant. The notes, recordings, and transcripts will be kept in a secure place, and will only be accessible to the researcher. This material will only be used for academic purposes. Data collected will be stored securely online in a folder only accessible to the principal investigator and his project supervisors – in line with the University of Cape Town's Data Management Plan (Data Management Plan is available upon request).

Privacy, Confidentiality, and Anonymity

Privacy and confidentiality will be strictly protected by the researcher, according to the ethical standards of UCT. The interview and focus group process will be strictly confidential and private – only the researcher and individual participants will be present during each process. Only the researcher will have access to specific information obtained from the participants during this study. Extracts from the interviews and focus groups will be included in the final research report. No personal or identifying details about participants will be included in the final research report. Participants will not be identifiable through the research report. Participating departments will be given a pseudonym (different name) and pseudonyms will be used for all participants in the writing up of the research. The final report will be examined by external examiners and the findings will be made available to participating agencies. Under no circumstances will participants' personal information be revealed in the report, or any other publications related to this study.

Should you at any time have any questions or queries with any part of the process, please feel free to contact the researcher, Blessed Mhungu, at mhnble002@myuct.ac.za or the supervisor, Assoc Prof Daniela Gachago, at daniela.gachago@uct.ac.za with any questions or queries related to this research.

Kind regards,

Blessed A Mhungu – Researcher

School of Education (UCT)

Mhnble002@myuct.ac.za

B2 Letter of Consent

Permission Letter and Consent Letter for Lecturers and Students

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Online studios and digital literacy skills among undergraduate students: An Activity Theory Perspective

University of Cape Town School of Education

Dear Lecturer / Student

You are kindly being asked to participate in *The Use of Online Studios to promote digital literacy skills among undergraduate students in discipline-specific Settings: An Activity Theory Perspective* study conducted by myself Blessed Mhungu and I am a Postgraduate student studying in the School of Education at the University of Cape Town. It is part of my research for my Masters in Education Technology at the University of Cape Town (UCT).

The proposed study seeks to investigate current pedagogies within the studio spaces with the aim to investigate the potential of online studios in design and IT education to promote digital literacy skills also known as the "Super Skills" OR 4C's of 21 st century learning among South Africa's undergraduate students. The goal is to strengthen graduate students' acquisition of these skills and to promote transformative learning as Anderson (2004) puts it, "transformative learning takes place when technology is used to foster high-levels of student-student interaction". This research also provides a platform for individual lecturers and key experts who use technology regularly in their teaching to share their views, experiences and provide support for further engagement.

Voluntary participation

Participation in this study is strictly voluntary and consensual, you are free to withdraw from this study and have your information withdrawn at any time without prejudice.

Research Process

Participation in this study will involve one-on-one interviews with lecturers, focus groups with students and classroom observations during their lecturing sessions at Cape Peninsula University of Technology. During participant observation of the physical studios' spaces, a simple observation that includes viewing of on-going lectures, actual students' activities inside the studio will be recorded upon consent. Participating in these activities will allow the researcher to spend sufficient time with the group or in the situation, to gain much deeper, richer and more accurate information.

In some cases, I will observe their courses on Blackboard regarding their structure and design for online studio learning. I would also like to collect students' on-going assignments and projects produced during their course of study with their permission. During the one-on-one interviews with lecturers, I will start off the interview by explaining the aim of the interview and emphasizing the confidentiality, anonymity and voluntary nature of the study.

The interviewee will then be given a consent form which will be signed off by both the interviewee and the interviewer. With the participant's permission, the interview will be recorded. The interviews will also be conducted in the English language either face-to-face or online via ZOOM or Ms Teams, in accordance

with the preferences of each interviewee. The interviews will have an average duration of 30 to 60 minutes. Each interview will be recorded on ZOOM or Ms. Teams and a recording will be available upon request from each interviewee.

For focus groups with students, I will use a mini focus group with 4-6 student participants over 60-90 minutes. The focus groups with the students will also be conducted in the English language either face-to-face or online via ZOOM or Ms. Teams, in accordance with the preferences of each participant.

