

**STUDENT USER EXPERIENCE OF A MOBILE LEARNING
APPLICATION AT AN ODEL INSTITUTION
IN THE GAUTENG PROVINCE**

by

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DECLARATION

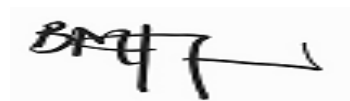
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Student user experience of a mobile learning application at an ODeL institution in the Gauteng Province

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements of originality.

I further declare that I have not previously submitted this work or part of it for examination at Unisa for another qualification or at any other higher education institution.



SIGNATURE

19 October 2022

DATE

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ABSTRACT

The advancements in technology and the adoption of online inventions have offered numerous opportunities for Open Distance eLearning (ODeL) institutions to conduct learning through mobile devices. ODeL institutions provide students with timeless learning through mobile learning applications (MLAs) without having to consider geographic boundaries. The provision of MLAs is meant to improve the overall learning experience of students. Therefore, it is important to find out if the user experience of students as primary users of the MLAs has been improved.

This study investigated the factors that influence the user experience of students when interacting with a mobile learning application at a higher education institution. The study proposed a framework of factors that influence the user experience of students when using an MLA. The framework can serve as a guideline to provide insight concerning the perceptions, challenges and experiences encountered when using the MLA. The framework can also serve as a guideline when developing MLAs.

The factors influencing the user experience of students when interacting with a mobile learning application were identified by conducting a literature review that resulted in the construction of a conceptual framework. The conceptual framework contributed to the formulation of the open-ended interview questions of this study. The qualitative data of the study was collected from University of South Africa students in the Gauteng province. Thematic analysis and the Atlas.ti software were used to analyse the qualitative data. The results of the analysed data indicated that the factors of user experience that were identified do influence the user experience of students when using the MLA. The proposed framework was presented as a contribution of this study.

KEYWORDS

User experience, Mobile Learning Applications, Higher education institution, Open Distance e-Learning.

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LIST OF ABBREVIATIONS AND ACRONYMS

The following abbreviations and acronyms are used throughout the study:

Abbreviation/ Acronym	Description
ODeL	Open Distance eLearning
ICT	Information and Communication Technology
HCI	Human-Computer Interaction
RPSC	Unisa Research Permission Subcommittee
ERC	Ethics Review Committee
UNESCO	United Nations Educational, Scientific and Cultural Organization
CSET	College of Science Engineering and Technology
SoC	School of Computing
Unisa	University of South Africa
App	Application
HEI	Higher Education Institution
MLA	Mobile Learning Application
UX	User experience
UXFMLASO	The user experience of mobile learning applications by students at an ODeL institution in the Gauteng Province framework

KEY TERMS

Keyword	Description
Student	A student is an individual who is enrolled at a university, college or higher education institution (HEI) to acquire knowledge on a specific field of study.
Lecturer	A lecturer is a professional individual who offers lectures to students at a university, college or higher education institution (HEI).
Higher education institution (HEI)	An HEI is an institution such as university or college that offers and delivers advance education to students.
Application (App)	An application refers to a software programme that is designed and installed on a computer or mobile device to conduct a certain task.
Mobile learning application (MLA)	An MLA is an application that is installed on a mobile device for the accessibility and use of learning content.
Human-computer interaction (HCI)	Human-computer interaction defines the design and interaction between humans and computers.
Open distance and e-learning (ODEL)	Open distance e-learning refers to the teaching and learning offered to students who have to fulfil multiple roles and are affected by the limitations of distance, cost and time, and offers them the opportunity to pursue their studies online.
Factors	The term factor refers to a fact, circumstance or influence that contributes to a certain result.
User experience (UX)	User experience refers to the individual's opinions and feelings after an interaction or expected interaction with a system, service or product.
Usability	Usability refers to the degree to which a certain individual can use a system, product, or service in a certain context to accomplish certain objectives through efficiency, effectiveness and satisfaction (ISO, 2019).
User-centred design (UCD)	User-centred design refers to organised processes that are focused on prioritising users as centres of system design and development.

CHAPTER 1:

SCOPE OF THIS RESEARCH STUDY

1.1 INTRODUCTION

Mobile phones have become smart, portable computers supporting a variety of services that have allowed the availability of information without geographical boundaries (Tiwary, 2021). High mobile phone penetration has led to the high demand for and the usage of content and services offered on mobile phones in business and social life (Sophonhiranrak, 2021), in learning (Meletiou-Mavrotheris, Mavrou & Rebelo, 2021), and in emergent circumstances such as during the Covid-19 pandemic (Almaiah, Al-lozi, Al-Khasawneh, Shishakly & Nachouki, 2021).

Mobile phones have resulted in significant changes to information search and consumption methods through various means (Amir, Marko & Teemu, 2022). Mobile phones also have the capability of running third party applications called mobile phone applications. Wotto (2020) stated that mobile phone applications include a wide range of academic applications (mobile learning applications or MLAs) that support the learning needs of students. The scholars, Kaur, Kalid and Savita (2021) added that MLAs provide an easy learning experience. McNulty (2021) defined an MLA as an application that is used in learning that takes place through the use of mobile devices such as tablets and smart phones.

Tiwary (2021) indicated that MLAs can enrich the student's academic experiences by providing inclusive access to information and an enhanced method of information delivery anywhere and anytime. Uthman and Aldraiweesh (2022) stated that MLAs have enabled online learning, the sharing of information and collaboration between students. Swain (2020) added that higher learning institution (HEIs) in developed and developing countries have adopted MLAs to improve the user experience (UX) of students. Criollo-C, Guerrero-Arias, Jaramillo-Alcázar and Luján-Mora (2021) stated that it is crucial to investigate the UX when students are interacting with MLAs. An improved UX of MLAs can encourage usage by students (Ali, 2018), and can enhance the academic performance of students (McNulty, 2021). Thus, this research investigated the UX of myUnisa, a mobile learning application at an Open Distance eLearning (ODEL) institution, the University of South Africa (Unisa) in the Gauteng

province of South Africa (SA). The framework that was proposed by this study makes recommendations regarding the development of MLAs at HEIs.

This chapter discusses the background, the purpose, the research problem, research questions, as well as the objectives of the current study. The design and methodology that applied to the current study are also outlined. Lastly, this chapter provides the structure of the dissertation and a summary of this chapter.

1.2 BACKGROUND

The increasing use of MLAs has changed the typical approaches to teaching and learning. As such, MLAs have become progressively more common, and consequently, have received growing attention from lecturers and researchers (Hamidi & Jahanshaheefard, 2019). Several researchers believe that MLAs enable an advanced and interactive teaching and learning process for lecturers and students (Kaur *et al.*, 2021). Research that was conducted in the United States of America (USA) among students at HEIs in relation to the use of MLAs showed that a significant number of students used MLAs (Reese, 2013). A study by McCain (2019) that explored the benefits of using MLAs, reported that MLAs make it easier to access information and improve communication amongst students, lecturers and HEIs Kankam (2020) added that students and lecturers can create study groups, communicate and share knowledge amongst themselves, while the HEI can keep students and potential students informed about activities that are taking place at the institution. The UX of this advancement in technology can only be decided by the relevant students regarding whether to accept or reject the service. Hence, the concept of UX plays a major role in MLAs (Kaur *et al.*, 2021).

In developing countries, MLAs provide basic resources such as digital access to educational materials and information to students (Briggs, 2014). However, Al-Adwan, Madadha and Zvirzdinaite (2018) indicated that developing countries are facing several challenges, hence, the sluggish pace in the adoption of MLAs. Despite the concerns raised by Al-Adwan *et al.* (2018) regarding the sluggish pace of the provision of MLAs in developing countries, Africa has shown rapid increases in the development of MLAs as more people gain access to mobile devices (Kankam, 2020; McNulty, 2021).

Criollo-C *et al.* (2021) reported that although there are advantages to the use of MLAs, there are also challenges. Edumadze, Dithokwa and Demuyakor (2022) indicated that UX factors are the challenges that hinder the effective use of MLAs. Sophonhiranrak (2021) highlighted that the factors of UX are due to unsatisfactory student UX. Mohammadi, Mohibbi and Hedayati (2021) accentuated that the success of MLAs depends on understanding the UX factors influencing the use of MLAs.

South Africa is one of the major Information and Communication Technology (ICT) markets on the African continent (International Trade Administration, 2021). Beyer (2020) stated that MLA initiatives are a vital requirement for HEIs in SA. To that end, South African HEIs have adopted the use of MLAs to improve student learning experiences and academic performance (Beyer, 2020). Over the past decade, there have been many governmental and non-governmental initiatives that were aimed at improving student performance by continuously investing in modern technology to ensure that SA reaches the global educational standards (Patel, 2018; International Trade Administration, 2021).

The Gauteng Department of Education has widely introduced mobile technologies in education (Patel, 2018). In 2015, the executive council member for education in Gauteng reported the process of transforming to digital learning to improve learning (City of Joburg, 2015). Unforeseen occurrences, such as the Covid-19 pandemic, also forced learning institutions to digitalise learning to minimise learning interruptions and the spread of Covid-19 (Meletiou-Mavrotheris *et al.*, 2021). The University of South Africa (Unisa) migrated to digital learning with the provision of myUnisa (a mobile learning application) platform. myUnisa is an academic student portal that provides access to information, services, and resources to students and staff at Unisa (Unisa, 2022).

