AN ANALYSIS OF STUDENTS' AND LECTURERS' EXPERIENCES OF LEARNING AND TEACHING MATHEMATICS EDUCATION ONLINE: A CASE OF THE UNIVERSITY OF NAMIBIA, KHOMASDAL CAMPUS

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ABSTRACT

This study analysed the online learning and teaching experiences of Mathematics Education modules from the perspective of both students and lecturers at the University of Namibia, Khomasdal Campus. The study adopted the concepts of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) to construct the conceptual framework. The conceptual framework was used to understand students' and lecturers' viewpoints on embracing technology during the online learning and teaching of Mathematics Education. Equally, the study adopted a qualitative case study design. Participants of this study comprised two undergraduate Mathematics Education course lecturers, ten third-year students, and eight fourth-year students studying towards a Bachelor of Education with Mathematics Education as one of their majors, who were taught online in 2021. The participants were purposively and conveniently selected as information-rich sources. Data was collected using semi-structured, face-to-face interviews, which were thematically analysed. The findings of the study revealed that students and lecturers had positive and negative experiences while learning and teaching Mathematics Education online. The positive experiences include flexibility and convenience in terms of time and place, access to resources, personalised learning, and responsibility and accountability for one's learning. The negative experiences include a lack of technological tools; internet connection issues; issues with the learning management system (LMS); insufficient internet data bundles; psychological challenges; lack of support from lecturers; academic dishonesty, and unconducive home environments for learning. Based on the findings, this study recommends that UNAM upgrades the LMS server so as to accommodate all lecturers teaching online simultaneously. In addition, the university should provide continuous professional development for lecturers and train both students and lecturers on learning and teaching online Further, the study recommends that UNAM provides both students and lecturers with appropriate technological devices, unlimited data bundles, and space for students to attend online classes. Finally, the study recommended that lecturers should record lessons, create online breakout rooms for student collaborations, and high schools should introduce a compulsory digital literacy subject.

Keywords: online learning, online teaching, Mathematics Education

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DEDICATION

To myself with gratitude and pride. This thesis is a testament to my perseverance, dedication, and passion for knowledge. I dedicate this thesis to the person I was, the person I am, and the person I am becoming. May this thesis motivate others to achieve their dreams.

DECLARATION

I, Hilda Inamumvulwa Theofilus, hereby declare that this study is my work and is a true reflection of my research and that this work or any part thereof has not been submitted for a degree at any other institution.

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LIST OF ABBREVIATIONS AND/OR ACRONYMS

ATU	Attitude Towards the Use
BI	Behavioural Intention to Use
CILT	Centre for Innovation in Learning and Teaching
CMS	Content Management Systems
DEC	Decentralised Ethics Committee
EE	Efforts Expectancy
FC	Facilitating Conditions
ICT	Information and Communication Technology
LMS	Learning Management System
MOODLE	Modular Object-Oriented Dynamic Learning Environment
PE	Performance Expectancy
PEOU	Perceived Ease of Use
PU	Perceive Usefulness
SI	Social Influence
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
UNAM	University of Namibia

CHAPTER ONE: INTRODUCTION

This Chapter discusses the study's background, problem statement, research questions, significance, limitations, delimitations, and definitions of key terms. It serves as the background of the entire research.

1.1 Background of the study

Mathematics plays a foundational role in education and is included in the curriculum at all levels, from primary to tertiary education, in many countries. For instance, UNESCO (2017) emphasises Mathematics Education as essential for developing logical reasoning and analytical thinking, while national education policies such as Namibia’s Curriculum Framework for Basic Education (2016) and South Africa’s Curriculum and Assessment Policy Statement (CAPS) document highlight its importance in preparing learners for scientific, technological, and economic participation. The significance of Mathematics Education extends beyond the classroom, as mathematical concepts and skills are indispensable in various aspects of life. Li and Shenfield (2019) observed that Mathematics Education demands students to develop a strong foundation in problem-solving, logical reasoning, and critical thinking. Mathematical skills are crucial for academic success and navigating the complexities of everyday life. For instance, budgeting, planning, and understanding financial transactions all require a grasp of mathematical concepts. Moreover, Mathematics Education is a gateway to numerous fields of studies and careers. It is a cornerstone of science, engineering, technology, and economics. Proficiency in Mathematics Education equips individuals with the tools to analyse data, make informed decisions, and contribute meaningfully to society.

Globally, the transition to online learning has significantly transformed educational practices, particularly in higher education. The COVID-19 pandemic accelerated this shift, prompting universities to adopt online teaching methods rapidly (Dhawan, 2020). In this context, understanding both students' and lecturers' experiences of online Mathematics Education has become increasingly vital. Given that Mathematics Education is often seen as a complex subject, especially in online settings, this study explores how university lecturers adapt their teaching strategies, such as by using visual tools, interactive platforms, and real-time feedback, to effectively engage students and support their understanding in virtual learning environments (Baker et al., 2020)

Ndala (2020) reported that online learning at university may further contribute to learning difficulties as students, fresh from secondary schools, may not have been privileged to have had internet facilities before. In addition, some lecturers may lack the necessary knowledge or training to effectively use technological tools for teaching Mathematics Education online, which can hinder student engagement and limit the depth of mathematical understanding. This highlights the need for targeted professional development to support lecturers in integrating digital technologies into their teaching practices.

Trenholm et al. (2019) added that online learning and teaching of Mathematics Education modules is not effective since learning and teaching Mathematics Education modules involves practical teaching and learning where students are involved in their understanding of mathematical concepts and practices for which online instruction may not cater. In addition, based on the large scale ($n > 14,000$ students) research carried out in the United States Mathematics Education students in online learning spaces do not perform as well as those in face-to-face classrooms (Vilardi & Rice, 2014; Xu & Jaggars, 2011). These findings concur with claims that online Mathematics Education learning and teaching are challenging to deliver (Glass & Sue, 2008; Junco et al., 2011).

Given the background that online Mathematics Education has generally been found challenging in international studies (e.g. Denbel, 2023; Stankous & Buibas,2016), the situation at the University of Namibia (UNAM) appears to be distinct, based on my first-year studies experiences, during which my coursework modules were offered online. It implies that there are unique factors and circumstances at UNAM that differentiate its online Mathematics Education programs from those observed elsewhere. This study aims to investigate the learning and teaching of Mathematics Education modules online in the Namibian context by analysing the experiences of both Mathematics Education students and lecturers at the UNAM Khomasdal Campus. The study makes recommendations for implementation going forward and contributes to local literature on the learning and teaching of Mathematics Education modules online.

1.1.1 The state of Online Learning and Teaching of Mathematics Education in Namibia

Although COVID-19 is no longer an immediate crisis, it marked a significant turning point in higher education by accelerating the adoption of online teaching and learning, including in Mathematics Education. This shift has had lasting effects on teaching practices, particularly in how digital technologies are integrated into instruction. For instance, Gervasius (2020), reporting on a circular issued by the Ministry of Education, Arts and Culture on April 15, 2020, noted that 32% of students in higher education lacked access to computers or the internet, a challenge that continues to shape digital teaching strategies today. Therefore, referencing COVID-19 provides important context for understanding the current state and challenges of online Mathematics Education teaching in Namibia. While the adoption of digital learning platforms aims to enhance educational accessibility, many students face barriers, including limited internet connectivity, inadequate technological resources, and a lack of digital literacy (Afzal et al., 2021). UNAM faced significant challenges during the rapid shift to emergency online teaching and learning, primarily due to limited technological infrastructure and insufficient technical support, a concern highlighted by Kadhila and Nyambe (2021). As a result, many lecturers resorted to merely uploading lecture notes or pre-recorded videos without interactive elements or real-time support. This lack of engagement and pedagogical depth compromised the quality of teaching and learning, particularly in subjects such as Mathematics Education, which benefit from active problem-solving and immediate feedback.

Moreover, it was the first time for UNAM to have teaching and learning taking place entirely online. Both students and lecturers had no prior experience in learning and teaching Mathematics Education modules online even though some lecturers had been employing blended learning, which involved both online and face-to-face classes. In addition, mathematics lecturers may struggle to explain mathematical concepts in an online Mathematics class visually, and students may have difficulty understanding these concepts due to the limited interaction in an online environment (Glass & Sue, 2008; Karal et al., 2013). The assumption that all students are digitally competent overlooks the reality that many still face challenges in accessing devices and reliable internet (Queiros & Villiers, 2016; Dube, 2020). In the context of this study, such disparities in student access directly affect how university mathematics lecturers design and implement online teaching strategies, potentially limiting the effectiveness of their pedagogical approaches and student engagement.

1.2 Statement of the problem

The increasing integration of online learning environments has significantly influenced the teaching and learning of Mathematics Education across educational levels, prompting a shift in instructional practices and pedagogical approaches. This shift has brought to light various challenges and experiences faced by both students and lecturers. Recent studies have highlighted concerns about student engagement, motivation, and comprehension in online mathematics courses (Wang et al., 2021; Martin et al., 2020). Furthermore, lecturers have reported difficulties in effectively delivering content and assessing student understanding in a virtual setting (Williams, 2024).

Despite these challenges, there is a lack of literature focusing specifically on the experiences of both students and lecturers in the context of online Mathematics Education at UNAM. The limited focus on the experiences of students and lecturers at UNAM restricts our understanding of the pedagogical strategies that truly support meaningful learning in online Mathematics Education. Hence, to fill the apparent gap in the literature, this study analyses the experiences of undergraduate Mathematics Education students and lecturers in learning and teaching Mathematics Education online at the UNAM Khomasdal Campus. The present study will further use the results obtained from this specific case to make recommendations on what should be encouraged and what should be attended to so as to improve the effectiveness of online learning and teaching of Mathematics Education modules, not only at the specific UNAM campus but within Namibia and the world at large.

1.3 Research questions

This study was guided by the following questions:

1. What were the experiences of students and lecturers at UNAM's Khomasdal Campus when learning and teaching Mathematics Education online during the COVID-19 pandemic?
2. Based on their experiences during the pandemic, what recommendations do students and lecturers at the Khomasdal Campus suggest for improving the learning and teaching of Mathematics Education online?

1.4 Significance of this study

The study's findings are expected to provide valuable insights that can improve the quality of online mathematics teaching and learning for both students and lecturers in Namibia. These insights may also contribute to local research on online education in tertiary institutions and be helpful to students and lecturers at universities globally.

Secondly, subsequent to this study, lecturers could be encouraged to undertake studies in information and communication technology (ICT) and online teaching methods to enhance their skills for effective delivery of Mathematics Education modules.

The findings can inform educational institutions and policymakers in Namibia by identifying both the successes and challenges experienced in online Mathematics Education. This knowledge can inform the development of targeted interventions, resources, and professional development programs designed to enhance online teaching and bridge the digital divide.

Ultimately, this study may provide valuable guidance to curriculum developers in Namibia on integrating ICT into education. Revising curricula at primary and secondary levels to include ICT knowledge will better prepare students for ICT-integrated pedagogy in higher education.

1.5 Limitations of the Study

This study was limited to undergraduate Bachelor of Education students majoring in Mathematics Education who were in their first and second years of studies, respectively, during the 2020-2021 period of online learning. At the time of data collection, these students were in their third and fourth years of study. This study also included lecturers who taught the relevant undergraduate Mathematics Education modules at the time, specifically at the UNAM Khomasdal Campus, due to resource constraints, such as time and finances. Interviews can introduce biases because they often lack anonymity; therefore, some participants may not be comfortable providing accurate data. This limitation was mitigated by ensuring that participants' real names were not reported in the data, thus protecting their identities.

1.6 Delimitations of the study

There are twelve (12) UNAM campuses in Namibia. However, this study was only restricted to UNAM Khomasdal Campus lecturers teaching undergraduate Mathematics Education courses/modules and undergraduate education students studying towards a Bachelor of Education in Senior Primary majoring in Mathematics Education. Other UNAM campuses were excluded from the study.

1.7 Key terms defined

In this study, defining key terms precisely is important to establish the focus of the study and simplify how they are used.

Online learning: Broadly, online learning refers to educational activities that take place over the internet, often through platforms like Learning Management Systems (LMS) and Content Management Systems (CMS), which are used to deliver content, track progress, and support communication (UNAM Centre for Innovation in Learning and Teaching, 2023, p. 4).

In this study, online learning refers to how Mathematics Education students at UNAM Khomasdal Campus accessed lessons, materials, and support remotely during 2020–2021 using platforms like Moodle, Zoom, WhatsApp, and email.

Online teaching: Refers to the delivery of instruction and facilitation of learning in a virtual environment. This can include live (synchronous) video sessions or pre-recorded (asynchronous) lessons (Hodges et al., 2020).

In this study, online teaching refers to the methods used by Mathematics Education lecturers at UNAM Khomasdal Campus to teach and support students remotely during the 2020–2021 academic year, utilising tools such as Moodle, Zoom, WhatsApp, and email.

Face-to-face learning: Generally, face-to-face learning refers to a traditional mode of education where teaching and learning take place in person, with students and lecturers interacting physically in a classroom setting (Kohnke et al., 2023).

In this study, face-to-face learning refers to the traditional classroom-based method of teaching Mathematics Education at UNAM Khomasdal Campus before 2020, which involved in-person interaction, group work, and the use of physical teaching tools.

Face-to-face teaching: The traditional method of instruction where lecturers and students are physically present in a classroom and interact with each other (Li & Wang, 2023).

In this study, face-to-face teaching refers to the method by which Mathematics Education was delivered at UNAM Khomasdal Campus prior to the transition to online learning. It included classroom-based lectures, group work, problem-solving sessions on the chalkboard, and opportunities for students to ask questions and receive real-time support. This mode of teaching provided the baseline against which participants compared their online teaching experiences.

Students' experiences: The overall impression a student forms of their time at a university, encompassing academic, social, and personal aspects (University of Oxford, 2023).

In this study, students' experiences refers to how Mathematics Education students at UNAM Khomasdal Campus felt and coped with learning online during the 2020–2021 period, including their access to materials, interaction with lecturers, motivation, and overall learning challenges or successes.

Lecturers' experiences: The subjective perceptions and encounters that lecturers have within the educational context, including teaching, research, and administrative responsibilities.

In this study, lecturers' experiences refers to how Mathematics Education lecturers at UNAM Khomasdal Campus adapted to online teaching during the 2020–2021 period, including their use of digital tools, teaching methods, student engagement, and related challenges or successes.