The notes, recordings, and transcripts will be kept in a secure place, and will only be accessible to the researcher. This material will only be used for academic purposes. Data collected will be stored securely online in a folder only accessible to the principal investigator and his project supervisors – in line with the University of Cape Town's Data Management Plan (Data Management Plan is available upon request).

Privacy, Confidentiality, and Anonymity

Privacy and confidentiality will be strictly protected by the researcher, according to the ethical standards of UCT. The interview and focus group process will be strictly confidential and private – only myself and yourself will be present during the interview. Only the researcher will have access to specific information obtained from the participants during this study. Extracts from the interviews and focus groups will be included in the final research report. No personal or identifying details about participants will be included in the final research report. Participants will not be identifiable through the research report. Participating departments will be given a pseudonym (different name) and pseudonyms will be used for all participants in the writing up of the research. The final report will be examined by external examiners and the findings will be made available to participating agencies. Under no circumstances will participants' personal information be revealed in the report, or any other publications related to this study.

Participant Information and Consent Form

I, _____ (full name/s & surname), a lecturer at (University name) _____ hereby give my consent and agree to participate in *The Use of Online Studios to promote digital literacy skills among undergraduate students in discipline-specific Settings: An Activity Theory Perspective* research project conducted by Blessed Mhungu from the University of Cape Town School of Education.

I acknowledge and understand that my participation entails:

- Being observed teaching in the Applied Design and Information Technology Department(s) in the Faculty of Informatics and Design of Cape Peninsula University of Technology (CPUT).
- Having researcher record these observations.
- Participating in an interview and focus groups.

I understand that my participation in this research is voluntary and my consent can be withdrawn at any time during the duration of the study. I understand that my own anonymity as well as those of the university and the students will be maintained in the reporting of the findings.

By signing below, I indicate my consent to participate in *The Use of Online Studios to promote digital literacy skills among undergraduate students in discipline-specific Settings: An Activity Theory Perspective* project conducted by Blessed Mhungu as it has been described to me in the information sheet. I understand the data collected from my participation will be used for academic publications and I consent for it to be used in that manner outlined above.

Signed: _____ Date: _____

Principal Name *(please print)*: _____

Principal contact *(optional)*: _____

Should you at any time have any questions or queries with any part of the process, please feel free to contact the researcher, Blessed Mhungu, at mhnble002@myuct.ac.za or the supervisor, Assoc Prof Daniela Gachago, at daniela.gachago@uct.ac.za with any questions or queries related to this research.

Kind regards,

Blessed A Mhungu – Researcher

School of Education (UCT)

Mhnble002@myuct.ac.za

B3 Interview Guide and Questions

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Online studios and digital literacy skills among undergraduate students: An Activity Theory Perspective

University of Cape Town School of Education

Questions

The proposed study seeks to investigate current pedagogies within the studio spaces with the aim to investigate the potential of online studios in design and IT education to promote digital literacy skills also known as the "Super Skills" OR 4C's of 21 st century learning among South Africa's undergraduate students. The focus of this study is to strengthen their acquisition of these skills and to promote transformative learning as Anderson (2004) puts it, "transformative learning takes place when technology is used to foster high-levels of student-student interaction". The questions are framed into, technical, social and organisational related factors (the human environment and the instructional design or course design) that could explain how online studios can be used to promote digital literacy skills among undergraduate students. In this research it is important to understand how students and lecturers' perceptions, digital literacy skills and usage patterns contribute to online studios promoting digital literacies in studio spaces.

Question 1– Seeks to understand pedagogical practices fostered in traditional studio spaces in relation to digital literacy skills, find insight on lecturers' understanding of (a) digital literacy, views perceptions and emerging technology tools (b) Lecturers' teaching and learning practices that they believe promote digital literacies (c) Emphasis will be place on course design and explanations why lecturers design their online courses that way in studio spaces:

1.1 To get lecturers' understanding of digital literacy skills in the studio. Examples of digital literacy skills are required here. Lecturers should at least cite two or three popular skills. It will be useful for lecturers to learn what digital literacy skills are and why they are important in a studio.