The innovation of MLAs has had both successes and failures (Evans, 2021). Research shows that enhancing the UX is a priority and critical for the future success of MLAs (Leteney, 2021). Furthermore, Evans (2021) indicated that investing in quality MLAs may improve the UX of students, which may encourage learning. Thus, the current study investigated the UX of students using an MLA at an HEI in the Gauteng province of SA.

According to Norman and Nielsen (2022), UX includes every characteristic of the user's interaction with the service, system or product. Hassenzahl (2018) expanded on this by describing UX as a momentary, positive or negative feeling that users get when using an interactive system, which describes how users feel, how enjoyable and satisfactory the system is, and comprises of every aspect of the system's desirability and usability. UX satisfaction improves the chances of users embracing the system or product (Andreas, Francisco, Jörg & María, 2022). The user, system and context were adopted as factors of UX that influence student satisfaction when using MLAs (Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021). Hassenzahl and Tractinsky (2006); Berni and Yuri (2021) stated that users have characteristics such as needs, motivation, perceptions, expectations, and past experiences that all play a role. For the purpose of the current study, the user is the student, the system is the MLA, and the context is the HEI.

1.3 PURPOSE OF THE STUDY

The purpose of this study was to explore how UX factors influence student satisfaction when using an MLA. The study focused on students as users of an MLA. Subsequently, the UX factors were determined before a proposed framework was formulated to support Unisa in ensuring that the student UX is positive and contributes to the overall enhancement of the learning experience. The resulting framework could also assist other HEIs to acknowledge the UX factors that influence student satisfaction when interacting with MLAs.

1.4 PROBLEM STATEMENT

While some studies have indicated that several HEIs have implemented MLAs as a learning platform, the student UX of MLAs still leaves much to be desired (Mohammadi *et al.* 2021), which is the problem statement of this study. According to Sophonhiranrak (2021), there are UX factors that influence student satisfaction with MLAs. Mohammadi *et al.* (2021) stated that the successful implementation and use of MLAs is highly associated with a comprehensive understanding of factors and challenges that influence the encounter with the MLAs amongst users. Hall and Batty (2020) accentuated that these factors tend to demotivate students. Criollo-C *et al.* (2021) added that the factors hinder students in the effective usage of MLAs, and there is a

need to address them to implement high quality MLAs. Criollo-C *et al.* (2021) further recommended that, to address these UX factors, it is essential that these factors be investigated and explored to develop and implement high quality MLAs. Nick (2023) suggested that ongoing investigations into UX are necessary, as the user expectations and requirements of MLAs continuously evolve.

Improving the quality of student UX of MLAs at HEIs brings about efficient and effective services, which not only improve productivity and user satisfaction (Swain, 2020), but positively impact the institution as a brand, deliver satisfactory service to students, and encourage the continuous use of the MLA (Ali, 2018). MLAs help deliver quality service and timeless learning experiences to students (Ssemugabi, 2019). Swain (2020) added that UX aims to provide positive experiences to students that retain their loyalty to the MLA. McCain (2019) agreed that positive UX can retain and attract students. Moreover, UX influences decision-making (Hall & Batty, 2020).

Hence, this study investigated the UX of students when interacting with the MLA offered at the University of South Africa, an HEI in the Gauteng province of SA, to attempt to solve the problem outlined in this study. Data was collected from students to gain insight into the UX of students with the MLA at the HEI.

1.5 RESEARCH QUESTIONS

The main research question of the study was formulated as follows:

What are user experiences (UX) of students when using mobile learning applications?

To answer the main research question, the following sub-research questions (SRQs) were set:

- SRQ1: Which user experience factors affect students when using mobile learning applications?
- SRQ2: How are students affected by the user experience variables when using a learning app?
- SRQ3: Which system characteristics of a mobile learning application are desired by students?
- SRQ4: How are students affected by mobile context variables when using a learning app?

- SRQ5: How can a conceptual framework be used to theorise about student user experience of mobile learning applications at a higher education institution?

1.6 RESEARCH OBJECTIVES

As previously stated, the aim of the current study was to investigate the user experience of students when using a mobile learning application.

The following objectives were formulated for the current study:

- To identify the user variables affecting student user experience of myUnisa.
- To determine the system characteristics desired for a mobile learning application.
- To discover the context variables affecting student user experience when using myUnisa.
- To propose a framework as part of theory building for a better understanding of student user experience of mobile learning applications at a higher education institution.

1.7 RESEARCH DESIGN AND METHODOLOGY

This study adopted the interpretivist research philosophy and employed an inductive reasoning approach to generate new theory which was implemented and executed in a qualitative research methodology. The study adopted purposeful sampling, and collected data from Unisa students in the Gauteng province through semi-structured interviews and open-ended questioning. Data was collected to investigate the phenomenon and to build a theory in the form of a proposed framework. This study used the six-step thematic analysis process and Atlas.ti software to analyse the qualitative data. The different phases of the research process are presented next.

1.7.1 Research process

A research process is an arrangement of well-defined phases in a research study (Cooper & Schindler, 2014). The current research being reported on in this dissertation was conducted in three phases to collect and interpret the qualitative data. Phase 1 resulted in the conceptual framework that was developed from the literature review. The first phase led to Phase 2 in which the qualitative data was collected, and which

resulted in the proposed framework provided in Phase 3 of the study. The sequential three phases are illustrated in Figure 1.1.

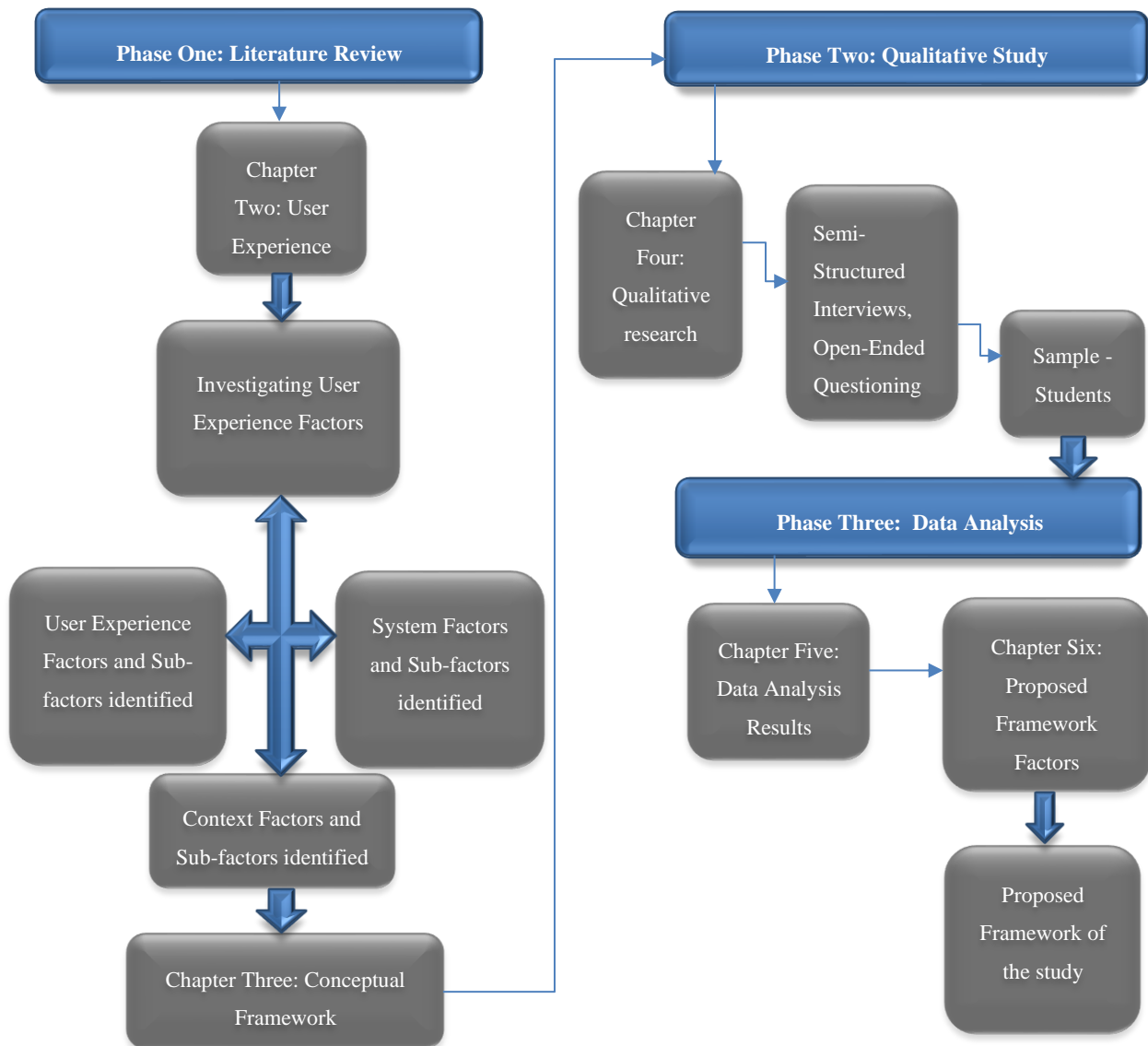


Figure 1.1: Research process of this study

Source: Researcher's own compilation

The phases of the current study are briefly discussed below.