Blended learning: "Is an approach to teaching that integrates or combines face-to-face and online instruction" (UNAM CILT, 2023, p.4).

In this study, blended learning refers to the combination of online platforms and in-person teaching used by Mathematics Education lecturers and students at UNAM Khomasdal Campus during and after the 2020–2021 period.

1.8 Chapter Summary

The Chapter presents the introduction and background context of this study to interpret the specific research issues that are central to the investigation. The scope of the research is defined through delimitations, and key definitions are provided to ensure a clear comprehension of the conceptual terms utilised throughout the work. The subsequent chapter will deliver a fresh review of relevant literature concerning the experiences of both students and lecturers in online Mathematics Education, focusing on the case of UNAM Khomasdal Campus.

CHAPTER TWO: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

This Chapter is divided in two subsections as it reviews literature relevant to this study and discusses the study's conceptual framework. The conceptual framework is divided into the following subsections: an overview of the model (TAM), an overview of the theory (UTAUT), and the application of TAM and UTAUT to the study.

2.1 Literature review

This section reviews literature linked to learning and teaching Mathematics Education online, and it is divided in four subsections. The section begins with literature linked to the learning and teaching of Mathematics Education online and the experiences of students in learning Mathematics Education online. Further, the section reviews the literature linked to the lecturers' experiences of teaching Mathematics Education online, and finally, it outlines the recommendations to improve the learning and teaching of Mathematics Education online based on lived experiences.

2.1.1 Learning and teaching of Mathematics Education online

Learning and teaching Mathematics Education online involves creating opportunities for students to actively engage with mathematical ideas, develop skills, and explore problem-solving through digital platforms and internet-based tools, rather than in the traditional face-to-face classroom (Johnson et al., 2020). Students interact with digital platforms, participate in live virtual sessions when needed, and complete tasks independently. Online presentations involve the following three common modalities of online learning as outlined by Napolitano et al. (2023).

1. *Synchronous*: In synchronous online learning, students and lecturers interact in real-time through video conferencing tools such as Zoom and Microsoft Teams (Teng & Wu, 2021).
2. *Asynchronous*: Asynchronous online learning allows students to access course materials, such as pre-recorded lectures, readings, and assignments, at their convenience (Singh et al., 2021). It also includes opportunities to respond to stimulus material or tasks in discussion forums or chats, which can take place at any time without the need for everyone to be online at the same time.
3. *Blended learning*: Also referred to as hybrid learning, it combines both synchronous and asynchronous elements. Students may attend live virtual sessions while accessing pre-recorded content and completing assignments independently (UNAM CILT,2022).

Even before the global shift towards online education, UNAM had already embraced blended learning, thoughtfully integrating digital tools with traditional teaching approaches to enhance the learning experience. When teaching Mathematics Education online, lecturers may use Learning Management Systems (LMS), such as Moodle and Canvas, to organise and distribute course materials, including video lectures, quizzes, assignments, and other resources (Jones, 2021). The LMS that UNAM uses for online course delivery is the Modular Object-Oriented Dynamic Learning Environment (Moodle). Moodle enables the lecturer to plan and assign activities to students so that students are engaged in discovery learning and collaboration (Chourishi et al., 2012). In addition to LMS, specific Mathematics software tools such as GeoGebra, MATLAB, and Wolfram Alpha are often integrated to help students visualise and solve complex Mathematics Education problems. While these tools are particularly valuable in online environments, they are also widely used to enhance face-to-face learning and teaching experiences.

2.1.2 Students' experiences of learning Mathematics Education online

In various studies, students shared a range of positive experiences with learning Mathematics Education through online platforms, especially during times when remote learning became essential, highlighting the lasting value of digital tools in supporting their understanding of the subject. This section first discusses the positive experiences identified in the literature before addressing the negative experiences and challenges that students faced. One of the key benefits of learning Mathematics Education online was increased flexibility and accessibility, allowing students to attend lessons more conveniently (Amoah & Le Roux, 2024; Ní Fhloinn & Fitzmaurice, 2021). Asynchronous online learning creates opportunities for students to engage with mathematical content at their own pace, using a variety of digital tools and resources that support personalised learning journeys; the tools and resources include interactive simulations and video tutorials, (Amoah et al., 2022). Radmer and Goodchild (2021) highlighted that effective teaching, learning, and assessment, facilitated by digital technologies along with improved communication channels between students and lecturers, contributed to students' positive experiences of learning Mathematics online. Borges and Costa (2022) found that students appreciated online learning strategies and tools, such as the ZOOM platform and the b-Mat@plicada educational videos, used by the lecturers,. In addition, a study by Boling et al. (2012) on factors contributing to positive online learning experiences found that when designing online courses, it is essential to incorporate practices like interactive elements and effective instructional strategies. These features enhance the online learning experience by promoting active engagement, fostering more profound understanding, and helping students feel more connected to the content and one another.

However, despite these positive aspects, students also encountered significant challenges. Students reported numerous negative experiences with learning undergraduate Mathematics Education modules online, and the challenges often stemmed from a lack of social interactions and lack of direct contact with lecturers. These limitations led to feelings of anxiety, and they negatively impacted learning outcomes (Radmer & Goodchild, 2021). Akayuure (2021) further noted challenges such as difficulties with logging in, network issues, poor timing, delayed real-time feedback, and the complexities of typing mathematical symbols in an online setting. Similarly, Borges and Costa (2022) highlighted challenges that emerged during periods of fully remote teaching, shedding light on the types of barriers students and lecturers encountered in adapting to online Mathematics Education. The barriers to effective online Mathematics Education learning include unstable internet connections, inadequate learning conditions at home, and students' reluctance to ask questions in virtual settings. These challenges are particularly significant given the nature of mathematics, which often requires real-time clarification, step-by-step guidance, and active problem solving, all of which can be harder to facilitate in an online environment. The impact of socioeconomic disparities on online learning also deserves attention. Bryant (2021) reported that students from disadvantaged socioeconomic backgrounds struggled more frequently due to unreliable internet access and a lack of technological tools, making it difficult for them to attend classes consistently.

Kawalilak et al. (2012) identified a lack of access to technological tools and lack of reliable internet connectivity as significant contributors to students' negative experiences of learning Mathematics Education online, as these issues often hindered access to the LMS. Similarly, Reju and Jita (2018) observed that not every student had a personal computer (PC), thus forcing some to rely on shared devices at local community or learning centres. The shared devices at learning centres, which were sometimes only available at a cost, placed a burden on families, particularly during the pandemic when financial strain was heightened. These challenges were reflected in academic performance, with Shone et al. (2023) reporting a notable decline in Mathematics Education outcomes for students lacking access to high-quality resources and effective self-directed learning strategies. In this study, the absence of real-time feedback in online settings often left students struggling to clarify misunderstandings. This not only slowed their progress but also affected their confidence in engaging with complex mathematical concepts (Yang et al., 2021).

In the same vein, Tatira (2022) suggests that a mix of benefits and drawbacks is almost universal in online Mathematics Education learning; however, the specific experiences differ based on individual student profiles. Many students were appreciative of the flexibility and convenience when learning mathematics online. Others struggled with the lack of a direct interface and the unique challenges of learning Mathematics Education remotely. Despite these varied experiences, Julien and Dookwah (2020) emphasised the importance of considering students' experiences when developing online learning policies. Since students are at the heart of the teaching and learning process, their satisfaction, especially in how they experience and engage with online Mathematics Education instruction, is essential for creating a supportive and effective digital learning environment.

2.1.3 Lecturers' experiences in teaching Mathematics Education online

Various studies conducted in Namibia (e.g., Kaisara & Walya, 2020; Mbongo et al., 2021; Hako et al., 2021) and internationally (e.g., Akpen et al., 2024; Mullen et al., 2021; Ní Fhloinn & Fitzmaurice, 2021) show that university Mathematics Education lecturers have experienced both rewards and challenges when teaching online.In the Namibian context, several benefits of online Mathematics Education teaching have been identified. These include increased flexibility, the capacity to manage large classes, and enhanced interaction between lecturers and students (Kaisara & Walya, 2020; Mbongo et al., 2021). However, such benefits were not experienced uniformly; they depended heavily on the digital tools used, the strategies employed, and the lecturer's level of preparedness. For example, the level of student engagement often varied based on whether synchronous or asynchronous teaching methods were used. Hako et al. (2021) further noted that teaching online also created professional learning opportunities for lecturers themselves as they developed new digital and pedagogical skills.

Similar experiences have been reported globally. Lecturers from countries such as the United States, Australia, and South Africa described increased flexibility, access to a wider range of digital tools, and the ability to offer more personalised feedback to students as benefits of online teaching (Johnson et al., 2020; Singh & Thurab-Nkhosi, 2021). These positive experiences often stemmed from the adaptability of online platforms, which enabled lecturers to tailor content, use interactive software, and connect with students beyond the limitations of the physical classroom.

Dhawan (2020) highlighted the advantage of reaching students across different geographical areas through online platforms. In addition, Ní Fhloinn and Fitzmaurice (2021) emphasised that recorded lessons allowed students to revisit material at their own pace, promoting better understanding and longer-term retention of mathematical concepts.

In contrast, several studies conducted in Namibia have revealed notable challenges that lecturers face when teaching Mathematics Education online. Among these were unreliable internet connectivity, limited access to digital devices, and a general lack of ICT skills among both lecturers and students (Mbongo et al., 2021). Low student attendance and a sense of isolation were also commonly reported, making the teaching experience feel disconnected and, at times, discouraging for lecturers.

Hako et al. (2021) added that frequent power outages and server issues further disrupted teaching and learning. In many cases, servers could not handle multiple users at once, resulting in missed lessons for both lecturers and students—a situation that understandably affected continuity and morale.

Similar concerns have been raised in global contexts. Gqoli and Kariyana (2023), for example, observed that teaching complex topics, such as Euclidean geometry, became especially difficult in online environments due to the abstract nature of the content and the limitations of available digital tools. Their study also pointed to broader issues, such as inadequate infrastructure and a shortage of teaching resources, particularly in under-resourced settings.

Furthermore, Rapanta et al. (2020) highlighted the absence of real-time interaction as a significant barrier. For subjects like Mathematics Education, where students often need immediate clarification and discussion around abstract ideas, the lack of direct engagement made it more difficult for both students and lecturers to stay connected in meaningful ways.

Fhloinn and Fitzmaurice (2021) provided insights into the mixed experiences of lecturers during emergency remote teaching of Mathematics Education. Many lecturers found the shift to online teaching beneficial. They gained new skills, knowledge, and resources which could enhance their direct teaching of Mathematics in the future. However, some lecturers found the transition challenging as they reported spending significantly more time preparing the materials to use during online classes. Consequently, they were likely to go back to more direct methods of lecturing when back in the classroom environment.

2.1.4 Recommendations for improving the learning and teaching of Mathematics Education online

Rapanta (2020) emphasises that addressing the negative experiences of both students and lecturers is crucial for the effective implementation of online learning and teaching of Mathematics Education at higher institutions. Numerous studies conducted in Namibia on learning and teaching Mathematics Education online (e.g., Hako et al., 2021; Mbongo et al., 2021) have indicated several recommendations for students, lecturers, and higher education institutions. The recommendations were made to amend online learning and teaching of Mathematics Education. While Hako et al. (2021) emphasise the need for formal training and ongoing support for students in using online learning tools, this study also recognises that lecturers equally require structured support. In the context of teaching undergraduate Mathematics Education courses online, it is essential that lecturers are not only provided with digital tools but are also empowered through continuous professional development that enhances their pedagogical and technological skills.

Mbongo et al. (2021) recommend that lecturers undergo formal training to optimise their online teaching methods. Additionally, strengthening mental health support is essential, not only to help lecturers cope with feelings of isolation and loneliness but also to support students who may be experiencing similar challenges in an online learning environment. To enhance online teaching, Bwalya and Kaisara (2020) underscore the need for improved technological infrastructure and support systems for lecturers. While Hako et al. (2021) recommend upgrading campus servers to minimise disruptions, this study argues that reliable infrastructure is only one part of the solution. In the context of teaching calculus online, seamless delivery also depends on equipping lecturers with the necessary digital skills and ensuring that they have access to stable platforms that support interactive, student-centred teaching.

Studies conducted globally on learning and teaching Mathematics online (e.g. Gqoli & Kariyana, 2023; Akayuure, 2021) align with the findings from Namibia and provide additional recommendations. Gqoli and Kariyana (2023) advocate for the integration of interactive technology in the form of Mathematics applications to be used as part of the learning environment for Mathematics. They also added that lecturers should undergo training in technical skills and should be provided with the resources enabling them to teach online. Further, Akayuure (2021) also added an upgrade of network bandwidth to improve access and a built-in Mathematics symbols application to the recommendations.

2.2 Conceptual framework

This section presents the study's conceptual framework. This study utilises components from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). This section is divided into three subsections. First, the model (TAM) and the theory (UTAUT) are discussed distinctively in subsections 2.2.1 and 2.2.2, and harmoniously, the conceptual framework that is drawn from this is presented in Subsection 2.2.3.

2.2.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is based on the theory of reasoned action and aims to better understand user acceptance or rejection of information technology systems by describing the motivational processes mediating system characteristics and user behaviour (Davis, 1985; Putra, 2019). As presented in Figure 2.1, adapted from (Dumpit & Fernandez, 2017, p.3), the original TAM has four main constructs, namely:

1. *Perceived ease of use* (PEOU): the extent to which a person believes that they will be free of effort if they use the system.
2. *Perceived usefulness* (PU): the degree by which a person believes using a specific system will boost their job performance and overall effectiveness.
3. *Attitude towards use* (ATU): a user's overall affective reaction or feelings about a system usage.
4. *Behavioural intention to use* (BI): the degree by which a person has expressed conscious plans on using and adopting the technology.