1.2 To find out how they [lecturers] taught remotely during Covid-19 whether they used emerging technologies or not throughout the pandemic. Examples of emerging technologies are required. How did they use the tools and how was their experience using the tools [here the researcher is trying to identify perceived ease of use and how the course was designed] (Instructional Design).

1.3 Do other lecturers believe in online studios and their ability to promote digital literacies? [perceived usefulness, under what circumstances, and why?]

Question 2– Seeks to understand how pedagogical practices in traditional studio spaces changed during Covid-19 and what impact it had on students' development of digital literacy skills in relation to digital literacy. Find insights on teaching and learning practices that were used by lecturers during Covid-19, main emphasis on (a) how they taught remotely *(ask them to explain in detail)*, (b) what emerging technology tools they used and whether they still use the same tools, (c) how did they interact with these tools, what challenges did they face while teaching *(probe further if they had any support or not)*.

B4 Participant Observation Guide (Studio/Classroom observations)

PROJECT TITLE:

Online studios and digital literacy skills among undergraduate students: An Activity Theory Perspective

University of Cape Town School of Education

Educator's Name		Subject	
Date:		Level of Study	
Lesson observed by:			

1.	PEDAGOGICAL PRACTICES IN TRADITIONAL STUDIO 1	CREATION OF A POSITIVE LEARNING AND TEACHING ENVIRONMENT

Criterion 1: Learning and teaching environment		Rating				Remarks
a	Seating arrangement promotes effective teaching and learning	1	2	3	4	
b	Classroom / Studio is tidy and clean	1	2	3	4	
c	Teaching and learning support material (e.g. Lecture slides and notes) are available and used in the classroom.	1	2	3	4	
	Criterion 2: Use of Digital Tools					
a	Encourages students to use digital technology tools	1	2	3	4	
b	Ensures that students access content on Blackboard or any other tools	1	2	3	4	
c	Communication between educator and learners reflects mutual respect, cooperation and understanding	1	2	3	4	
d	Uses various communication tools to communicate with students	1	2	3	4	

2.	PEDAGOGICAL PRACTICES 2	CURRICULUM KNOWLEDGE AND DIGITAL LITERACY

Criterion 1 Knowledge of subject		Rating				Remarks
a.	Has adequate subject knowledge and uses it effectively	1	2	3	4	
b.	Sets appropriate tasks for learners at the level of study	1	2	3	4	
c.	Uses a variety of digital tools and other teaching resources to facilitate learning	1	2	3	4	
Criterion 2: Planning and presentation						
a	Lesson is logical, coherent and meaningful to learners	1	2	3	4	
b	Lesson is built on past knowledge and experience of learners	1	2	3	4	
c	Encourages interactive learning including class discussions, learner questions and demonstrations	1	2	3	4	
d	Responds appropriately to learner questions and inputs	1	2	3	4	

Overall Remarks:

Researcher	Educator
Signature:	Signature:
Date:	Date

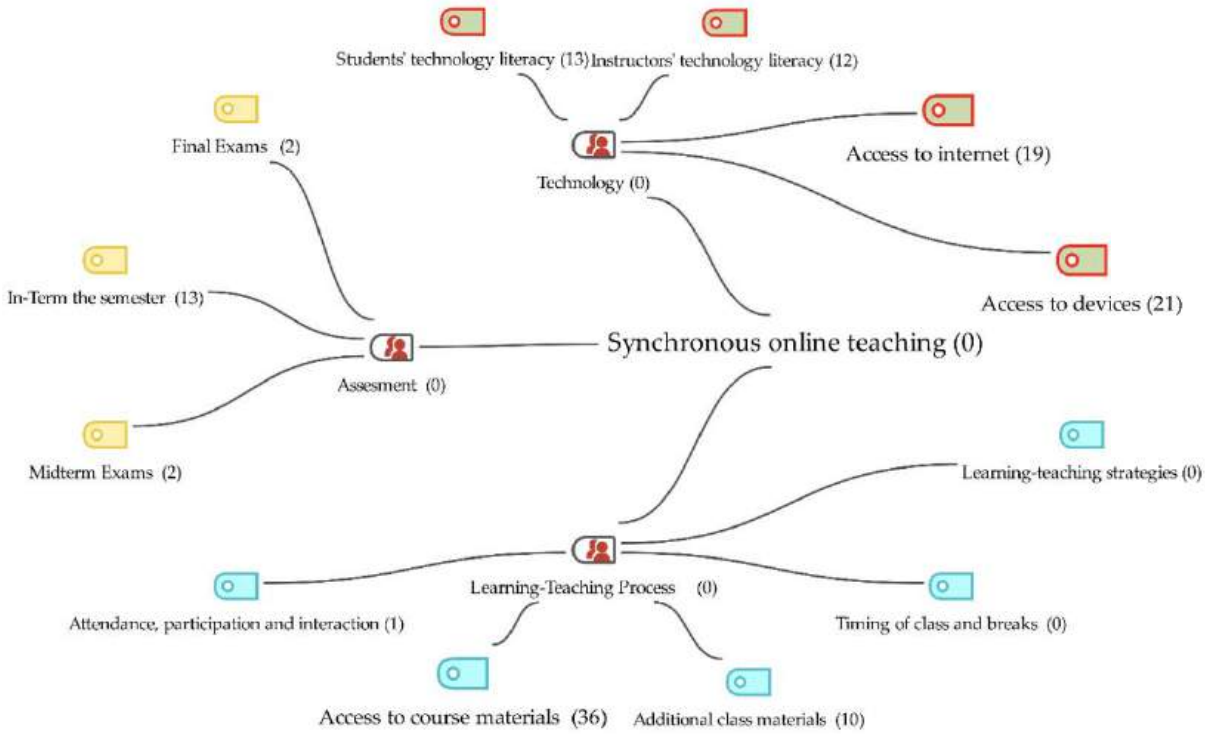
Appendix C: Data

C1 Data from Interviews, Focus groups and Observation

A1 fx

	A	B	C	D
1		Documents	Percentage	Percentage (valid)
2	technology	0	0,00	0,00
3	Subjects	1	6,67	7,69
4	support	1	6,67	7,69
5	Unpreparedness	3	20,00	23,08
6	Blended learning	7	46,67	53,85
7	Access	4	26,67	30,77
8	Rules & Control	10	66,67	76,92
9	Challenges	9	60,00	69,23
10	training	2	13,33	15,38
11	Community	8	53,33	61,54
12	Resistance	7	46,67	53,85
13	Support	13	86,67	100,00
14	Assessments	8	53,33	61,54
15	Student engagement	6	40,00	46,15
16	Contradiction	9	60,00	69,23
17	Tension	2	13,33	15,38
18	Protests & Disruptions	8	53,33	61,54
19	Tension	7	46,67	53,85
20	Training	11	73,33	84,62
21	Technological tools	13	86,67	100,00
22	Collaborative skills	11	73,33	84,62
23	Student-centred	6	40,00	46,15
24	Socio-Cultural influences	10	66,67	76,92
25	Communication	11	73,33	84,62
26	Teaching	11	73,33	84,62
27	Creativity	11	73,33	84,62
28	Teaching and Learning Before pandemic	12	80,00	92,31
29	DOCUMENTS with code(s)	13	86,67	100,00
30	DOCUMENTS without code(s)	2	13,33	-
31	ANALYZED DOCUMENTS	15	100,00	-

C2 MAXQDA Codes



	Themes	The meaningful whole of the categories			(Strong) coexistence and/or conflicts between categories, codes, or subcodes
	Categories (in different colors	Meaningful structures formed by the combination of codes			(Weak) coexistence and/or conflicts between categories, codes or subcodes
	Codes (in different colors)	Meaningful structures formed by combining subcodes			Themes main subject and the themes
	Subcodes	Subcodes that make up the codes			

** Different colors used in categories and codes have been used to visualise different categories and codes.*