1.7.1.1 Phase 1: Literature review

The literature review in Chapter Two of this study investigated the phenomenon under study by reviewing previous research to contribute to answering the research question and to build proper viewpoints that defend the study. This phase intended to support by answering **SRQ1**: Which user experience factors affect students when using mobile learning applications?

Upon answering SRQ1, the literature review discussed the UX as part of human-computer interaction, and investigated the factors influencing the UX of students while interacting with the MLA. The factors of UX identified in this phase were: the user, the system and context. The identified factors have sub-factors that are applicable to the current study. This phase resulted to the contextualisation of the factors influencing the UX, and presented the conceptual framework of the factors that may influence the UX of the students at HEIs as presented in Chapter Three.

1.7.1.2 Phase 2: Data collection

This phase consisted of semi-structured interviews that used open-ended questioning to collect data, as presented in Appendix D. The interview questions were based on the conceptual framework formulated in Phase 1. The interviews with the targeted students were conducted over a period of two months. The interview schedule consisted of two sections. The first section collected demographic data from the participants, while the second section collected data about the factors that could influence the UX of students while using the MLA. Data was collected to answer the following SRQs:

SRQ2: How are students affected by the user experience variables when using a learning app?

SRQ3: Which system characteristics of a mobile learning application are desired by students?

SRQ4: How are students affected by mobile context variables when using a learning app?

SRQ5: How can a conceptual framework be used to theorise about student user experience of mobile learning applications at a higher education institution?

The data collected from the interviews was used in Phase 3 (data analysis) of the study.

1.7.1.3 Phase 3: Data analysis

In this third phase of the study, thematic analysis was employed to analyse the data using themes and codes. This phase used the data collected from the interview questions constructed in Phase 2. The results of the data analysis were discussed and used to test the proposed framework for the study. The proposed framework

represented the UX of factors that influence students when using the MLAs at HEIs to answer the main research question: *What are user experiences (UX) of students when using mobile learning applications?*

1.8 ETHICAL CONSIDERATIONS

This study adhered to the ethical principles set by Unisa on Research Ethics to confirm the safety, rights and privacy of the participants. The following ethical considerations were adhered to when conducting this research:

- voluntary participation,
- informed consent,
- privacy,
- confidentiality, and
- trustworthiness

Before conducting the research, the Unisa's Ethics Review Committee from the College of Science, Engineering and Technology (CSET) provided ethical clearance for this study (Appendix B). As Unisa students participated in this study, the researcher had to obtain approval for students to participate in the research. Therefore, Unisa's Research Permission Sub-Committee (RPSC) of the Senate Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) authorised the study to use Unisa students (Appendix C). Additionally, student participants of the study voluntarily signed Informed Consent Forms (Appendix A).

1.9 SCOPE AND LIMITATIONS OF THE STUDY

The following limitations applied to the current study:

- The study was limited to one HEI, the University of South Africa (Unisa).
- Data collection for the study was limited to students registered at the University of South Africa who had previously used myUnisa.
- The study focused on the user experience of the students when interacting with an MLA.

- Since the study investigated the student UX of an MLA at only one institution of higher education, the generalisability of the results across HEIs is limited.

1.10 CONTRIBUTION OF THE STUDY

The study contributed to the existing knowledge regarding UX factors for MLAs. The practical contribution of the research was related to the user experience framework of mobile learning applications by students at an ODeL institution in the Gauteng province (**UXFMLASO**). The proposed framework determines the perception pertaining to user experience (positive or negative) of students when interacting with the MLAs at HEIs.

The framework can serve as a guideline when developing or improving MLAs at HEIs, and is likely to benefit Unisa, other institutions, researchers, the department of education and policy makers to make informed decisions when implementing or enhancing MLAs. Additionally, the developed framework may be used to ensure that MLAs provide students with a more pleasant and satisfactory learning experience. Furthermore, the results from the study could be used to increase the external validity of earlier research that derived similar outcomes.

1.11 STRUCTURE OF THE RESEARCH DISSERTATION

This dissertation consists of seven chapters. The chapters explain how the dissertation is structured. The structure of the dissertation is illustrated in Figure 1.2.

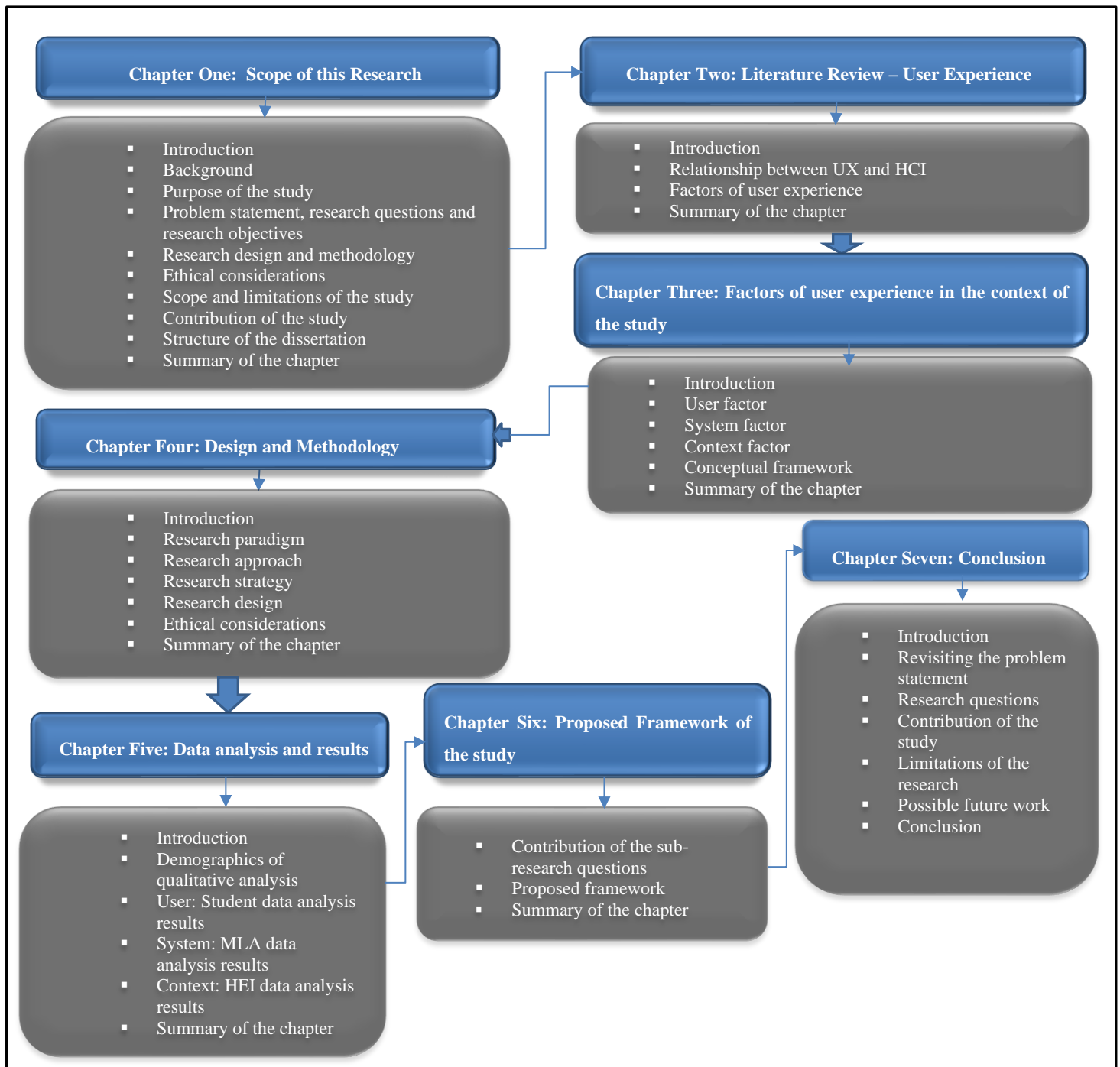


Figure 1.2: Structure of the dissertation

Chapter 1: Scope of this research

This chapter provided the background, the purpose and the problem of the study. The research questions, objectives and contribution of the study were also provided. Additionally, this chapter presented a discussion of the research methodology applied, the ethical aspects, and the scope and limitations of the study.

Chapter 2: Literature review

This chapter presents the relationship between UX and Human-computer interaction and factors of UX. The factors of UX that influence the students when using MLAs are presented in this chapter as the user, system and context. The outcome of this chapter was a development of a theoretical framework.

Chapter 3: Factors of user experience in the context of this study

In this chapter, the identified UX factors are discussed as applied in this study. The conceptual framework was developed to illustrate these factors, and was used to develop the open-ended interview questions used in the study.