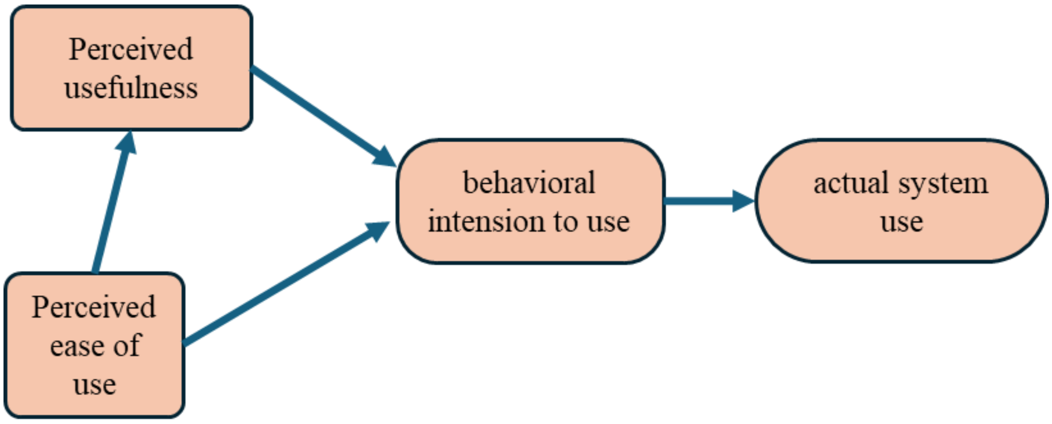

Figure 2.1 *Technology Acceptance Model (TAM)*

Teo (2011) conducted a study titled "*Factors influencing teachers' intention to use technology*" and applied TAM to investigate the intent of teachers to use technology in their classrooms. The study highlighted how PU and PEOU influenced the attitudes of teachers towards adopting technology. Lazim (2021) applied TAM to examine the factors of students' acceptance of online learning in a higher education institution and found that students' acceptance behaviour towards online learning is influenced by the mediating role of attitude between PEOU and PU. Venkatesh and Davis (1996) assert that perceived usefulness (PU) plays a critical role in influencing actual system usage, with their findings indicating a strong and positive correlation between the two. Venkatesh et al. (2003) suggested that FC determines actual usage and not BI. The idea is that in the context of facilitating condition (FC), such as access, infrastructure, training, technical support, and other relevant factors, would mostly affect the nature, type, and frequency of use and not the users' intentions.

Saleem et al. (2016) reported that the use of online platforms exhibits a relationship between performance expectancy (PE), efforts expectancy (EE), facilitating condition (FC), and behavioural intention to use (BI), which in turn, affects students' and lecturers' technology use behaviour. Sanches and Hueros (2010) conducted a study titled "Motivational factors that influence the acceptance of Moodle using TAM", and it revealed that technical support has a direct effect on PEOU. Also, Ngai et al. (2007) revealed that technical support has a direct effect on PU. Previous studies that employed TAM primarily examined how technology was adopted based on only four constructs of TAM but did not focus on the lived experiences of the users and external factors which are crucial for successful implementation. To close this gap, this study shifts its focus to these user experiences and extends the model to external factors (FC).

2.2.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

United Theory of Acceptance and Use of Technology **(**UTAUT) is a synthesis of previous technology acceptance theories developed by Venkatesh et al. (2003), and it suggests that the actual use of technology is determined by behavioural intention. As presented in Figure 2, UTAUT, adapted from Venkatesh et al.,2003; Xue et al.,2024, has four key constructs, namely:

1. *Performance expectancy*: the measure by which a person believes that using the system will help him or her conquer wins in the job performance.
2. Effort *expectancy*: the measure of ease associated with the system usage.
3. *Social influence*: the measure by which a person perceives those influential others believe he or she should use the new system.
4. *Facilitating conditions*: the measure by which a person believes that an organisation and technical infrastructure is there to support the system usage.

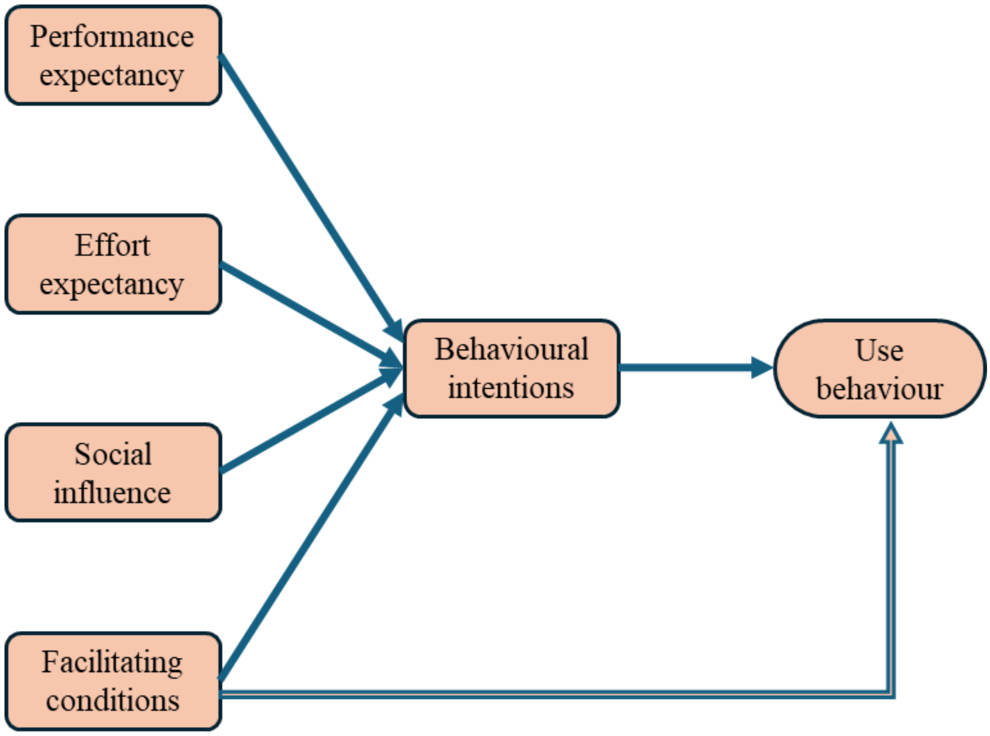

Figure 2.2 *The Unified Theory of Acceptance and Use of Technology (UTAUT)*

UTAUT has been significantly utilised to study online learning adoption in higher institutions. Research has identified several factors influencing behavioural intention (BI) and user behaviour (UB) of online learning systems. Performance expectancy (PE), effort expectancy (EE), and social influence (SI) positively affect BI (Handoko, 2019; Semlambo et al., 2023). Additionally, perceived information quality; compatibility; trust; awareness; resource availability; self-efficacy, and security contribute to students' acceptance of mobile learning (Almaiah et al., 2019). Facilitating conditions (FC) and BI positively impact UB (Semlambo et al., 2023). However, some studies found that lecturer influence and FC may not significantly affect BI or UB (Handoko, 2019). A study by Alshabeb et al. (2020) that reviewed recently published literature that used the UTAUT theory as a guideline for research in Saudi education concluded that FC, PE, and EE had positive effects on users' intention to utilise technologies in the Saudi education environment. The UTAUT model has been applied across various educational contexts, including e-learning systems and institutional repositories (Kocaleva et al., 2014). Understanding these factors is critical for successfully implementing online learning technologies in institutions of higher learning.

EI-Masri and Tarhini (2017) conducted a study on the circumstances affecting the embracing of e-learning systems in Qatar and the USA extended UTAUT in order to investigate the adoption of e-learning systems in institutions of higher learning in the Gulf region, thus emphasising the impact of PE, EE, and social influence (SI) on students' acceptance of e-learning technologies. EI-Masri et al. (2017) also found that EE and SI increase students' embracing of e-learning systems in developing countries compared to developed countries. To the best of my knowledge, no study in Namibia has utilised the UTAUT framework in the context of online Mathematics Education teaching. This study addresses that gap by focusing on lecturers' and students' experiences with undergraduate online Mathematics Education instruction.

2.2.3 Application and relations between TAM and UTAUT in this study

In this study, TAM is used to focus on individual acceptance of technology through its core constructs of perceived usefulness (PU) and perceived ease of use (PEOU) which provide a foundational understanding of user attitudes. On the other hand, UTAUT expands this perspective by incorporating performance expectancy (PE), effort expectancy (EE), and facilitating conditions (FC), thus offering a broader framework for understanding technology use in an online education context. By drawing on both models, this study captures both the depth of individual motivation (as highlighted in TAM) and the wider contextual and organisational factors addressed by UTAUT, thereby providing a more comprehensive analysis as shown in the conceptual model in Figure 3, which is adapted from Figure 2.1 and Figure 2.2. TAM and UTAUT are well-suited for analysing the experiences of both students and lecturers in learning and teaching Mathematics Education online, as they provide a framework to assess users' approval and adoption of new tools. In addition, combining TAM and UTAUT was done to provide insight into factors that influence students' and lecturers' experiences of learning and teaching mathematics online, which could inform adjustments in instructional design, technology use, and support systems to better meet the user's needs (Venkatesh et al., 1986; Davis, 2003).

While well-established frameworks like TAM and UTAUT offer robust models for understanding technology acceptance, this study employs a combined structure to address specific nuances in the online teaching and learning context during and after the COVID-19 pandemic. In particular, TAM provides a foundational lens to explore individual attitudes toward technology through perceived usefulness (PU) and perceived ease of use (PEOU), which remain relevant and widely validated. UTAUT extends this understanding by incorporating broader, contextual elements such as performance expectancy (PE), effort expectancy (EE), and facilitating conditions (FC), which are critical when examining institutional and infrastructural influences.

The decision to use both frameworks, rather than relying solely on one of them, allows for a richer, more layered analysis that bridges personal, pedagogical, and systemic factors influencing technology use. This approach responds to calls in recent literature (e.g., Venkatesh et al., 2012; Al-Okaily et al., 2020) for more integrative models that reflect real-world complexity rather than isolating individual or organisational elements.

The order in which TAM precedes UTAUT in the framework reflects a logical progression: starting from the individual user's perception and experience before expanding outward to encompass broader contextual and environmental factors. This structure aligns with the study’s aim to understand both personal acceptance and the institutional conditions that shape technology use in higher education.

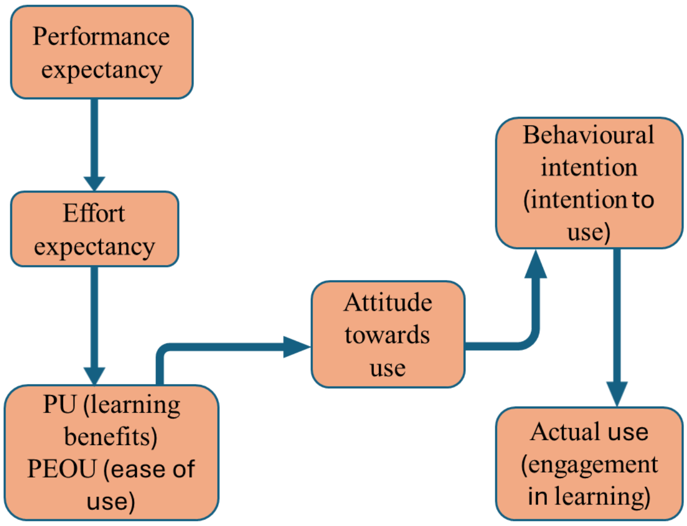

Figure 2.3 *Conceptual Framework for this Study*

In this study, TAM and UTAUT constructs that will be used will be operationalised as follows:

1. **PU**: It is about whether students believe online learning tools and platforms improve their Mathematics Education learning outcomes and how online tools enhance lecturers’ teaching effectiveness.
2. **PEOU**: It is how easy students find it to navigate and use online learning platforms for Mathematics Education, and how easily lecturers can incorporate online tools into their teaching workflow.

3. **PE:** It concerns students' perceptions of how online Mathematics Education learning impacts their academic performance and the belief that online teaching enhances lecturers' ability to teach Mathematics Education effectively.
4. **EE:** It concerns students' ease of using online platforms for learning Mathematics Education and the ease with which lecturers can integrate and use online tools in their teaching practices.
5. **FC:** It involves students ease of accessing the resources and support they need for successful online interactions, e.g. reliable internet, suitable devices, and technical support and institutional support for lecturers, such as access to professional development, reliable technical assistance, and adequate digital tools for Mathematics Education instruction.

2.3 Chapter Summary

This chapter discussed the historical overview of various issues and best practices in learning and teaching Mathematics Education online; the lived experiences of both students and lecturers on learning and teaching Mathematics Education online, and the study's conceptual framework. The TAM model and the UTAUT theory are utilised to establish a conceptual framework for learning and teaching in a technology-driven environment. The subsequent chapter outlines the methodology and design that guided the present study.

CHAPTER THREE: METHODOLOGY

In this chapter, the methodology used for conducting the research study will be presented. It includes the research design; samples and sampling procedures; research instruments; population; data collection procedures; data analysis; pilot study, trustworthiness of the data, as well as ethical considerations.

3.1 Research design

This study employed a qualitative case study design, which provided a comprehensive understanding of the online Mathematics Education learning and teaching at the UNAM Khomasdal Campus. A qualitative case study is a research design that helps in the exploration of a phenomenon within some particular context through various data sources and a variety of lenses to reveal multiple facets of the phenomenon (Yazan, 2015). A qualitative case study design was chosen to enable the researcher focus on a case related to a specific problem: teaching and learning Mathematics Education online, and to obtain in-depth information (Patton, 2015). The qualitative case study design allowed the researcher to delve into the participants' personal experiences and viewpoints, thereby offering a deeper insight into the issue. As McMillan and Schumacher (2001) stated, qualitative research explores individuals' social activities, beliefs, and perceptions, interpreting phenomena through their subjective meanings.

While this study is fundamentally qualitative, certain results are semi-quantitated where appropriate to enhance clarity and transparency. Neale et al. (2014) argue that the use of numbers in qualitative research, for example, to describe sample characteristics such as participant numbers and key demographics, is both essential and widely accepted. Beyond descriptive statistics, semi-quantification can improve the transparency of data analysis, add precision to findings, help patterns emerge more clearly, and enhance the overall meaning of key results by providing focused emphasis. This balanced approach ensures that the study remains rooted in qualitative inquiry while benefiting from the strengths of descriptive quantification.

3.2 Population

For this study, the broader population includes all Mathematics Education lecturers and all students specialising in Mathematics Education at the senior primary level within the Bachelor of Education programme at the UNAM Khomasdal Campus. The population consisted of two Mathematics Education modules lecturers, seven hundred and forty-one (741) third-year students studying towards a Bachelor of Education (Senior Primary) majoring in Mathematics Education, and seventy-seven (77) third-year students also specialising in Mathematics Education at the senior primary level.