Chapter 4: Research design and methodology

This chapter presents the design and methodology adopted for this study. The design and methodology of the study include the research paradigm (interpretative), research approach (inductive), research design (qualitative), research strategy (qualitative interviews), data collection and data analysis methods. Additionally, this chapter presents the ethical considerations.

Chapter 5: Data analysis and results

This chapter discusses the analysis of the data collected through semi-structured interviews and open-ended questioning. Data analysis and results were consequently provided to test the proposed framework.

Chapter 6: Proposed framework of the study

This chapter provides the data that was integrated and presented into the proposed framework to represent the user experience of students when using MLAs at HEIs. The proposed framework answers the main research question.

Chapter 7: Conclusion

This chapter presents the problem statement, discusses how the research questions of this study were answered, and outlines the contribution, scope and limitations of the study. Additionally, this chapter discusses possible future work.

1.12 SUMMARY OF THE CHAPTER

This chapter presented a discussion of the background, the purpose, and the research problem of the study. This chapter included a discussion of the research questions, research objectives, research design and methodology and the ethical considerations of the study. Additionally, this chapter presented the scope and limitations, contribution of the study and the structure of the research.

The next chapter presents the literature review of UX. The chapter investigates and identifies the factors that may influence the UX of students when using MLAs at HEIs. This chapter also discusses the factors identified from UX frameworks. Additionally, this chapter presents the theoretical framework formulated from the identified UX factors.

CHAPTER 2: LITERATURE REVIEW - USER EXPERIENCE

2.1 INTRODUCTION

This chapter presents a discussion of the literature review that was conducted to support the research in answering the problem of the study and to contribute to addressing SRQ1: *Which user experience factors affect students when using mobile learning applications?*

This chapter aims to provide a review of the relevant literature related to the current study. The literature review is a study of academic sources such as dissertations, journal articles and books that provide an overview of what has been identified or unidentified about the research questions (McCombes, 2023). To conduct the literature review, the study adopted the scoping review and reviewed more than 60 related research papers, conference papers, academic journals, online books and online articles through various internet sources such as the Google search engine, South African Government websites, the Unisa website, myUnisa Library and journal publishing sources. The journal publishing sources included sources such as Google scholar, Research gate, SAGE, Elsevier and Science direct.

The current study investigated the UX of a student when using an MLA. Norman and Nielsen (2022) stated that interaction with the system influences the UX of the user. Therefore, the study investigated the factors that could influence the UX when students interact with the MLA at an HEI. The available literature regarding the UX, MLAs and mobile learning at HEIs was studied. The focus was on the factors of UX to allow the current study to identify a gap in the body of knowledge, to build a theory and to develop a conceptual framework.

This study used keywords to enable the literature review. These keywords included terms such as user experience, user experience frameworks, usability and mobile learning applications. The study used keywords searches such as human-computer interaction, definition of user experience, difference between user experience and usability, user experience factors, UX in mobile learning application, mobile learning at HEIs, factors influencing mobile learning applications, and characteristics of the MLA that influence the UX. The literature included an investigation of the factors of

user experience, frameworks of user experience, mobile learning applications, and mobile learning at HEIs. The UX of lecturers and lecturing staff using MLAs were excluded from the current study.

The UX process provides a systematic method of design evaluation and analysis of the whole experience when using technology (Amir *et al.*, 2022), and plays an important role when developing and using systems offered by technology (Thomas, 2022 & Nick, 2023). The UX of a system is perceived by how users summarise the interactions after using it (Andreas *et al.*, 2022), and it goes further than customary usability by considering characteristics such as fun, pleasing appearance, pleasure and personal development related to the interaction with the system (Ssemugabi, 2019). The delivery of a quality UX has developed into a main determining factor of success for digital systems and services (Leteney, 2021).

Muditha (2020) stated that UX changes based on the user needs and goals that change with time. Berni and Yuri (2021) added that UX changes are not only dependant on the user, but also on the circumstances, system and context in which the interaction occurs. Hence, the significance of investigating the factors of UX that may have an influence when a user (student) interacts with the system (mobile learning application).

Figure 2.1 presents the main factors of UX based on a user's interaction with a product within a specific context. The factors are the user, product and context of use, as presented in Figure 2.1. As illustrated below, the factors identified have sub-factors that can influence the UX when a user interacts with the system. For the purpose of this study, the 'user' refers to the student, the 'system' refers to the MLA, and the 'context' is the HEI. In addition, to clarify, the current study uses terms such as system, product, service, interactive system, interactive technology, technology, and mobile technology interchangeably to refer to the MLA.

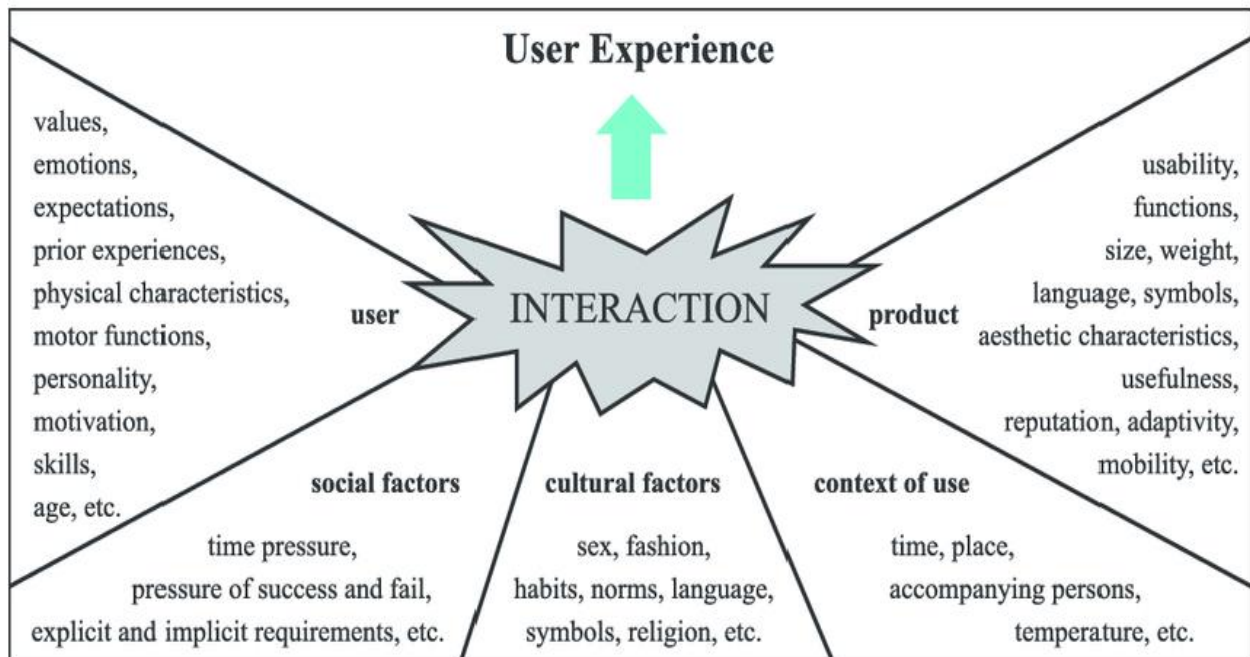


Figure 2.1: User experience factors

Source: Arhippainen & Tähti (2003)

The next section (Section 2.2) discusses UX as part of the HCI in terms of defining UX, UX perspectives, differentiating experience and user experience, and differentiating user experience and usability. UX factors are discussed in Section 2.3. Section 2.4 provides a summary of the chapter.

2.2 RELATIONSHIP BETWEEN USER EXPERIENCE AND HUMAN-COMPUTER INTERACTION

Human-computer interaction (HCI) refers to a multidisciplinary field which is centred on the computer technology design and the interaction with users (Muditha, 2020; Amato, 2021). HCI focuses mainly on adapting computers to the nature of human beings, and how to use computers as an instrument for supporting, enhancing or performing necessary tasks (Hassenzahl, 2008; Nick, 2023). HCI design focuses on confirming that the user interaction with the system feels more natural (Muditha, 2020). HCI practitioners pay attention to how users interact with technology to optimise the systems to allow for better efficiency. This means that the aim of HCI is to minimise unnecessary interaction with technology so that users are able to use technology with minimal disturbance (Amato, 2021). Initially, HCI was proposed during the 1980s together with computer development, but today it is inclined to apply to UX design

(Muditha, 2020), which is a discipline that primarily reflects on user needs for the ease of interaction for numerous interfaces (Amato, 2021).

There is a noticeable rising interest in UX in the HCI community (Hassenzahl, 2018), which has resulted in UX turning to a sub-field of HCI (Rachel, 2022). The research on UX gained momentum within the HCI community and evolved into a well-known field that expanded from the usability concept (Kelvin, 2022). The development of the interactive systems presents new challenges to the implementation of HCI and UX (Amir *et al.*, 2022). UX has become a factor that is recognised in the successful use and acceptance of interactive systems, though it received less attention in the past (Botha, Calteaux, Herselman, Grover & Barnard, 2012).

UX quality is a main factor in any interactive technology. It has been indicated that users accept and use the system if it provides quality UX and can make life easy (Amir *et al.*, 2022). Research has shown that enhancing the UX is a priority and a crucial factor for the future success of HCI systems (Leteney, 2021). Swain (2020) stated that positive UX retains user's loyalty to the system. McCain (2019), similarly, indicated that positive UX can attract students. Hall and Batty (2020) added that positive UX can influence the decision-making. Additionally, Ali (2018) indicated that when organisations, as brands, are able to successfully deliver satisfactory UX of their systems, they create a desirable environment for users to interact with the organisation.

Although the current study presents a brief discussion of HCI (as a UX design), HCI, HCI design and UX design are excluded from the study. Figure 2.2 presents a systematic overview of what HCI is.

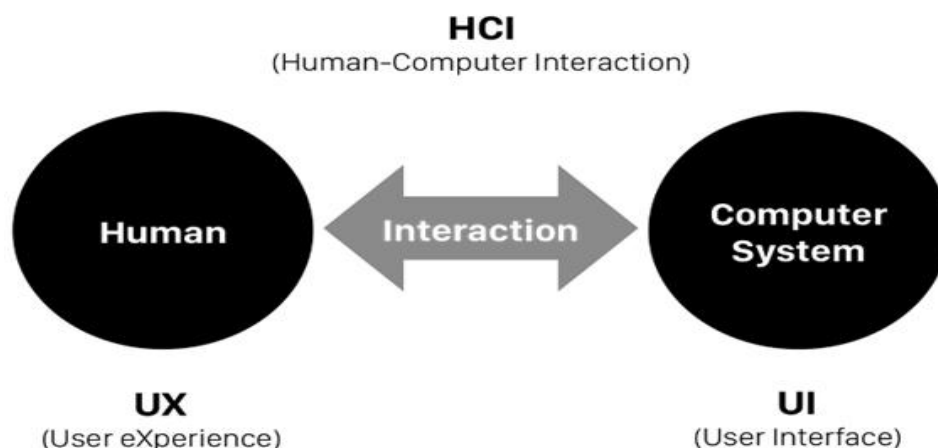


Figure 2.2: User interface (UI), user experience (UX) and human-computer interaction (HCI)

Source: Soomin (2015)

Section 2.2.1, below, defines the concept of UX, Section 2.2.2 discusses different viewpoints of UX, Section 2.2.3 differentiates between experience and UX, and Section 2.2.4 distinguishes between usability and UX.

2.2.1 Definitions of user experience

The concept of UX has changed into a widespread subject that has expanded on the usability concept in the HCI space. Although the HCI community appears to embrace UX, it has been noted that it might take some time to fully understand what UX is (Hassenzahl, 2018; Berni & Yuri, 2021). According to Nakamura, De Oliveira and Conte (2019), the UX concept is a seasoned field that is well defined. However, Nakamura *et al.* (2019) argued that even though UX is a growing field which is well defined, there is currently no official definition of UX. Nevertheless, the HCI community has attempted to formulate many definitions to describe UX (Nakamura *et al.*, 2019).

Hassenzahl and Tractinsky (2006) argued that the definition of UX depends on how the system is viewed. Roto (2006) indicated that a definition of UX is dependent on whether UX is viewed as an attitude, sensation, emotion, perception or mental state. Consequently, a definition of UX is determined by how the study is viewed (Harpur, 2013). Berni and Yuri (2021) highlighted that the UX concept is viewed from different perceptions because UX is ambiguous and systems have different objectives in terms of UX. Berni and Yuri (2021) advised that the focus of a UX objective should be on the emotions, individuality and values of the user.

According to Preece, Rogers and Sharp (2015), UX comprises of its functionality, usability, content, aesthetics, sensual appeal, emotional appeal and the look and feel. Abro, Sulaiman, Mahmood and Muzafar (2015); Berni and Yuri (2021) refer to UX as a dynamic process that includes traditional HCI. Abro *et al.* (2015); Berni and Yuri (2021) added to this by stating that UX is not only dynamic, but is a subjective and context-dependent process that occurs when users interact with a system, product, service, or with an object. Berni and Yuri (2021) stated that the process of UX changes depending on particular factors such as the user, system, context and circumstances of use.

According to Ssemugabi (2019) UX is a personal, subjective feeling about the product that focuses on the user. Norman and Nielsen (2022) stated that UX refers to user characteristics when interacting directly with an organisation, its products and services. The International Organization for Standardization (ISO) (2019) indicated that the focus of UX is on users' reactions and perceptions resulting from the experience with an interactive system. Berni and Yuri (2021) maintained that the user's reactions and perceptions may result in feelings of pleasure and satisfaction while using a system, or it may have the opposite result. Andreas *et al.* (2022) added that the feelings of pleasure and satisfaction imply that user needs and expectations are being met.

Hassenzahl (2018) further elaborated that the positive or opposite feeling that users get when using an interactive system explains how users feel about a system, how enjoyable and satisfactory users find the system, and comprises of every aspect of the system's usability and desirability from the perspective of the user. Andreas *et al.* (2022) agreed that UX is the overall user perception when interacting with a system, and added that user perceptions consist of effectiveness, efficiency, emotional satisfaction and the expectations that are created for subsequent user interactions with the system.

Berni and Yuri (2021) incorporated three factors in defining UX as the result of the context, which is the environment in which the user's interaction with the system occurs. Similarly, Hassenzahl and Tractinsky (2006); Berni and Yuri (2021) incorporated three factors in defining UX that result from a user's mind, such as needs, perceptions, motivation, moods, expectations, and past experience; the qualities of a system, such as functionality, usability, complexity, visual attractiveness, and purpose; and the environment or context in which the interaction takes place. This definition includes both the system's hedonic and pragmatic qualities. Berni and Yuri (2021) stated that the pragmatic quality refers to the system's usability and functionality, which addresses the task-oriented goals, while the hedonic quality refers to other goals such as pleasure and attractiveness. This study investigates the UX of the students when interacting with an MLA, and both pragmatic and hedonic qualities are included.

Relative to this study, the above definitions of UX consist of the user (the student, in this case), interaction with the system (the MLA), and the context (in this case, the

HEI). This study adopted the definition by Hassenzahl and Tractinsky (2006); Berni and Yuri (2021), which incorporated three factors in defining UX (the consequence of the user's internal state, such as needs, moods, perceptions, motivation, expectations, and past experience; the quality of the system, such as functionality, usability, complexity, visual attractiveness, and purpose; and the environment or context in which the interaction takes place).

The user characteristics, system qualities and the context in which the interaction happens form the UX. As indicated by Norman and Nielsen (2022), UX focuses primarily on the whole user interaction with the system. With regard to the user characteristics, students' needs, perceptions, motivation, expectations and past experiences with the MLA were included in this study. The study excluded moods and emotions displayed by the student, such as joy and sadness. However, the study discussed the emotions of the user even though emotions were excluded from the study.

2.2.2 Perspectives on UX

The field of UX focuses on the study, design and evaluation of user experiences when interacting with a system in a particular context (Berni & Yuri, 2021; Amir *et al.*, 2022). The user interaction with the system in a particular context has an influence on UX (Berni & Yuri, 2021). Kaasinen, Roto, Hakulinen and Turunen (2015) stated that UX can be perceived from different perceptions, namely, as a phenomenon, field of study, or practice, based on the focus of the research. The different viewpoints on UX as stated by Roto, Law, Vermeeren and Hoonhout (2011) are briefly discussed below.

UX as a phenomenon:

This viewpoint includes the following:

- Defining the notion of UX (what UX is and what it is not);
- Differentiating between various kinds of UX; and
- Defining the consequences and circumstances of UX.

UX as a field of study:

This viewpoint includes the following:

- Discovering the methods of designing systems which qualify certain UXs;

- The exploration and development of UX design and assessment; and
- The comprehensive study of UX as a phenomenon (the creation of user experiences, what are users experiencing, what are users expecting to experience or what users have experienced).

UX as a practice:

This viewpoint includes the following:

- Evaluating UX;
- Envisioning UX (as part of a design practice);
- Delivering designs intended to enable a particular UX; and
- Representing UX (building a prototype showing and communicating the anticipated UX to others).

The current research focused on all of these UX viewpoints, in that the phenomenon of UX was explored by conducting a literature review, UX as a field of study was investigated to determine the factors that influence the UX of students while interacting with the MLA at HEIs, and UX as a practice evaluated the UX of students based on the identified factors to gather data related to their individual experiences to gain a deeper understanding of the phenomenon and to improve the UX.

UX evaluation is the process of identifying and acknowledging potential challenges, to consequently, provide ways to improve the system for users (Anindita, 2020). The literature stipulates that the evaluation of UX involves UX evaluation as a whole, and may be evaluated from the user's expectation *before* interacting with the system, *during* the actual interaction with the system, and the reflection *after* the interaction with the system (Muditha, 2020). Furthermore, UX evaluates the efficiency and effectiveness (usability) of a system based on the user's view concerning needs, perception, expectations, motivation and past experiences of the system (Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021), as adopted by this study. Andreas *et al.* (2022) indicated that UX can be conceptualised as the satisfaction factor of usability, and as the user reaction and perception which results in user satisfaction and user performance (with both the hedonic and pragmatic qualities considered).