3.3 Sample and sampling procedures

This study employed total population sampling, focusing on all lecturers who taught Mathematics Education modules online during the 2020-2021 academic year. This approach was adopted because the group was small and directly relevant to the study's focus, allowing for the gathering of rich, context-specific insights.

The Mathematics Education lecturers who taught Mathematics Education modules online in 2020-2021 were included in the study, using a total population sampling approach. Creswell (2014) describes total population sampling as a purposive approach in which all individuals who satisfy predefined criteria within a specific population are deliberately selected for inclusion in the study. In this case, only two lecturers were responsible for teaching Mathematics Education online to Bachelor of Education (Senior Primary) students during the pandemic at the UNAM Khomasdal Campus. As such, both were included in the study, ensuring that the full range of relevant teaching experiences was captured.

Creswell (2014) further notes that total population sampling is particularly suitable when the population is small and all members are considered information rich sources. Third- and fourth-year Mathematics Education major students who were taught Mathematics Education courses in the 2020-2021 academic year were selected using purposive and convenience sampling methods. The researcher believes that third- and fourth-year students majoring in Mathematics Education who were taught Mathematics Education courses in 2021 are the agents of knowledge and information for the study.

Total population sampling, a type of purposive sampling, was used to identify and include all information-rich participants relevant to the study, an approach particularly effective when dealing with a small, well-defined group (Patton, 2015). This involves identifying and selecting individuals or groups of individuals who are especially knowledgeable about or have experienced a phenomenon of interest (Creswell & Clark, 2018). While total population sampling was used to select lecturers, convenience sampling was employed to select student participants based on their availability and willingness to participate (Etikan et al., 2016). This approach was practical given the large student population and logistical constraints.

This sample included all the Mathematics Education modules lecturers (two), ten (10) third-year students, and eight (8) fourth-year students who began their Bachelor of

Education in Senior Primary Education Honours with Mathematics Education in the 2020-2021 academic year. The 2020 and 2021 cohorts were selected because they experienced the whole shift to online learning at UNAM; thus, they offer valuable insights into how lecturers adapted during that unique and challenging period. The sample consisted of 20 people in total. Participants distribution is shown in Table 1.

3.4 Research instruments

In this study, data were collected through face-to-face semi-structured interviews (Appendices 7, 8, 9) with all Mathematics Education lecturers, third- and fourth-year Mathematics Education major students. The researcher chose semi-structured interviews because they enable the interviewees to express themselves and provide detailed information about the research problem (John & Christensen, 2014). Interview questions were slightly different to fit the participants. The lecturers were asked questions about their experiences, and students were asked questions about their experiences as well. However, all participants were asked questions relating to the research questions.

The interview guides were developed by the researcher and adapted from Radmehr and Goodchild (2022) to suit the Namibian context and research focus. To ensure validity and reliability, two experts in Mathematics Education reviewed the instruments, and their feedback helped refine the questions. A pilot study with third-year students was also conducted and ensured that the questions were clear and relevant.

3.5 Data collection procedures

After obtaining ethical clearance and institutional permission from UNAM’s Decentralised Ethics Committee (DEC), the researcher scheduled appointments with the selected students and lecturers. Interviews were conducted face-to-face during the day, depending on participants’ availability, and lasted approximately 25 minutes. With consent, some interviews were voice-recorded to ensure accuracy. The recordings were securely stored on the researcher’s password-protected device. Thereafter, the recordings were transcribed, and the data were anonymised and organised for analysis. The raw data will be securely stored and deleted four years after the study's completion.

3.6 Data analysis

In the present study, data analysis involves breaking down raw data into its components to uncover patterns, relationships, or trends that can inform conclusions and answer research questions. The interpretation of qualitative data is grounded in an interpretive philosophy that focuses on the subjective meanings and symbolic significance embedded within the data (Shamoo & Resnik, 2003). In addition, qualitative data were interpreted to understand how lecturers personally made sense of their experiences of teaching Mathematics Education modules online, focusing on their views, challenges, and teaching practices. In this qualitative study, an inductive approach through thematic analysis was employed, allowing patterns and themes to emerge directly from the participants’ experiences without imposing pre-set assumptions. This approach was suitable as it aligned with the study’s aim to explore lecturers’ real-life views and practices in teaching mathematics online.

Kiger and Varpio (2020) assert that thematic analysis is a robust and suitable method for exploring patterns of experience, thought, and behaviour within qualitative data, making it particularly well-aligned with the aims of this study. This study followed the six-phase thematic analysis process developed by Braun and Clarke (2006), as supported by Pathan and Abbasi (2020), which is a widely recognised method for identifying and analysing patterns in qualitative data. As illustrated in Figure 3.1 on Page 33, the first phase involved becoming familiar with the interview transcripts through repeated reading and initial noting of ideas. This is a very critical stage that empowers researchers to read between the lines to identify codes or meaningful patterns, which can be potential indicators. The second stage was to generate the initial codes. At this stage, the researcher carefully attends to codes, labels, and categories for further processing.

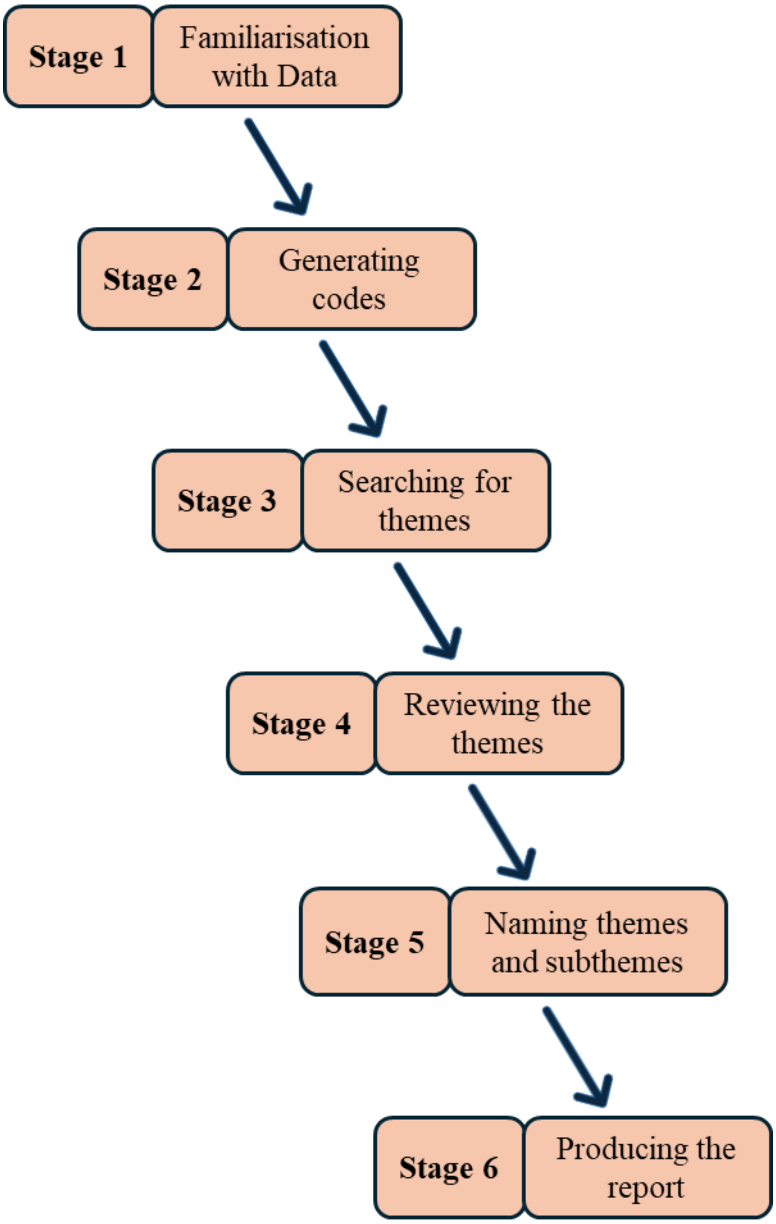

Figure 3.1 *Coding Stages in Thematic Analysis*

Based on the inductive analysis of the data, the researcher highlighted the keywords in the responses and familiarised them with the recurring keywords. Stage Three was to examine themes; relationships among identified themes were also established. Stage Four involved verifying that the reviewed themes accurately represented all the data coded in Stage Two. Stage Five was for the identification of themes and subthemes. Stage Six, the final stage, involved the production of a descriptive report detailing the data that led to the study's findings and discussion.

3.7 Trustworthiness of the data

In qualitative studies, trustworthiness is commonly assessed through credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). These concepts help ensure that the findings are well-grounded in participants' experiences and that the research process is transparent, consistent, and reflective of the context in which the data were generated. This explanation advises that if the same instrument is used under similar conditions, the results should be of comparable quality. Thus, the research instruments were submitted to the researcher's supervisor for evaluation by expert judgment, correction, and relevant suggestions to validate and test reliability. Comments and recommendations made by the supervisor were integrated to revise the instrument that underwent pilot testing. That was so that the research tools captured the topics being investigated.

The trustworthiness of this study was established using the criteria proposed by Lincoln and Guba (1985), which include credibility, transferability, dependability, and confirmability. These principles were also applied in similar qualitative research, such as a study by Ilonga et al. (2020), to ensure rigour and transparency.

Credibility was addressed through accurate transcription of voice-recorded interviews and triangulation of data from both students and lecturers. Transferability was supported by providing a thick description of the research context and participants. Dependability was ensured through a clear and consistent research process, including documentation of procedures and peer feedback. Confirmability was maintained by grounding interpretations in participants' actual responses and maintaining an audit trail. Trustworthiness is important in qualitative research to support the argument that the findings of the inquiry are worthy and accurate. Credibility was established through extended engagement with participants during the interviews. Data saturation was reached when participants began repeating similar ideas, and no new information or patterns were discovered during the last interviews. This point was identified through repeated review of the interview transcripts and survey responses where participant responses began to show clear patterns and overlap. As additional data confirmed rather than expanded existing themes, it indicated that a sufficient depth of understanding had been achieved regarding the phenomenon under study.

For interviews that were recorded, interview transcriptions were compared with the recordings to confirm that they accurately represented participants' words. To support transferability, the researcher provided rich, detailed descriptions of the research context, participants, and data collection processes. While transferability cannot be guaranteed, this level of contextual detail enables readers and future researchers to determine whether the findings may apply to similar settings. Additionally, verbatim quotations were part of the data analysis to support the findings. To ensure dependability, all interviews where participants gave consent were voice-recorded to capture their responses accurately. These recordings were transcribed verbatim, and the analysis process was thoroughly documented to provide a clear audit trail. This systematic approach ensured consistency and transparency in the collection and interpretation of data. Equally, the findings were cross-checked against related literature by the researcher, and the research design was clearly and thoroughly described. The confirmability of data was enhanced through documentation and the transparency of the methodology, data analysis, and conclusions.

3.8 Pilot study

A pilot study, also known as a feasibility study, is a pre-test of a specific research tool, such as a questionnaire or an interview guide (Platton, 1990). The interview guide was pilot tested with six undergraduate education students majoring in Mathematics Education who had experience with online learning, as well as one undergraduate Mathematics Education lecturer from the UNAM Main Campus who had taught online. This was done to assess both the content and construct validity of the instrument. Pilot interviews were conducted with both a student and a lecturer to evaluate the clarity, relevance, and flow of the interview questions. This process helped identify any ambiguous or confusing items and allowed for refinement of the guide to ensure that it was well-aligned with the research objectives and that it was understandable to participants. Yusof and Ali (2011) assert that reliability, referring to the consistency of research instruments, and validity, indicating the accuracy of the data collected, are fundamental criteria for identifying potential bias and distortion, as well as for establishing the overall trustworthiness of a study. Furthermore, Muzah (2011) stated that a pilot study is conducted to: improve both validity and reliability; ensure that the questions mean the same to all participants; estimate the length of time it will take the participants to respond to the questions; check that all the questions and instruments are concise and clear, and that there are no biased items. Furthermore, McMillan and Schumacher (2014) noted that a pilot study also provides an initial indication of the possible types of responses and whether revisions are necessary to avoid the ceiling or floor effect. A pilot study has the advantage of providing early warnings of possible failure of the main study, indicating where the research tools may not be followed or whether proposed methods and instruments are inappropriate or overly complex (Anupama, Chaudhary, & Lakshmi, 2023). During the pilot study, feedback from the only participating lecturer was reviewed to identify any ambiguities or weaknesses in the interview guide. Although not extensive enough for complete thematic analysis, the responses were examined for preliminary patterns and insights to inform refinement of the data collection instrument. The pilot study was completed within three weeks. Preliminary results of the pilot study indicated that participants comprehended the research instruments, as evidenced by their ability to respond to the questions clearly and appropriately. Based on this observation, no revisions or adjustments to the interview questions were deemed necessary.

3.9 Research ethics

Adherence to ethical guidelines is paramount in all research endeavours (American Psychological Association, 2010). As a result, this study adhered to research ethical norms. An ethical clearance certificate was obtained from the University of Namibia's Decentralised Ethics Committee (DEC). A research permission letter was issued by Postgraduate Research Support Services. The Executive Dean of UNAM's Faculty of Education and Human Sciences, as well as the Associate Dean of UNAM's School of Education, granted permission to conduct research at UNAM Khomasdal Campus. After obtaining approval to conduct the research from the Executive Dean of the Faculty of Education and Human Sciences, as well as the Associate Dean of the School of Education, the researcher contacted the participants and explained the purpose of the study. The explanation of the study's purpose made the participants aware of the study's aims and provided an understanding of the study's nature. All participants received a signed statement from the researcher (Appendix 6) outlining the ethical measures taken to protect their identity and the use of their data. While the responses were not anonymous, participants were assured of pseudonymity, with identifying details removed during transcription and reporting. Although full confidentiality could not be guaranteed due to the intent to share findings for educational improvement, participants were informed that their data would be presented in a way that protected their personal identities and professional roles. Participants also signed consent forms (Appendix 5), and they were made aware that participating in the study was completely voluntary and that they could withdraw from this study at any time. They were also guaranteed that all information obtained during the interviews would only be used for the study. The researcher also sought permission from the participants so as to audio-record the interviews. All interview data have been securely stored on a protected device, with access limited to the researcher and authorised supervisors from UNAM. Under UNAM's ethical guidelines, the data will be retained securely for five years following the completion of the study, after which it will be safely disposed of.

3.10 Chapter summary

This chapter discussed the methodological approach undertaken in the study. It described the qualitative case study design, the characteristics of the study population, and the sampling techniques applied for participant selection. It also detailed the procedures for data collection and analysis, as well as the measures implemented to ensure research trustworthiness. Ethical considerations and the pilot study used to validate the research instruments were addressed concisely.

CHAPTER 4: PRESENTATION AND DISCUSSIONS OF RESULTS

This chapter consists of two sections, 4.1 and 4.2, which present the results of the data analysis and a discussion of these results, respectively.

4.1 Presentation of results

A total of twenty (20) participants participated in the study; these participants were given pseudonyms to protect their identities, with LA representing Lecturer A; LB representing Lecturer B; 4SA representing fourth-year Student A until 4SH, and 3SA representing third-year Student A until 3SJ.

The presentation of results is organised according to four subheadings, each aligned with the study's research questions. This structure was chosen to ensure that the findings respond to the specific areas of inquiry explored in the study. This structure also reflects the key themes and sub-themes that emerged from the qualitative analysis of the closed-ended and open-ended interview data.

This section of the presentation of results is arranged according to the following subheadings.

4.1.1 General information of the participants

4.1.2 Students' knowledge of smartphone or computer usage

4.1.3 Student and lecturer participants' experiences of learning and teaching Mathematics Education online

4.1.4 Recommendations for improving the online learning and teaching of Mathematics Education

The first part of the findings chapter presents demographic and contextual information, including the participants' level of study and their prior exposure to online learning. This information is displayed in both tables and presented through a descriptive narrative. The subsequent section focuses on participants’ digital readiness for online Mathematics Education instruction. Data here were analysed descriptively to determine students’ familiarity with digital devices and tools before and during the shift to online learning. Information is presented in descriptive form. Subheading 4.1.3 is the central analytical section of the study; it is structured around three main themes that emerged from the data, namely students’ and lecturers’ responses to statements on learning and teaching Mathematics online, experiences with resources, and experiences with challenges. Themes two and three are further divided into subthemes, namely technological tools, internet access, and LMS, for Theme Two. Giving up and emotional distress; support; responsibility and learning environment; academic conduct as well as inconvenience and time are the subthemes under Theme Three. These subthemes reflect the deeper layers of participants' lived experiences during online Mathematics Education and were derived through thematic analysis of interview transcripts and open-ended responses. Subheading 4.1.4 was also a theme and is divided into subthemes that directly address the final research question and offer practical insights into improving future online Mathematics Education instruction. The subthemes under subheading 4.1 are: enhance resource availability; foster engagement; collaboration and support; professional development for lecturers, and training on digital tools for students.

4.1.1 General information of the participants

This section provides demographic and contextual information, including participants' study level and prior exposure to online learning. Data are presented using descriptive summaries and tables to set the scene for understanding their experiences.

The characteristics of the participants who were involved in the data collection, as well as the distribution of participants who were interviewed, are summarised in Table 4.1.

Table 4.1: **Distribution of Participants**

Participants		**Gender**		**Total**
		Female	Male	
Lecturers		1	1	2
Students	Third year	6	4	10
	Fourth year	7	1	8
Total		14	6	20

Table 4.1 shows that 20 people participated in the study. Among these participants, 14 out of 20 were female, and 6 out of 20 were male.

Table 4.2 presents the approximate number of hours participants spent online each week for both academic and non-academic purposes. This information is included to provide insight into students' general engagement with digital platforms, which is relevant to understanding their preparedness and digital habit factors that influenced their experiences of learning Mathematics Education online and which directly relate to the study's first research question.

Table 4.2: Estimated time in hours the participants spent per week online

Participants	Estimated number of hours spent online for academic purposes			
	Less than 1	**1-5**	**6-10**	**11 & above**
Lecturers	0	1	0	1
4th year students	0	6	2	0
3rd year students	0	10	0	0
Total	**0**	**17**	**2**	**1**
	Estimated number of hours spent online for non-academic purposes			
	Less than 1	**1-5**	**6-10**	**11 & above**
Lecturers	0	1	1	0
4th year students	0	0	6	0
3rd year students	0	0	9	0
Total	**0**	**1**	**16**	**3**

Table 4.2 shows that of the participants, 17 out of 20 spent 1-5 hours; 2 out of 20 spent 6-10 hours, and 1 out of 20 spent 11 hours or more online for academic purposes. Table 2 also reveals that of the participants, 1 out of 20 spent 1-5 hours; 16 out of 20 spent

6-10 hours, and 3 out of 20 spent 11 hours or more online exploring the internet for non-academic purposes. These data suggest that while participants do engage in academic activities online, they tend to spend more time browsing the internet for non-academic purposes. The pattern may indicate a need for strategies that encourage students to balance their online time more effectively in favour of academic engagement.

4.1.2 Students’ knowledge of smartphone or computer usage

This sub-heading focused on presenting qualitative results regarding the students’ knowledge of using devices, such as smartphones and computers, that play a significant role in learning Mathematics Education online. Participants were asked whether they had used smartphones or computers before enrolling at UNAM. All ten third-year student participants indicated that they had used a computer/smartphone before enrolling at UNAM, and all participating students indicated that they had good knowledge of using smartphones and computers although they struggled with the usage of mathematical symbols. Four of the eighteen student participants shared that their knowledge of computer usage was great because they hold certificates in office administration, and their coursework primarily focused on computer skills such as typing words, creating PowerPoint presentations, and other similar tasks.

4.1.3 Students’ and lecturers' experiences when learning and teaching Mathematics Education online

This subheading is divided into three themes. Theme one is presented in tables and descriptive form, and Theme Two and Theme Three are divided into subthemes and presented in descriptive form. Student and lecturer participants were asked, through semi-structured interviews, to indicate their of experiences learning and teaching Mathematics Education online by responding to eleven (11) Likert-scaled statements on learning and teaching Mathematics Education online. The statements focused on of resources (such as smartphone/computer, internet access) and challenges encountered in using them.

Theme 1: Lecturers' and students' responses to statements on learning and teaching Mathematics Education online

Lecturer participants were asked to indicate their experiences of teaching Mathematics Education online by responding to eleven Likert-scale statements which explored aspects such as confidence with digital tools, perceived student engagement, and effectiveness of online instruction. The results of the responses are presented and discussed in the section below. The responses aim at answering Research Question One, which in turn aims to determine the students' and lecturers' experiences when learning and teaching Mathematics Education online.

All lecturer participants agreed that they provided students with fair and clear assessments. In addition, they disagreed with the following statements: *The students' attendance in online classes is better than in face-to-face classes; students are actively involved in the learning-teaching process,* and *lecturers use a wider range of resources in online teaching than in face-to-face classes*. There is, however, contrast between their responses to the following statements: *Many mathematical problems cannot be solved through online learning*, and *the course materials used are well-developed for teaching Mathematics Education online*. One of the two participating lecturers strongly agreed with the two statements, while the other lecturer participant strongly disagreed with the two statements. One of the two lecturer participants was neutral regarding the flexibility provided by online teaching and learning, the condition of their devices, their skills to deliver online classes, as well as their internet access.

Student participants were also asked to indicate their experiences with learning Mathematics Education online by responding to eleven (11) Likert-scaled statements. Table 4 summarises student participants' responses to the eleven Likert-scaled statements.

Table 4.3: Students' Responses on the Eleven Likert-Scaled Statements

f-frequency; SD-strongly disagree; D-disagree; N-neutral; A- agree; SA- strongly agree.

Statement	SD	D	N	A	SA
My attendance in online classes is better than in face-to-face classes.	4	5	5	4	0
The flexibility provided by the online classes is better for me than the face-to-face classes.	2	2	2	11	1
My smartphone/ laptop/desktop PC is good enough to use for online learning.	2	6	5	5	0
The environment in my house is suitable for online learning.	1	8	5	4	0
Assessments given by lecturers are fair and clear.	0	9	5	2	2
Lecturers are actively involved in the learning-teaching process.	0	4	10	2	2
Lecturers use a wider range of resources in online teaching than in face-to-face classes.	12	6	0	0	0
Lecturers have the skills to deliver online classes.	0	8	10	0	0
Many mathematical problems cannot be solved through online learning.	0	0	0	8	10
I have reliable access to the internet for my school needs.	2	6	7	1	2
The course materials are well-developed for learning Mathematics Education online at my university.	0	6	10	2	0

Table 4.3 indicates that all student participants concurred that *many mathematical problems cannot be solved through online learning*; four out of eighteen students strongly disagreed that *their attendance in online classes is better than in face-to-face classes*, and four out of eighteen students agreed with the same statement. Only four out of eighteen of the students agreed that *the environment in their house is suitable for online learning*. Further, nine out of eighteen students disagreed that *assessments given by lecturers are fair and clear*. Two out of eighteen students strongly disagreed that they had reliable access to the internet for their school needs, while two out of eighteen students strongly agreed with the same statement. Additionally, twelve out of eighteen students agreed that *the flexibility provided by online classes is better for them than the face-to-face classes,* and twelve out of eighteen students were neutral in response to the statements regarding: *lecturers' active involvement in the learning-teaching process*; *the lecturers' skills in delivering online classes* as well as *course materials are well-developed for learning Mathematics Online at the university.*

Theme 2: Students and lecturers' experiences of terms of resources (such as smartphone/computer, internet access)

Students and lecturer participants were asked to indicate how they experienced learning and teaching practices of Mathematics Education online in terms of resources. Responses aimed to answer Research Question One, which is to determine students' and lecturers' experiences when learning and teaching Mathematics online. Responses from this theme were divided into subthemes as discussed below.

a) Technological tools

Many (fourteen out of twenty) of the participants experienced problems with technological tools. One of the two lecturer participants and three third-year student participants reported that they had old laptops that were very slow. A few (Three out of eighteen) student participants added that their phones were slow due to a lack of storage space since they had their notes saved on their phones. Another (one out of eighteen) student participant reported not owning a smartphone or laptop, so they relied on family members' phones, which were often used for work since the family members were working from home. Moreover, another (one out of eighteen) student expressed that she/he did not have devices, and his/her parents only managed to buy the devices almost a month after the online classes had started. Several (six out of eighteen) student participants also mentioned that they missed out on classes at the beginning of the classes because they did not own smartphones, and they only managed to buy them after almost a month. Similarly, other students also mentioned that they did not own devices, but they managed to join classes by joining their classmates who owned devices. This finding highlights the role of peer support in overcoming digital access barriers, suggesting that social collaboration played a critical role in enabling continued learning during periods of online instruction. Another (one out of eighteen) student participant shared that she/he did not own a smartphone or laptop and had to rely on community libraries, which were sometimes overcrowded. This highlights the digital divide faced by some students and underscores the challenges associated with unequal access to technology and learning spaces. Such findings add value to this study by illustrating how limited access to digital resources can affect students' participation in online Mathematics Education classes and their benefit from online Mathematics Education. Below are a few verbatim quotations from LA, 3SA, 3SJ, 4SA and 4SE.

> *"My laptop was old, so it was very slow. It took longer to switch on and display content, so it was very frustrating to use."*

"My smartphone was very slow because I had a lot of notes saved in it; the slowness was due to space."

"I missed out on classes for almost a month; I didn't have a smartphone or PC; my parents only managed to buy it after almost a month."

"I didn't have a device; I used to join my classmates who had devices."

"I didn't have a smartphone or laptop. I used my cousins' phones sometimes, but most of the time, they used it to work; they worked online from home."

"I didn't have a smartphone or laptop, so I used to go to the community library, but it is usually full."

In contrast, one lecturer participant did not experience any technological problems. A few (two out of seven) fourth-year student participants also added that they did not experience any technological challenges; they owned working smartphones and laptops. Below are some verbatim quotations from LB and 4SC:

"I did not have issues with resources; my laptop was working perfectly well."

"I had a proper laptop as well as a smartphone."

b) Internet access

Many (fourteen out of eighteen) student participants along with one of the two lecturer participants experienced internet connection challenges. The lecturer participants noted that their internet connection was not good, and uploading files online took longer. Student participants added that the data bundles that UNAM provided per month were not enough, and they needed to top up to attend classes for the entire month. Several (nine out of eighteen) student participants also noted that the internet could be very slow at times, and one student participant reported hotspotting their parents' phone for internet connection. The following are verbatim quotations from LB, 3SJ and 3SF:

> *"The internet connection was bad; sometimes uploading a file could take an hour."*
>
> *"The 12GB of data UNAM provided was not enough because it couldn't last a month. Sometimes, when my monthly data is finished, I use the community library to attend my classes, but there were many people, and the internet was slow."*
>
> *"I didn't have reliable internet access. I sometimes hotspotted with my parents' devices when they were at home."*

On the positive side, LB expressed:

> *"Internet connection was not an issue for me; I had Wi-Fi at home."*

Similarly, 3SI added:

> *"I always had internet, even when UNAM data was done, my parents always topped up."*

c) Learning Management System (LMS)

LA expressed dissatisfaction with UNAM's LMS:

> "*The system (Moodle) we were using here at UNAM used to get overwhelmed, and no one could access it, which is understandable since over 12 campuses were using it."*

Theme 3: Students and lecturers' experiences in terms of challenges

Students and lecturer participants were asked to indicate how they experienced learning and teaching practices of Mathematics Education online in terms of challenges. The responses aimed to answer Research Question One, which sought to determine students' and lecturers' experiences when engaging in learning and teaching Mathematics online. As seen below, responses from this theme were divided into five subthemes.

a) Giving up and emotional distress

Lecturer participant LA noted that some students gave up on online classes; they would log in but would leave their devices unattended to engage in other activities. Likewise, LB added that they experienced many technical difficulties with the LMS, and students were not attending classes. Thus, they gave up online teaching and started teaching via face-to-face mode in small groups. Student participant 3SD expressed the following:

> *"If the lecturer didn't start teaching face-to-face, I would have failed; learning Mathematics online was so stressful."*

Below are LA and LB's verbatim quotations.