Different perspectives and methods of how UX and experience are referred to in general and in the literature are discussed in the next section. The discussion focuses

of the three different viewpoints of UX that people may take when referring to UX. Although the section discusses three different perspectives (experience, user experience and co-experience), this research has an interest in two (experience and user experience) as the commonly used terms.

2.2.3 Difference between user experience and experience

Experience and user experience are two different terms that are often misunderstood, partly because these terms both involve humans (users) and their experiences. A discussion of these terms may assist in clarifying the intended perspective of this study when referring to UX. Although the concept of UX is smaller in scope than experience, UX remains a term that can refer to numerous forms of experience (Roto *et al.*, 2011). Experience is a recollection of previous occurrences that happened in a diversity of contexts (Amir *et al.*, 2022). The phenomenon of UX is a specific concept that is related to the experiences resulting from interacting with a system over a period, even though UX is still a subdivision of experience as a general concept (Roto *et al.*, 2011).

Andreas *et al.* (2022) referred to UX as the systems, services, products and objects in which an interaction between a user and a user interface takes place. The term 'co-experience' refers to the creative and collaborative UX (experiencing together) with a product that is constructed in social interactions (Battarbee, 2004). According to Forlizzi and Ford (2000) co-experience refers to a socially constructed experience in which individuals' events and interpretations are being influenced by other individuals in the same physical or virtual setting. Roto *et al.* (2010) clarified that co-experience is not limited to interaction with the system, but similarly includes individuals creating and simultaneously experiencing a circumstance together.

To simplify these terms (namely, UX, experience and co-experience), Forlizzi and Battarbee (2004) described the term 'experience' as something that is part of daily life and occurs frequently. Roto *et al.* (2011) stated that, in general, experience entails everything that is individually encountered, undergone, or lived through. However, UX and co-experience generally differ from experiences, in that they simply refer to the experience resulting from an encounter with the system (Roto *et al.*, 2011).

UX is influenced by expectations and past experiences and is rooted in a cultural and social context (Berni & Yuri, 2021). The definition by Hassenzahl and Tractinsky (2006); Andreas *et al.* (2022) support this view in defining UX as the consequence of

the user's past experiences and expectations that results from an interaction with a system in a certain context or environment. The current study focused on the UX of the student from an interaction with the MLA, as opposed to the experience that the student encounters daily.

In the HCI environment, UX and usability are perceived to be similar or interrelated terms (Komninos, 2019). The differentiation between UX and usability is discussed below.

2.2.4 Difference between user experience and usability

HCI shifted its focus from concentrating only on usability when considering the quality of interactive systems (Hassenzahl, 2018). The reason for this move was that just like UX, researchers recognise that there are limitations when considering usability only (Amir *et al.*, 2022). As such, usability and UX are different but interrelated (Komninos, 2019). Usability is considered to be the foundation of the UX, hence, it is a challenge to produce a valuable UX without usability (Barmann, 2019).

This is in line with the view that usability focuses mainly on improving the task efficiency and effectiveness of the system (Amir *et al.* 2022), while UX focuses mainly on how a user perceives the system's efficiency and effectiveness (Andreas *et al.*, 2022). Therefore, Dyvliash (2018) stated that usability ensures that user expectations are met to support that view.

In the current research, students use mobile applications for learning purposes at HEIs. For students to gain the maximum benefit from the use of MLAs, there are several factors that ought to be considered to provide for various needs of users (Sabir, 2018). Among these factors is usability and UX (Amir *et al.*, 2022). Althunibat, Almaiah and Altarawneh (2021) indicated that these factors of usability and UX contribute to positive influences on the actual use of MLAs.

Although it has been discussed and re-defined many times by many authors, there is still a trend indicating the confusion between usability and UX within the HCI community (Trista, 2018), and the difficulty to separate the two (Berni & Yuri, 2021). While UX is typically acknowledged as an extension of usability, the lack of a formal definition for usability and UX might be a contributing factor to the confusion (Berni & Yuri, 2021).

According to Norman and Nielsen (2022), usability refers to a quality attribute of a particular system to achieve a certain goal, with the focus on the user interface of a system and whether it is easy to learn, easy to use, pleasant, etc. The ISO (2019) stated that usability is all about the efficiency, effectiveness and overall user satisfaction. Furthermore, Berni and Yuri (2021) indicated that usability is not about the actual system, but rather about how users understand and use the system (user-friendliness, effectiveness and efficiency). Whereas, UX involves every aspect of users when interacting directly with an organisation, its products and services (Norman & Nielsen, 2022), as opposed to only focusing on effectiveness, efficiency and satisfaction. Ssemugabi (2019) agreed that UX is a personal, subjective feeling about the system that tends to focus on the user, and goes further than customary usability by considering characteristics such as fun, pleasing appearance, pleasure, and personal development related to the interaction with the system. Hassenzahl (2018) simplified UX as the positive or negative feeling users get when using a system.

Joint research on B2B (business-to-business) web users by Huff, Edmond and Gillette (2015) revealed that 46% of users do not interact with a website because it is not clear what the organisation is about, for instance, there is a lack of clear and effective messaging, 44% of users abandon the website because there is no contact information, while 37% of users ditch the website because of poor navigation or design. Although the joint study focused on websites, the results of the study can also be applied to mobile applications. The results of Huff *et al.*'s study (2015) revealed both usability and UX issues. This is an indication that UX and usability are both important for the success of a system. This is supported by a research conducted by Amir *et al.* (2022), which indicated that the success of a system requires that both usability and UX are considered when designing and developing systems, and that general perspectives regarding the relationship between the two also need to be considered. However, the focus of the current study is on the UX of students using the MLA, and therefore, the design and development of the MLA do not form part of this study.

Kelvin (2022) accentuated that usability is aimed to improve user performance, whereas UX is usually used to improve user satisfaction with the focus on both the hedonic and pragmatic qualities (Andreas *et al.*, 2022). If one concept is prioritised above the other, the focus of the development is bound to change to either satisfaction

or performance (Law, Roto, Hassenzahl, Vermeeren & Kort, 2009). Komninos (2019) stated that users should effectively and efficiently complete their objectives in a satisfactory manner, without seeking other resolutions to achieve their objectives because of bad UX or usability. In addition, users want the experience to be pleasant, simple and seamless, which means that usability and UX should be easy, intuitive, emotionally rewarding and satisfactory (Trista, 2018). Amir *et al.* (2022) cautioned that systems that fail to create clear and easy features can destroy the excitement in the system, as well as the organisation behind it.

It is evident that the HCI community has been debating the relationship between UX and usability (De Kock, 2017). Figure 2.3 presents the common perspectives that can be considered to elucidate the diverse perspectives on UX and usability (Moczarny, De Villiers & Van Biljon, 2012). These views are briefly discussed below the figure.

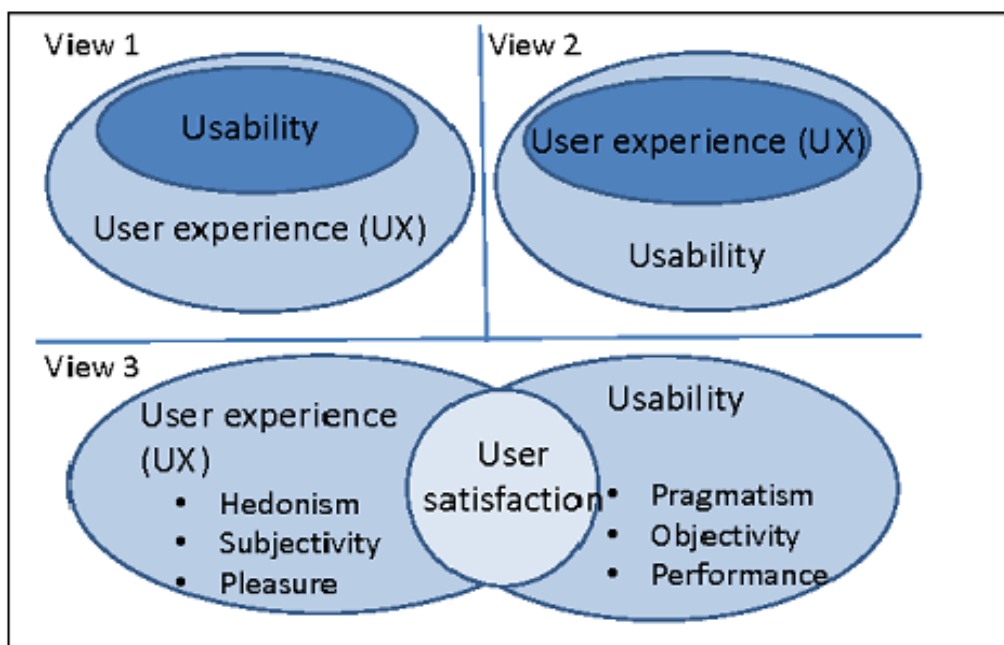


Figure 2.3: Diverse perspectives on UX and usability

Source: Moczarny *et al.* (2012)

View 1 as depicted in Figure 2.3

Usability is a UX factor. Hence, usability is incorporated in UX (Kelvin, 2022; Berni & Yuri, 2022).