> *"Teaching online was not that different from face-to-face teaching, except that during online teaching, students just log in and disappear, and only a few used to participate."*

> *"Teaching online was just a lot; sometimes, you must send methods on WhatsApp prior to the class, and not all students had smartphones. I couldn't do demonstrations while teaching, either. Also, only less than half of the class attends the classes. I just gave up teaching online and divided students into small groups and taught them face-to-face."*

LB stated:

> *"I was under a lot of pressure. I got COVID-19, and I was bedridden for six weeks; my work was still waiting for me; hence, I didn't finish the content, though I tried my best."*

b) Support

Student participants noted that they experienced a lack of support from the lecturers because they couldn't get hold of the lecturers after classes to ask questions. For instance, 3SG and 4SH said:

> *"I didn't understand the content, but then the lecturer was not in the office for consultations, so there was no one to assist me."*

> *"Not being able to consult the lecturer was bad for me; in class, I couldn't ask because I felt comfortable alone with the lecturer."*

c) Responsibility and learning environment

Regarding responsibility and learning environment, 3SG stated:

> "*I would still say I had a great experience. You were alone in your own space with no physical presence of other students to distract you. I also learned how to be responsible for my learning."*

Similarly, 3SA added:

> *"I had just gotten into university from high school. I used to have the teacher in front of me, and suddenly, teaching was online without any training. Things changed drastically; I was not ready for such a responsibility."*

Furthermore, 3SH expressed dissatisfaction with the learning environment as they noted:

> “*Another challenge I experienced was that the home environment was not conducive to online learning- everyone was curious to know what was happening and ask questions. At the same time, you were supposed to listen to the lecturer.”*

Additionally, 4SE backed 3SH: “*Another challenge I experienced is that sometimes during classes, some of the students are in noisy places, and their background noise was very disturbing.”*

d) Academic misconduct

Some student participants expressed disappointment in themselves as they resorted to cheating and plagiarism due to easy access to notes and the internet during assessments, as well as their phones, and they could call their classmates and write individual assessments in a group. Student 4SB asserted:

> *“Another challenge for me was cheating and plagiarism when writing tests and quizzes since we always had access to our notes, and we could also collaborate to write our assessments in a group. I am not proud of myself for doing that because I breached the code of conduct for UNAM students.”*

e) Inconvenience and time

Three of the eighteen student participants noted that learning Mathematics Education online was inconvenient for them as they couldn’t grasp the content, and lesson time was shorter. Student 4SA stated:

> “*Online learning was such an inconvenience; I couldn’t grasp the content, and the lecturer was no longer in the office where I could go for help to understand.*

Another issue was that the lesson time was shorter because the lecturer had to give time for students to join the class."

4.1.4 Recommendations for improving the learning and teaching of Mathematics Education online

Theme 1: Recommendations for improving the learning and teaching of Mathematics Education online

Under this theme, students and lecturers were asked for suggestions to improve online Mathematics Education learning and teaching based on their experiences. The responses sought to answer Research Question Two, which aimed to provide recommendations for improving the learning and teaching of Mathematics Education online. The responses from this theme were divided into three subthemes as discussed below.

a) Enhance resource availability

Lecturer participant LA suggested that UNAM should provide reliable internet access to staff because they had to use their personal internet. They stated:

> *"UNAM should provide reliable internet because I had to use my internet, which is unacceptable."*

Twelve of the eighteen student participants added that UNAM should provide access to updated devices and increase monthly data allowances for students. For example, 4SA noted:

> *"I suggest that UNAM provide unlimited data bundles for students and help students acquire proper devices."*

Furthermore, 4SF suggested that: "*lecturers should record all their lessons and share the link with the students so that the students who miss classes can catch up"*.

Moreover, 4SE suggested:

> *"UNAM provide computer labs that students without computers or smartphones can use to attend their classes."*

b) Foster engagement, collaboration and support

Two of the eighteen student participants suggested that lecturers should make use of breakout rooms for students' collaborations and that lecturers should also take attendance before teaching, as 4SA expressed:

> *"Lecturers should make use of breakout rooms for students' collaborations so that struggling students receive help immediately, and lecturers should also recognise each student before they start teaching."*

Likewise, LB added:

> "*Lecturers should also give many activities or assessments to the students so that they don't get affected negatively e.g. not qualifying for exams if they missed some activities."*

LB further indicated that UNAM should offer training on digital tools such as Moodle, Canvas, Google Classroom, and online teaching and learning techniques to both lecturers and students alike.

> *"Intensive training on Moodle, Canvas, Google Classrooms and so on should be conducted for both students and lecturers."*

Lastly, participants suggested that both lecturers and students need motivation and regular mental health check-ups.

"Both lecturers and students were going through a lot with online teaching and learning; motivation as well as psychological assistance is needed now and then."

c) Professional development for lecturers and training on digital tools for students

Participant 3SB recommended the inclusion of basic technological device knowledge as a compulsory subject so that students are well prepared for online learning when they go to university.

"High schools should introduce compulsory basic computer or smartphone knowledge as a subject so that students don't struggle with operating computers and smartphones for learning online purposes when they get to universities."

Participant 4SE supported 3SB by suggesting that:

"UNAM should invest in training students and lecturers on learning and teaching Mathematics online; lecturers need to know the right platforms that will allow them to write during the lesson when explaining."

Further, LA also added that:

"*UNAM should empower the IT department to work on the LMS so that it solves problems when we can't access the system."*

Contrarily, two of the eighteen student participants expressed that they did not recommend online learning and teaching of Mathematics, citing numerous challenges and the subject's practical nature. For instance 4SA expressed:

"I do not recommend online learning and teaching of undergraduate Mathematics because the challenges were many, and also Mathematics as a

subject requires practical teaching, in my opinion, a lecturer writing as they explain, not just explaining as we experienced it."

4.2.3 Linkage of the conceptual framework to the findings

This subsection presents the findings in Table 4.3, Subheading 4.1, using the constructs of TAM and UTAUT. First, the statements are grouped into relevant constructs (PEOU/EE, PU/PE, and FC) in Table 4.4 and Table 4.5, respectively. Subsequently, the agreement and disagreement responses are compared.

a) Lecturers' experiences of learning Mathematics Education online based on TAM and UTAUT constructs

Table 4.4: Lecturers' Experiences of Teaching Mathematics Education Online Based on TAM and UTAUT

Construct	Statement					
		A	**SA**	**D**	**SD**	**N**
PEOU/EE	The assessments I give are fair and clear.	1	1	**0**	**0**	**0**
	I have the skills to deliver online classes.	**0**	1	**0**	**0**	1
PU/PE	I use a wider range of resources in online teaching than in face-to-face classes.	**0**	**0**	1	1	**0**
	Many mathematical problems cannot be solved through online learning.	**0**	1	**0**	1	**0**
FC	My smartphone/ laptop/desktop PC is good enough to use for online learning.	1	**0**	**0**	**0**	1
	The environment in my house is suitable for online learning.	**0**	1	1	**0**	**0**
	I have reliable access to the internet for my school needs.	**0**	1	**0**	**0**	1
	The course materials are well-developed for learning Mathematics Education online at my university.	**0**	1	**0**	1	**0**

i) PEOU/EE and lecturers' experiences of teaching Mathematics Education online

In this study, there were more agreements on PEOU statements than disagreements. These disagreements highlight challenges such as limited digital literacy, difficulty accessing or operating the platforms, and struggles with engaging with complex mathematical content, including symbols, equations, and graphs, in a digital format. This reveals that lecturers found it easy to incorporate and use online tools into their teaching workflow.

ii) PU/PE and lecturers' experiences of teaching Mathematics Education online

Analysis of the Likert-scale responses to perceived usefulness (PU) statements, as presented in Table 3, revealed that more lecturers disagreed than agreed with the idea that online tools enhance their effectiveness in teaching Mathematics Education. This pattern reflects a general scepticism toward the instructional value of digital technologies. While previous studies (e.g., Baturay & Yukselturk, 2015; Reju & Jita, 2018) report a mix of positive and negative perceptions regarding the usefulness of online tools in Mathematics Education, the disagreement observed in this context appears more pronounced, possibly due to challenges related to training, infrastructure, or local teaching practices.

iii) FC and lecturers' experiences of teaching Mathematics Education online

A higher level of agreement than disagreement was observed in response to the facilitating conditions (FC) statements, thus suggesting that lecturers perceive having adequate institutional support, such as access to professional development, reliable technical assistance, and appropriate digital tools, for teaching Mathematics Education as important. The recommendation for UNAM to provide reliable internet access contrasts with a lecturer's experience, who expressed frustration at having to rely on personal Wi-Fi, calling it unacceptable. There is also a need for capacity building among the lecturers.

b) Students' experiences of learning Mathematics Education online based on TAM and UTAUT constructs

Table 4.5: Students' Experiences of Learning Mathematics Education Online Based on TAM and UTAUT

Construct	Statement	A	SA	D	SD	N
PEOU/EE	Assessments given by lecturers are fair and clear.	2	2	9	0	5
	Lecturers have the skills to deliver online classes.	0	0	8	0	10
PU/EE	Lecturers use a wider range of resources in online teaching than in face-to-face classes.	0	0	6	12	0
	Many mathematical problems cannot be solved through online learning.	8	10	0	0	0
FC	My smartphone/ laptop/desktop PC is good enough to use for online learning.	5	0	6	2	5
	The environment in my house is suitable for online learning.	4	0	8	1	5
	I have reliable access to the internet for my school needs.	1	2	6	2	7
	The course materials are well-developed for learning Mathematics Education online at my university.	2	0	6	0	10

i) PEOU/EE and students' experiences of learning Mathematics Education online

More students disagreed with the PEOU statements than agreed, thereby highlighting the challenges many face in navigating and using online learning platforms for Mathematics. These difficulties suggest that digital tools are not always intuitive or accessible, particularly when applied to complex mathematical content.

ii) PU/PE and students' experiences of teaching Mathematics Education online

An equal number of students agreed and disagreed with the Perceived Usefulness (PU) statements, indicating divided opinions. While some students believed that online learning tools and platforms can enhance their Mathematics Education learning outcomes, others were sceptical about their effectiveness. This contrast suggests that perceptions of usefulness may depend on individual learning experiences, preferences, or access to supportive learning environments.

iii) FC and students' experiences of teaching Mathematics Education online

There were more disagreements than agreements on the FC statements, indicating that many students lacked the necessary resources and support for successful online mathematics learning. Common challenges included unreliable internet connections, inadequate access to appropriate digital devices, and limited technical support.

These findings, together with the earlier observations on PEOU and PU, suggest that FC plays a crucial role in shaping users' perceptions of the usability and value of online learning technologies. This interpretation is consistent with the work of Sanchéz and

Hueros (2010), who found that technical support has a positive influence on PEOU, and with Ngai et al. (2007), who demonstrated that FC also impacts PU.

Lecturer responses in this research indicated greater access to infrastructure, technical support, and training, which contributed to their perception that online tools were easier to use. This highlights the significance of FC in strengthening both PEOU and effort expectancy (EE), which in turn shape PU, performance expectancy (PE), user attitudes, and system usage. In contrast, students reported limited access to these support systems, which negatively influenced their perceptions of ease of use and reduced their willingness to adopt online tools for learning.

Interestingly, while lecturers reported better facilitating conditions, some still perceived technology as less applicable for teaching purposes; meanwhile, students with poorer FC demonstrated mixed views, some found technology helpful, while others did not. This this nuanced relationship between FC and PU challenges the assumptions of the original TAM (Davis, 1996; Venkatesh & Davis, 1996), which proposes a strong positive correlation between PU and system usage.

These findings align with Saleem et al. (2016), who emphasised the interplay of PE, EE, FC, and BI in technology adoption, and with Chang (2012), who confirmed that all four constructs of UTAUT contribute to BI, with PE being the strongest predictor. Using the Unified Theory of Acceptance and Use of Technology (UTAUT) as a conceptual framework, this research examined the determinants of continued use of online learning and teaching following the COVID-19 pandemic. Results show that technology acceptance among both lecturers and students is influenced by five key constructs: perceived ease of use (PEOU); perceived usefulness (PU); perceived effort (PE); external efficacy (EE), and facilitating conditions (FC). These findings are consistent with the research of Alshabeb et al. (2020) in the Saudi Arabian education context, which found that FC, PE, and EE have a positive impact on users' intentions to adopt educational technologies.

4.2 Discussions of results

This section presents the results previously discussed and interpreted in Section 4.1, linking the findings to the conceptual framework and literature review. This section is made up of two subsections. Subsection 4.2.1 discusses the results previously presented in Section 4.1, and Subsection 4.2.2 discuss the conceptual framework concerning the empirical data on student and lecturer experiences with technology, outlined in Section 4.1.

4.2.1 Students' and lecturers' experiences in terms of resources

a) Technological tools

As presented in chapter 4 (4.1.3), theme 1, this study found that most students and one lecturer experienced a lack of technological tools and slow technological devices. Some students had to rely on family members' devices, share devices with classmates, or rely on computers at community libraries. Such findings align with previous study results by Kawalilak et al. (2012), which indicated that technological tools and the availability of internet connectivity are some of the factors contributing to students' negative experiences of online learning since they could not access the LMS. Another study by Reju and Jita (2018) also revealed that not all students had access to a PC at home, making them reliant on shared computers at community learning centres. In contrast to the majority, a few (three out of eighteen) students and one lecturer did not experience any technological problems, and this finding is unique to this study as previous studies (e.g. Kawalilak et al.,2012; Reju & Jita,2018) all reported that students experienced challenges with technological tools.

b) Internet access

The current study found that many students and one lecturer experienced internet connection issues, which led to slow-loading pages for some participants. These findings are in agreement with those of (Borges & Costa, 2022; Kawalilak et al.,2012; Mbongo et al., 2021) who, likewise, reported that both students and lecturers experienced a lack of stable internet connection. Several student participants in this study reported that the monthly data bundles provided by UNAM were insufficient to sustain their online learning activities throughout the month. As a result, they had to purchase additional data, when financially possible, to stay connected and continue their academic work. At the same time, some had to hotspot with their parents' devices. These findings are unique to this study because previous studies (e.g., Borges & Costa, 2022; Kawalilak et al., 2012; Mbongo et al., 2021) did not report on students receiving data from their institutions or hotspotting with their parents' devices. In this study, one lecturer and one student reported that they did not experience any issues related to internet access during online mathematics teaching and learning. Their experiences contrast with those of the majority of participants, who faced frequent connectivity challenges.

c) Learning Management System (LMS)

In this study, one of the lecturers experienced challenges with Moodle, UNAM's LMS of choice, which was sometimes inaccessible. These findings highlight ongoing infrastructure and accessibility issues that continue to affect online teaching. While similar problems were noted more than a decade ago by Kawalilak et al. (2012), who reported that students lacked the technological tools and internet connectivity required to access the LMS, this study shows that such challenges persist despite advancements in digital education. More recent studies (e.g., Rafig et al., 2024) similarly confirm that access and infrastructure remain barriers in many educational contexts.

Theme 3: Students and lecturers' experiences in terms of challenges

This study also found that, other than resources, participants experienced other challenges. The challenges include:

a) Giving up and emotional distress

This study revealed that some students and a lecturer gave up on online learning and teaching because of the many challenges they experienced, which hindered learning and teaching. Other participants also lost interest in learning online. The findings are unique to this study as previous studies (e.g. Mbongo et al., 2021; Kaisara & Bwalya, 2020; Hako et al., 2021) did not report students and lecturers giving up on learning and teaching Mathematics Education online. This study also revealed that one lecturer experienced emotional distress as learning and teaching Mathematics Education online happened during the COVID-19 pandemic. The lecturer contracted the virus and faced an increased workload, which led to significant stress, and was unable to finish the course content. The findings partly agree with Radmer and Goodchild's (2021) study, which revealed that students missed social interactions and face-to-face contact with lecturers, leading to anxiety.

b) Support

This study found that student participants experienced a lack of support from the lecturers as they could not reach them for further explanations. This finding aligns with Yeung and Yau's (2021) study which also revealed that students were unable to interact with their lecturers to receive immediate feedback. To facilitate learning, students depended on emails as a means of interaction with lecturers even though they did not seem to favour this method. These responses, in a way, confirm how student-to-lecturer interactions and lecturers' feedback are crucial components of online learning (King, 2014).

c) Responsibility and learning environment

The current study found that a few students expressed having had a great experience learning online as they noted that it taught them self-responsibility in relation to their studies. Additionally, some student participants had not had ample opportunity to adjust to university life as they had just completed high school, and the transition to online learning occurred quickly. These findings are unique to this study. Furthermore, this study also found that some students experienced an unconducive home environment during classes as their family members were present and curious to know what was happening during lessons. These findings align with Borges and Costa's (2022) study, which reported that students faced a lack of appropriate conditions at home while learning Mathematics Education online.

c) Academic misconduct

This study also found that some student participants were academically dishonest during online assessments as they shared assignment answers, which constitutes plagiarism. These findings are consistent with Yeung and Yau's (2021) study, which found that students had a high likelihood of committing plagiarism or cheating, as online tests were administered, and students had access to resources.

e) Inconvenience and time

This study found that some students found online learning inconvenient because they did not understand course content which was taught online, and the teaching time per period was shorter due to the technicalities associated with online learning and teaching. These findings are unique to this study, as previous studies (e.g., Yeung & Yau, 2021) on online learning and teaching experiences have only reported that students were troubled mainly by assignment deadlines, citing unclear instructions.

4.2.2 Recommendations for improving the learning and teaching of Mathematics Education online

Theme 4: Recommendations for improving the learning and teaching of Mathematics Education online

Participants recommended the following strategies to mitigate the challenges inherent to learning and teaching Mathematics Education online.

a) Enhance resource availability

During the interviews, several lecturers and students recommended that UNAM should improve internet reliability for both staff and students to enhance online teaching and learning. This suggestion emerged from their experiences with frequent connectivity disruptions that negatively affected live sessions, timely access to resources, and communication. These participant-driven recommendations align with Bwalya and Kaisara's (2020) findings which emphasised the importance of institutional support and improved technological infrastructure for effective online instruction. Equally, participants recommended that UNAM should purchase updated devices for both students and lecturers, as well as increase the monthly data bundles. These findings are unique to this study, likely influenced by the unprecedented impact of the COVID-19 pandemic, which highlighted the critical importance of access to digital devices for both students and lecturers. Previous studies (Amoah et al., 2022; Hako et al., 2021), conducted before or during the early stages of the pandemic, did not emphasise or recommend that higher education institutions take active steps to provide such devices, possibly because the urgency and scale of remote learning had not yet been fully realised. Moreover, students recommended that UNAM should provide a resourced, conducive environment where students with a lack of resources could attend online classes. These findings are also unique to this study.

b) Foster engagement, collaboration, and support

In this study, students suggested that lecturers should foster student-student engagement and collaborations through online breakout rooms. In addition, some lecturers in this study recommended increasing the number of continuous assessments completed during online learning. They explained that providing multiple opportunities for assessment could help accommodate students who miss tasks due to connectivity issues or personal challenges, thereby reducing the risk of disqualification from examinations. These context-specific recommendations are unique to this study and could inform more flexible and inclusive assessment practices for online Mathematics Education in Namibia and similar higher education contexts globally. Further, students and lecturers in this study suggested that UNAM should offer support to both groups by motivating them frequently and ensuring they receive regular mental health check-ups. This finding concurs with results from a similar study conducted by Mbongo et al. (2021) that suggested psychological support should be offered to lecturers to mitigate the feelings of isolation and loneliness during the learning and teaching of Mathematics Education online.

c) Professional development for lecturers and training on digital tools for students

In this study, students and lecturers suggested that UNAM should offer training on Learning Management Systems (LMSs) as well as online learning and teaching strategies to both lecturers and students. This is not a unique finding for this study as Hako et al. (2021) also recommended that higher institutions provide support and formal training on online learning tools to students. A similar study by Gqoli and Kariyana (2023) also recommended that lecturers receive training in technical skills and get empowered with the essential tools and resources to teach Mathematics Education online. Students in the present study also suggested that basic knowledge of technological devices should be a compulsory subject at high school level to build students' digital literacy skills. This is a unique finding for this study, as previous studies on learning and teaching Mathematics Education online focused on students and lecturers, rather than on students' experiences with technology in high school. A lecturer in the present study suggested that UNAM should empower the IT department with the capacity to handle all LMSs. This recommendation aligns with a study by

Hako et al. (2021), which recommended for higher institutions' management to provide support to lecturers. In this study, some student participants went so far as to recommend the discontinuation of online Mathematics Education learning, expressing strong dissatisfaction with their experiences. While previous studies have documented various challenges associated with teaching and learning Mathematics Education online, none of them, based on the literature reviewed, explicitly suggested the complete abolition of online mathematics instruction. This makes the current finding a noteworthy contribution, as it highlights the depth of frustration felt by some students in this context.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The findings of the present study indicate that both students and lecturers experienced a range of outcomes in the context of online Mathematics Education. While positive aspects of learning and teaching Mathematics Education online, such as flexibility, enhanced access to resources, and opportunities for personalised learning were acknowledged, notable challenges also emerged, affecting the overall teaching and learning experience.

The negative experiences of learning and teaching Mathematics Education online include a lack of technological tools; internet connection issues; issues with LMS; insufficient data bundles; psychological challenges; lack of support from lecturers; academic dishonesty, and non-conducive home environments for learning. Through students' and lecturers' responses, it can be deduced that if the negative experiences are not addressed, the learning and teaching of Mathematics Education online will be hindered. This study extended TAM and UTAUT constructs and found that facilitating conditions (FC), in terms of technical support and resources, influences how users perceive the use of technology. This implies that good FC leads users to perceive technology as easy to use, whereas poor FC leads users to perceive technology as not easy to use. The five constructs from TAM and UTAUT, namely: perceived ease of use (PEOU); perceived usefulness (PU); performance expectancy (PE), efforts expectancy (EE), and facilitating conditions (FC), all influence the students' and lecturers' acceptance to continue the practice of learning and teaching Mathematics Education online. To give a clear view of the analysis of students' and lecturers' experiences on the practice of learning and teaching Mathematics Education online, the researcher elaborated the recommendations of the study, aligning them with the two main questions of this study as follows.

Research question 1: What are the experiences of students and lecturers when learning and teaching Mathematics Education online?

The findings of this study show a consensus of negative experiences, among students and lecturers, when learning and teaching Mathematics Education online in terms of resources as well as challenges. Some of the negative experiences include: lack of technological tools; internet connection issues (unreliable internet access); issues with UNAM's chosen learning management system (LMS) known as Moodle, insufficient data bundles; psychological challenges; lack of support from lecturers; academic dishonesty and non-conducive home environments for learning.

On the contrary, some lecturers and students had positive experiences when learning and teaching Mathematics Education online; these include flexibility and convenience, access to resources, personalised learning, and responsibility and accountability for one's learning.

Research question 2: Based on the students' and lecturers' current experiences, what are their recommendations for improving the learning and teaching of Mathematics Education online?

Both student and lecturer participants proposed different strategies to improve online learning and teaching experiences of Mathematics Education.

This study highlights the need to upgrade the UNAM learning management system (LMS) server, and the provision of continuous professional development for lecturers to stay updated on newer technologies. The study further proposes training both students and lecturers on learning and teaching online, recording lessons by lecturers, and providing access to students. Also proposed is the provision of devices and learning space for students who do not own technological devices; offering support and collaboration to students via online breakout rooms; the provision of unlimited data bundles to both students and lecturers, and lastly, the introduction of Digital Literacy as a mandatory subject at high school level.

5.2 Recommendations of the study

To enhance the teaching and learning of Mathematics Education content online, the following actions are recommended based on the study's findings.

- Ensure reliable internet access for both students and lecturers.
- Provide appropriate technological devices to support online learning and teaching.
- Offer structured training to lecturers on effective methods for teaching Mathematics Education online.
- Provide orientation and support for students to develop skills for learning Mathematics Education in an online environment.

5.2.1 Recommendations for UNAM

Based on findings that revealed system overloads on the LMS, limited digital skills among both lecturers and students, and a lack of access to appropriate devices and conducive learning environments, the following recommendations are made for UNAM.

- Upgrade the LMS server to handle simultaneous online teaching across faculties.
- Provide continuous professional development to help lecturers stay abreast of emerging technologies.
- Offer training to both students and lecturers on effective online teaching and learning practices.
- Supply functional technological devices to those without access to technological devices, and create on-campus learning spaces for students with non-conducive home environments.

5.2.2 Recommendations for lecturers

Based on the finding that some students struggled to keep up with content during live sessions, and they expressed the need for peer support and access to recorded materials, the following recommendations are made for lecturers.

- Create online breakout rooms to encourage student collaboration and peer-assisted learning.
- Record lessons to allow students to revisit the material after classes or to catch up on sessions that they missed.

5.2.3 Recommendations for high schools

Based on findings that many students struggled with basic digital skills needed for online Mathematics Education learning, the following is recommended.

- High schools should introduce a compulsory subject focused on digital literacy, specifically covering the academic use of computers and smartphones.

- The subject should equip students with skills relevant to blended and online learning environments at tertiary level, particularly in subjects like Mathematics Education.
- Early exposure to educational technologies can help reduce the learning curve and improve student engagement and performance in university-level online Mathematics Education.

5.2.4 Recommendations for further research

The study focused solely on students' and lecturers' experiences of learning and teaching Mathematics Education online. Therefore, the following recommendations are made for future research.

- Further research is needed to explore similar experiences in other subjects.
- Additional studies should be conducted at different UNAM campuses and other universities in Namibia. Such research would enable comparison of student and lecturer experiences across various institutions and academic disciplines in Namibia.

5.3 Chapter Summary

Chapter Five presented the conclusion of the study's findings, based on the answers to the research questions and the recommendations made for and by various stakeholders to improve the learning and teaching of Mathematics Education online.

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APPENDIX 1: ETHICAL CLEARANCE CERTIFICATE

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: **WKC0027** **Date: 04 July 2023**

This Ethical Clearance Certificate is issued by the University of Namibia Decentralized Ethics Committee (DEC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the **School of Education (Windhoek & Khomasdal Campuses) Decentralized Ethics Committee**.

Title of Project: Analysis of students' and lecturers' experiences of learning and teaching mathematics online.
Researcher: Hilda I Theofilus
Student number: 201201894

Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee.
3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee.
4. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,

ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.

Dr. Job U. Hengari (Chairperson, Windhoek & Khomasdal Campuses Decentralized Ethics Committee)

Prof. Davis Mumbengegwi
(Head, Multidisciplinary Research)

APPENDIX 2: RESEARCH PERMISSION LETTER

CENTRE FOR RESEARCH SERVICES
Office of the Pro-Vice Chancellor: Research, Innovation & Development
University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park, Office F223 - Fblock, Second Floor
☎ +264 61 206 4673; E-mail:kmbulu@unam.na; URL: http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

RESEARCH PERMISSION LETTER

Date: 21/08/2023

Student Name: Hilda Inamumvulwa Theofilus

Student Number: 201201894

Programme: Master of Education (Mathematics Education)

Approved Research Title: Analysis of students' and lecturers' experiences of learning and teaching Mathematics online: A case of the University of Namibia's Khomasdal Campus.

TO WHOM IT MAY CONCERN:

I hereby confirm that the above-mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

Dr. AEE Shikongo
Head: Postgraduate Research Support Services
Tel: +264 61 206 3129
E-mail: aeshikongo@unam.na

CENTRE FOR RESEARCH SERVICES
Office of the Director
2023 -08- 21
University of Namibia
UNAM

APPENDIX 3: LETTER TO THE EXECUTIVE DEAN: FACULTY OF EDUCATION & HUMAN SCIENCES

Hilda Inamumvulwa Theofilus

Cell: 081 417 3512

e-mail: mstheofilus@gmail.com

P.O.Box 22727 ,Windhoek

August 23, 2023

University of Namibia

Faculty of Education and Human Sciences

The Executive Dean

Dear Dr. Mosimane

RE: REQUESTING PERMISSION TO CONDUCT RESEARCH FOR MASTERS PROGRAM

I am Hilda Inamumvulwa Theofilus, student number 201201894, currently a registered Master of Education (Mathematics Education) student, at the University of Namibia. As part of the partial fulfilment of the Masters in education degree, I am required to conduct research. My research title is: **Analysis of students' and lecturers' experiences of learning and teaching Mathematics online: A case of the University of Namibia's Khomasdal Campus**. The findings of this study will contribute to local literature on the subject, as well as help uncover critical areas that are vital in learning and teaching Mathematics online for both students and lecturers in Namibia which in turn could be used by students and lecturers from other universities across the globe.