View 2 as depicted in Figure 2.3

In usability, UX is perceived as a subjective factor of user satisfaction. Hence, the consideration of UX as a usability factor (Berni & Yuri, 2021).

View 3 as depicted in Figure 2.3

While UX and usability are distinct, the two concepts are closely related. Though these concepts are interrelated and consist of common attributes, they have different characteristics (Norman & Nielsen, 2022; Berni & Yuri, 2021).

Though the current research is in agreement with all three views, the current study applied the all-inclusive perspective where usability is a factor that is incorporated in UX, as shown in Figure 2.3 in View 1. For the purpose of this study, usability is acknowledged as a main factor embedded in UX. The current study identified the user, system and context as factors influencing the UX. The system factor identified some of the characteristics of usability, such as efficiency, effectiveness and satisfaction that are part of the evaluation in the study. This implies that the perceived usability is considered when evaluating the UX, that UX included usability and UX completed usability as supported by Berni and Yuri (2021). The characteristics of usability have an influence on the UX of students when interacting with the MLA. Additionally, Amir *et al.* (2022) emphasised that usability is part of UX, not the actual UX.

To evaluate the UX of students' interaction with the MLA, the factors of UX (user, system and context), as identified in the literature and adopted by this study, are discussed next.

2.3 FACTORS OF USER EXPERIENCE

This section presents a discussion of different UX frameworks that are used in designing and evaluating UX. These UX frameworks shaped and guided the study in identifying the UX factors applicable to this study. The UX frameworks consist of factors that may influence the UX of students using MLAs at HEIs. Berni and Yuri (2021) stated that the factors of UX may be used to define the circumstances in which a certain UX was felt by a certain user.

Jumisko-Pyykkö and Vainio (2010) indicated that 'component' as a term is used, in addition to terms such as factor, components, aspect, dimension, state and

environment. Abro *et al.* (2015) used the term ‘factors’ in the title of their journal article: “Understanding factors influencing User Experience of interactive systems: A literature review”. The term ‘factors’ was also used by Semerádová and Weinlich (2020) in a recent study titled: “Factors influencing user experience”. This implies that these terms can be used interchangeably depending on the researcher’s preference. For the purpose of the current study, the word ‘factor’ is used, and the term ‘sub-factor’ is used to refer to a subcomponent.

The next sections discuss the UX frameworks as relevant to this study. As indicated by Kaasinen *et al.* (2015), each UX framework carries a different viewpoint that supports the multidisciplinary character of UX. This indicates that for every system development, the UX goals might be different, resulting in diverse factors based on the objective and context in which the system is used.

2.3.1 Frameworks on user experience

In system design or development, UX is ambiguous and can be seen from different perceptions, as systems have different UX objectives, and based on the objective and context, the factors of each system can be different (Berni & Yuri, 2021). The sections below present a discussion of several frameworks on UX which were found in literature.

2.3.1.1 Diverse sources of UX

According to Kaasinen *et al.* (2015), the development of a system has different kinds of objectives. As displayed in Figure 2.4, the individual, the situation, the kind of product and time have an influence on UX. Berni and Yuri (2021) stated that the UX in user-product interaction is mostly influenced by users interacting with a product in a cultural or social context. The scholars, Basri, Noor, Adnan, Saman and Baharin (2016) stated that UX is influenced by the product’s features and forms, while users influence UX through their feelings, emotions and past knowledge.

Figure 2.4 illustrates the diverse source of UX.

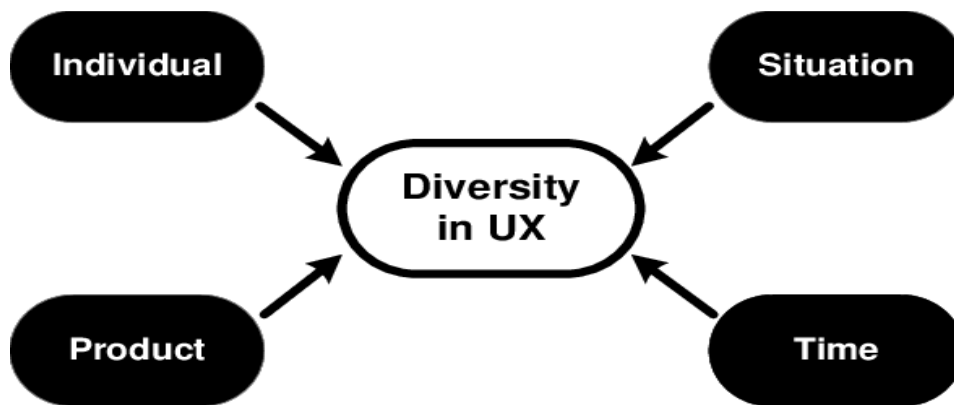


Figure 2.4: Diverse sources of UX

Source: Basri *et al.* (2016)

2.3.1.2 Anderson's user experience hierarchy of needs

Newbold (2018) adapted Stephen Anderson's model of needs (2011) to construct a hierarchy of user needs model for product design. As presented in Figure 2.5, Anderson (2011) developed a model of that which constitutes quality UXs on websites. This model can be applicable to mobile applications and any other system development. According to this model, user experiences should be developed in this sequence: functional, reliable, usable, convenient, pleasurable and meaningful to provide positive UX (Newbold, 2018).

Figure 2.5 demonstrates that the product needs to satisfy the functionality requirements first to be reliable, usable (ease of use), convenient, and it needs to be pleasurable before it is meaningful. Anderson (2011) stated that when a product is meaningful, it means that it connects personally and leaves an impression with the user. A product that leaves an impression is deemed to have provided positive UX.

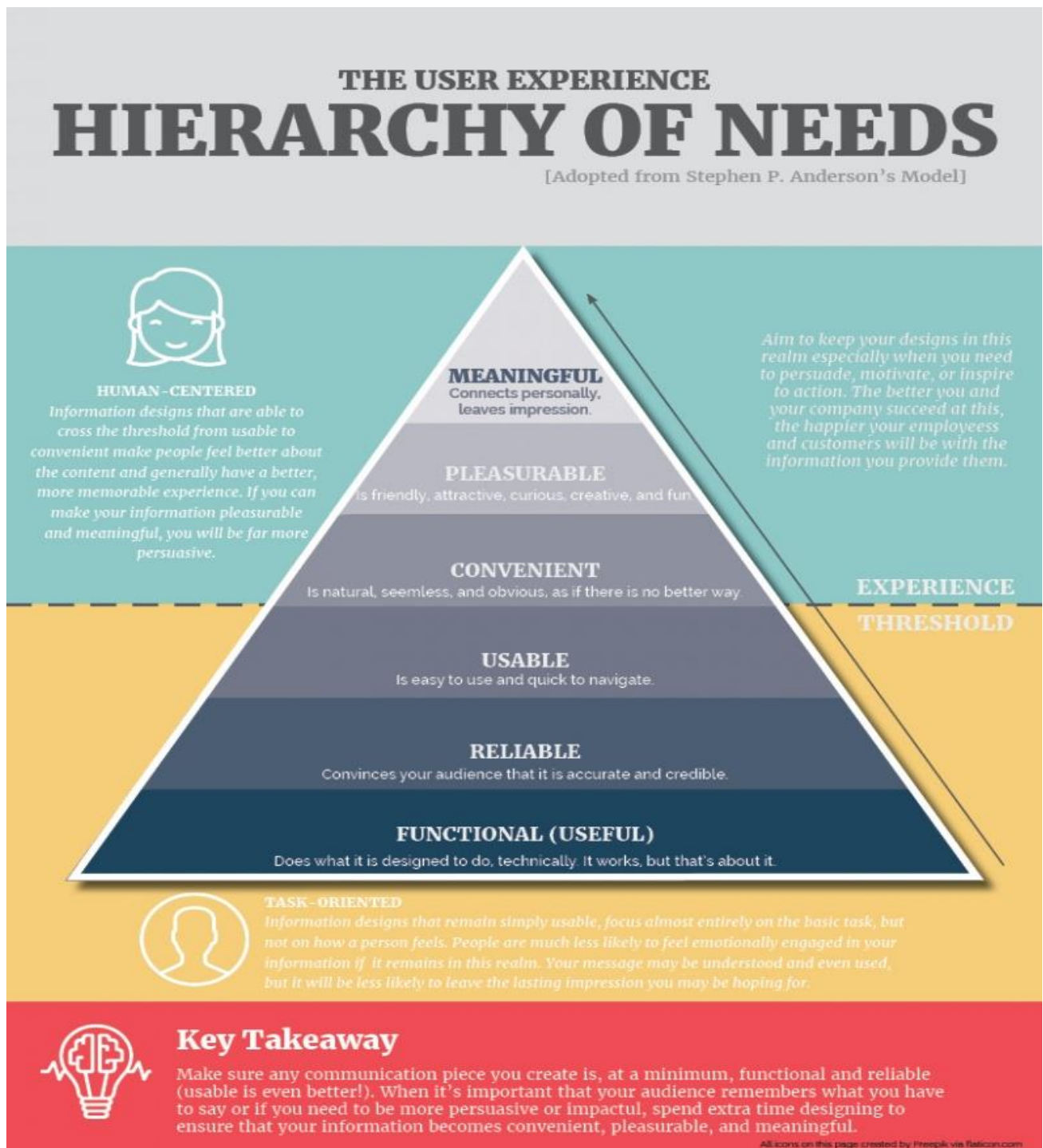


Figure 2.5: Anderson's user experience hierarchy of user needs

Source: Anderson, (2011), created by Newbold (2018)

Anderson's user experience hierarchy of user needs can be explained as follows:

- **Functional:** Systems are required to be understandable, usable and accessible. If the system lacks these characteristics, UX fails.