I am humbly requesting your good office to grant me permission to collect data from, University of Namibia's Khomasdal campus to complete my studies. In this study, I plan to conduct formal interviews with ten percent of the Mathematics lecturers and ten percent of the third- and fourth-year undergraduate students who were first years in 2020-2021 respectively at Khomasdal campus who are studying towards Bachelor of Education in senior primary Education Honours with Mathematics as one of their major subjects.

I am planning to collect data in September 2023, from the 11th to the 22nd of September. I will observe all ethical protocols, including securing informed consent from ten percent of the Mathematics lecturers and ten percent of the third- and fourth-year undergraduate students who were first years in 2020-2021 respectively at Khomasdal campus who are studying towards Bachelor of Education in senior primary Education Honours with Mathematics as one of their major subjects the lecturers and the students who are participants. I have attached the Ethical clearance certificate from the University of Namibia's Research Ethics Committee and the research permission letter from the University of Namibia's Head of postgraduate studies.

Your consideration and support in this regard is highly appreciated.

Yours Sincerely,

Hilda.I.Theofilus

APPENDIX 4: LETTER TO THE ASSOCIATE DEAN: SCHOOL OF EDUCATION

Hilda Inamumvulwa Theofilus

Cell: 081 417 3512

e-mail: mstheofilus@gmail.com

P.O.Box 22727 ,Windhoek

August 23, 2023

University of Namibia

School of Education

The Associate Dean

Dear Dr. Nyambe

RE: REQUESTING PERMISSION TO CONDUCT RESEARCH FOR MASTERS PROGRAM

I am Hilda Inamumvulwa Theofilus, student number 201201894, currently a registered Master of Education (Mathematics Education) student, at the University of Namibia. As part of the partial fulfilment of the Masters in education degree, I am required to conduct research. My research title is: **Analysis of students' and lecturers' experiences of learning and teaching Mathematics online: A case of the University of Namibia's Khomasdal Campus**. The findings of this study will contribute to local literature on the subject, as well as help uncover critical areas that are vital in learning and teaching Mathematics online for both students and lecturers in Namibia which in turn could be used by students and lecturers from other universities across the globe.

I am humbly requesting your good office to grant me permission to collect data from, University of Namibia's Khomasdal campus to complete my studies. In this study, I plan to conduct formal interviews with ten percent of the Mathematics lecturers and ten percent of the third- and fourth-year undergraduate students who were first years in 2020-2021 respectively at Khomasdal campus who are studying towards Bachelor of Education in senior primary Education Honours with Mathematics as one of their major subjects.

I am planning to collect data in September 2023, from the 11th to the 22nd of September. I will observe all ethical protocols, including securing informed consent from ten percent of the Mathematics lecturers and ten percent of the third- and fourth-year undergraduate students who were first years in 2020-2021 respectively at Khomasdal campus who are studying towards Bachelor of Education in senior primary Education Honours with Mathematics as one of their major subjects the lecturers and the students who are participants. I have attached the Ethical clearance certificate from the University of Namibia's Research Ethics Committee and the research permission letter from the University of Namibia's Head of postgraduate studies.

Your consideration and support in this regard is highly appreciated.

Yours Sincerely,

Hilda.I.Theofilus

APPENDIX 5: CONSENT FORM FOR STUDENTS AND LECTURERS

Dear Participant,

Re: INFORMATION LETTER AND CONSENT FORM FOR RESEARCH STUDY TO BE CONDUCTED

Title of Study: *An analysis of Students' and lecturers' Experiences of learning and teaching Mathematics online: A case of the University of Namibia's Khomasdal campus.*

Principal Investigator: Hilda Inamumvulwa Theofilus

University of Namibia

Master of Education

(Mathematics Education)

mstheofilus@gmail.com

081417 3512

Background

You, …………………………………………………., are cordially invited to take part in a research study. Before you decide to participate in this study, it is crucial that you understand the research being conducted and what it will entail. Please take some time to read the following information carefully. For more information, you may contact me on the contact details provided.

Purpose and Benefit

The purpose of my research is to analyse students' and lecturers' experiences of learning and teaching Mathematics Education online: A case of the University of Namibia's Khomasdal Campus. This study will be conducted toward attaining a Master's Degree in Education (Mathematics Education). Furthermore, this study will make appropriate recommendations for learning and teaching Mathematics Education online. Moreover, your active participation in this study will be highly appreciated.

Study Procedure

A Semi-structured interview session of about 15-25 minutes will be organised (depending on the time you may be free).

Risks

There will be no risks or harm in participating in this study. If you find anything upsetting in the study, do not hesitate to bring it to my notice. In case of unforeseeable risks, efforts will be made to minimise such risks.

Confidentiality and anonymity

Confidentiality will be maintained throughout this study since this study will only be used for academic, and professional presentations as well as publication purposes. Data collected by this study will be anonymous using pseudonyms. Your name will not be reported, neither on the data collection instrument, research reports nor in any final publication.

Costs to Subject and Compensation

There are no costs, and no monetary compensation to you for your participation in this study.

Consent

By signing this consent form, I confirm that I have read and understood the information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and at no harm or cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Signature______________________ Date _____________________________

APPENDIX 6: STATEMENT BY THE RESEARCHER

Statement by the Researcher/Person taking Consent

I have accurately read out the information sheet to the potential participant and to the best of my ability made sure that the participant understands that the following will be done:

1. Clearly explain the purpose of this study to the participants
2. Inform the participants that the information should be given voluntarily, and they have the right to withdraw from this study at any time
3. Explain to the participants that the information recorded will be kept confidential, and his/her participation in this study is anonymous
4. Obtain consent from the participants.

I confirm that the participant was allowed to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Hilda. I.Theofilus

Name of Researcher/ …………………… ………………………..

Person taking Consent Signature Date

………………………. ……………………. …….. (day/month/year)

APPENDIX 7: 3RD YEAR STUDENTS' INTERVIEW GUIDE

1. INTRODUCTION

Dear Mathematics student,

Please respond to the interview questions as honestly and completely as possible. May I have your permission to audio record our conversation? The data to be collected will strictly be used to compile the report for my research study.

2. INTERVIEW QUESTIONS

PART 1: CLOSED-ENDED-QUESTIONS

A. BASIC DEMOGRAPHIC INFORMATION: Place an (x) on the answer of your choice.

i) Sex: Male [ ] Female [ ]

ii) Age: Less than 25 [ ] 25- 34 [ ] 35- 44[ ] 45- 54 [ ] 55 & above [ ]

iii) Estimated number of hours I spend per week online exploring the internet for academic purposes: less than 1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 & above [ ]

iv) Estimated number of hours I spend per week online exploring the internet for other (non-academic) purposes: less than 1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 & above [ ]

B. ONLINE LEARNING OF MATHEMATICS EDUCATION AT THE UNDERGRADUATE LEVEL

Select and rank your response by placing an 'x' on the answer of your choice using:

SD – strongly disagree; D – disagree; N – Neutral; A – agree and SA-strongly agree

Statement	**A**	**SD**	**D**	**N**	**SA**
My attendance in online classes is better than in face-to-face classes.					
The flexibility provided by the online classes is better for me than the face-to-face classes.					
My smartphone/ laptop/desktop PC is good enough to use for online learning.					
The environment in my house is suitable for online learning.					
Assessments given by lecturers are fair and clear.					
Lecturers are actively involved in the learning-teaching process.					
Lecturers use a wider range of resources in online teaching than in face-to-face classes.					
Lecturers have the skills to deliver online classes.					
Many mathematical problems cannot be solved through online learning.					
I have reliable access to internet for my school needs.					
The course materials are well-developed for learning Mathematics Education online at my university.					

PART 2: OPEN-ENDED QUESTIONS

1) General knowledge

a) Had you used a computer/ smartphone before joining UNAM?

b) How would you describe your knowledge with smartphone/computer usage?

2) Students' experiences of learning Mathematics Education online.

a) What challenges did you experience in terms of resources (such as smartphone/computer, internet access) required for you to learn Mathematics Education online?

b) How did you address these challenges?

c) How was learning Mathematics Education online for you?

d) How were you assessed?

e) What other challenges did you experience while learning Mathematics Education online?

2) Recommendations

From your own experiences, suggest how online teaching and learning of undergraduate Mathematics Education can be improved.

Are there any other issues that you consider worth mentioning that I haven't asked you about learning Mathematics Education online?

Thank you for your time!

APPENDIX 8: 4TH YEAR STUDENTS' INTERVIEW GUIDE

1. INTRODUCTION

Dear Mathematics Education student,

Please respond to the interview questions as honestly and completely as possible. May I have your permission to audio record our conversation? The data to be collected will strictly be used to compile the report for my research study.

2. INTERVIEW QUESTIONS

PART 1: CLOSED-ENDED-QUESTIONS

A. BASIC DEMOGRAPHIC INFORMATION: Place an (x) on the answer of your choice.

i) Sex: Male [ ] Female [ ]

ii) Age: Less than 25 [ ] 25- 34 [ ] 5- 44[ ] 45- 54 [ ] 55 & above [ ]

iii) Estimated number of hours I spend per week online exploring the internet for academic purposes: less than 1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 & above [ ]

iv) Estimated number of hours I spend per week online exploring the internet for other (non-academic) purposes: less than 1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 & above [ ]

B. ONLINE LEARNING OF MATHEMATICS EDUCATION AT THE UNDERGRADUATE LEVEL

Select and rank your response by placing an ‘x’ on the answer of your choice using:

SD – strongly disagree; D – disagree; N – Neutral; A – agree and SA – strongly agree

Statement	**A**	SD	D	N	SA
My attendance in online classes is better than in face-to-face classes.					
The flexibility provided by the online classes is better for me than the face-to-face classes.					
My smartphone/ laptop/desktop PC is good enough to use for online learning.					
The environment in my house is suitable for online learning.					
Assessments given by lecturers are fair and clear.					
Lecturers are actively involved in the learning-teaching process.					
Lecturers use a wider range of resources in online teaching than in face-to-face classes.					
Lecturers have the skills to deliver online classes.					
Many mathematical problems cannot be solved through online learning.					
I have reliable access to internet for my school needs.					
The course materials are well-developed for learning Mathematics Education online at my university.					

PART 2: OPEN-ENDED QUESTIONS

1) **General knowledge**

   a) How would you describe your knowledge with smartphone/computer usage?

2) **Students' experiences of learning Mathematics Education online**.

a) What challenges did you experience in terms of resources (such as smartphone/computer, internet access) required for you to learn Mathematics Education online? How did you address these challenges?
b) How was learning Mathematics online for you?
c) How were you assessed?
d) What other challenges did you experience while learning Mathematics Education online?

3) **Recommendations**

   a) From your own experiences, suggest how online teaching and learning of undergraduate Mathematics Education can be improved.
   b) Are there any other issues that you consider worth mentioning that I haven't asked you about learning Mathematics Education online?

Thank you for your time!

APPENDIX 9: LECTURERS' INTERVIEW GUIDE

1. INTRODUCTION

Dear Mathematics Education lecturer,

Please respond to the interview questions as honestly and completely as possible. May I have your permission to audio record our conversation? The data to be collected will strictly be used to compile the report for my research study. Your name will not be revealed throughout the interview process.

2. INTERVIEW QUESTIONS

PART 1: CLOSED-ENDED-QUESTIONS

A. BASIC DEMOGRAPHIC INFORMATION: Place an (x) on the answer of your choice.

i) Sex: Male [ ] Female [ ]

ii) Age: Less than 25 [ ] 25- 34 [ ] 35- 44[ ] 45- 54 [ ] 55 & above [ ]

iii) Years of teaching experience: 1-2 [ ] 2-3 [ ] 3-4 [ ] 4-5 [ ] 5 & above [ ]

iv) Estimated number of hours I spend per week online exploring the internet for academic purposes: less than 1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 & above [ ]

v) Estimated number of hours I spend per week online exploring the internet for other (non-academic) purposes: less than 1 [ ] 1 – 5 [ ] 6 – 10 [ ] 11 & above [ ]

B. ONLINE TEACHING OF MATHEMATICS EDUCATION AT UNDERGRADUATE LEVEL

Select and rank your response by placing an ‘x’ on the answer of your choice using:

SD – strongly disagree; D – disagree; N – Neutral; A – agree and SA – strongly agree

Statement	**A**	SD	D	N	SA
The students’ attendance in online classes is better than face-to-face classes.					
The flexibility provided by the online classes is better for me than the face-to-face classes.					
My smartphone/ laptop/desktop PC is good enough to use for online teaching.					
The environment in my house/office is suitable for online teaching.					
The assessments I give the students are fair and clear.					
Students are actively involved in the learning process.					
I use a wide range of resources in online teaching than in face-to-face classes.					
I have the skills to deliver online classes.					
Many mathematical problems cannot be solved through online learning.					
I have reliable access to the internet.					
The course materials I use are well developed for teaching of Mathematics Education online.					

PART 2: OPEN-ENDED QUESTIONS

1) **Lecturers' experiences of teaching Mathematics Education online**.

a) What challenges did you experience in terms of resources (such as smartphone/computer, internet access) required for you to teach Mathematics Education online?
b) How did you address these challenges?
c) How was teaching Mathematics Education online for you?
d) How did you assess your students?
e) What other challenges did you experience while teaching Mathematics Education online?

2) **Recommendations**

a) From your own experiences, suggest how online teaching and learning of undergraduate Mathematics Education can be improved.
b) Are there any other issues you consider worth mentioning that I haven't asked you about learning Mathematics Education online?

Thank you for your time!

APPENDIX 10: LANGUAGE CERTIFICATE

30 June 2025

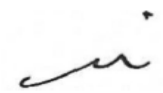
Editing Certificate

RE: Master's Thesis Language Editing – Hilda Inamumvulwa Theofilus

This letter serves to certify that the Master's thesis titled, **An analysis of students' and lecturers' experiences of learning and teaching Mathematics Education online: A case of the University Of Namibia, Khomasdal Campus** by **Hilda Inamumvulwa Theofilus** was submitted to me for language editing.

The thesis was professionally language edited, and track changes and suggestions were made. Changes and suggestions made relate to aspects of language use including: grammar, spelling, punctuation, sentence structure, diction, coherence and cohesion. The research content and the author's intentions were not altered during the editing process, and the author(s) has/have the authority to accept or reject my suggestions.

Issued by:



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