- **Reliable:** Following the functionality, the system and the environment in which an interaction occurs, requires reliability. An unreliable system is untrustworthy, lacks credibility and affects the functionality.
- **Usable:** This is the usability of the system. The system needs to be as efficient and effective as possible to satisfy the user. If users cannot achieve their goals as a result of errors, connection problems, unnecessary misturns, unavailability of the information or system, then the system is not usable.

Threshold: The system needs to at least meet the three characteristics above to meet the users' needs below:

- **Convenient:** Beyond the functionality, reliability and usability threshold, the system needs to be convenient. Convenience implies that systems are easy to navigate through, easy to use and natural.
- **Pleasurable:** Pleasurable implies that the system is enjoyable, user-friendly and aesthetically pleasing.
- **Meaningful:** A system becomes meaningful when the functionality, reliability, usability, convenience and pleasurability have been met. Meaningful systems directly influence user perspectives and emotions (Newbold, 2018). User emotions and perspectives influence the UX.

2.3.1.3 Research framework of user experience

An experimental study of user emotion reactions was proposed by Mahlke (2008). As illustrated in the Research framework of user experience in Figure 2.6, a user's interaction with the system depends on the properties of the system, though, user characteristics and context parameters play a critical part too.

According to Figure 2.6, emotional reactions are presented as a UX factor and not as a consequence. Although emotional reactions are presented as a factor, the emotional reactions result from other factors such as instrumental and non- instrumental qualities. Based on this viewpoint, UX is created by the characteristics of emotions. UX results from an interaction between a user and the system in a certain context.

Mahlke (2008) stated that an interaction with the perceived instrumental and non-instrumental qualities causes an emotional reaction from the user, which determines the UX. Instrumental qualities include the aspects of the system such as usability and

usefulness. Non-instrumental qualities include the aspects of the system such as symbolic, aesthetic and motivational. Emotional reactions include the subjective feelings, motor expressions, cognitive appraisals, physiological reactions and behavioural tendencies of the user. The consequences of the UX are the whole judgement, choice between alternatives, and usage behaviour.

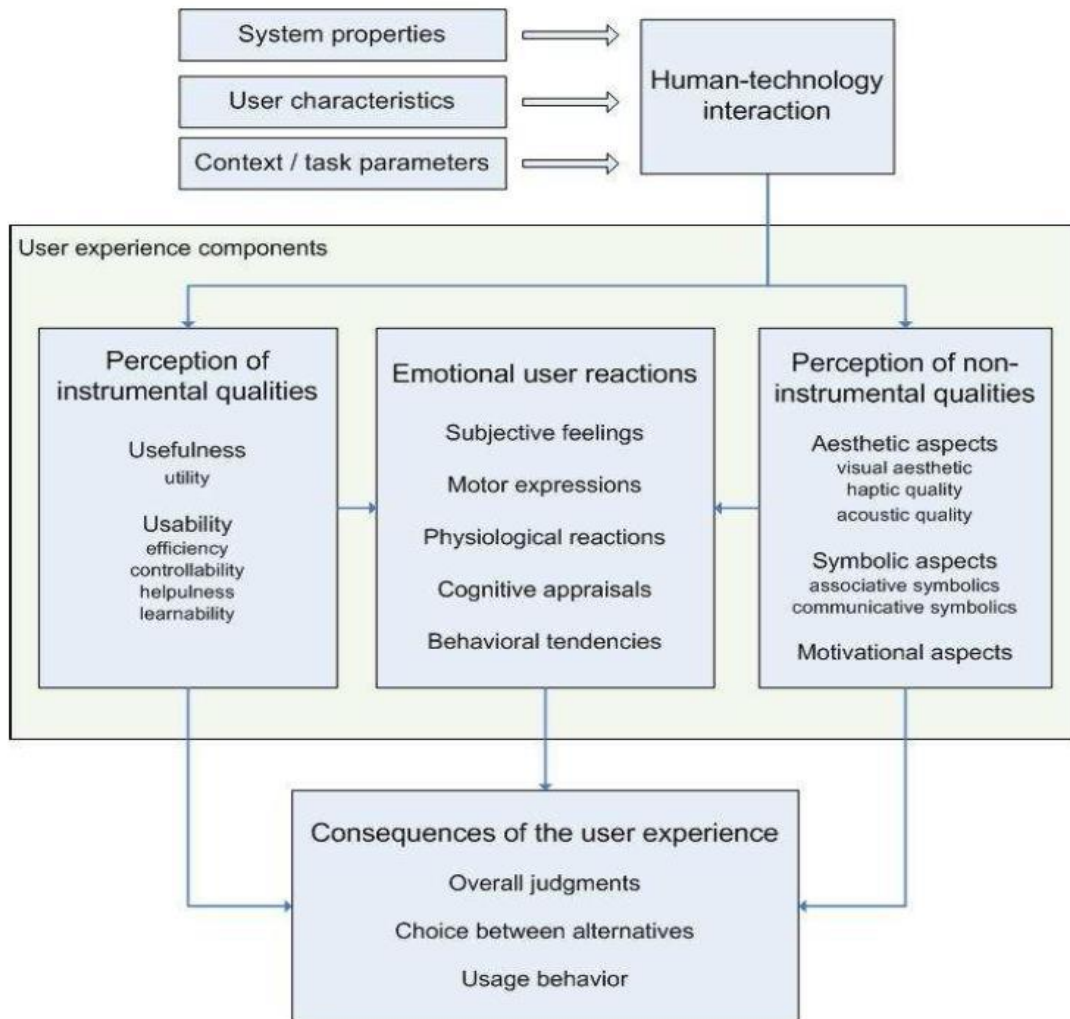


Figure 2.6: Research framework of user experience

Source: Mahlke (2008)

2.3.1.4 UX Framework during interaction

Roto (2007) presented the framework of UX during an interaction, as seen in Figure 2.7. This is a UX evaluation framework that illustrates an interaction involving a user and system in a certain context.

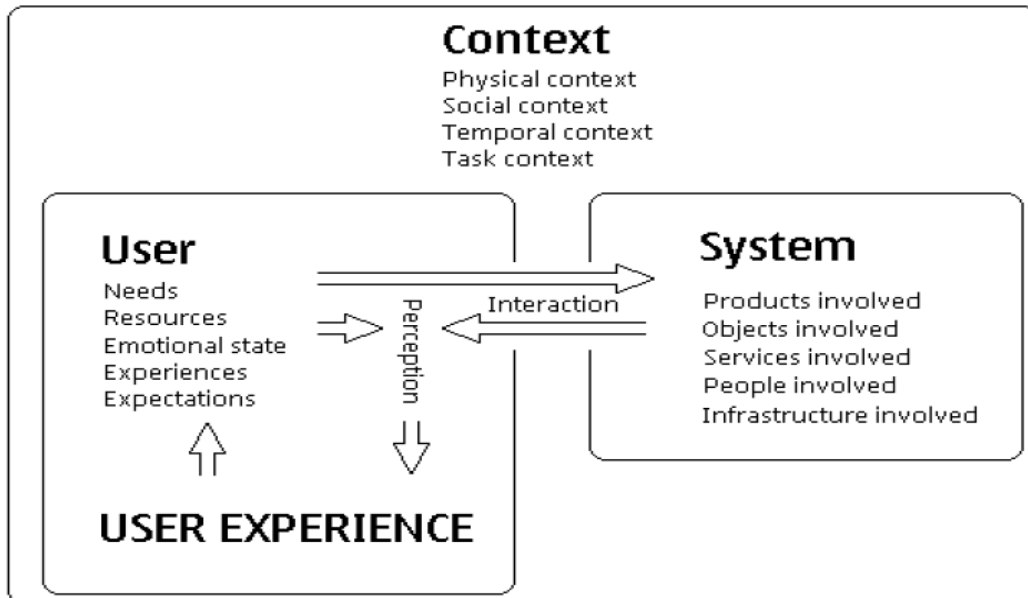


Figure 2.7: UX during interaction

Source: Roto (2007)

According to Figure 2.7, UX results from the user interaction with the system in a particular context, and that interaction leads to the user perception of the interaction with the system, which is the UX.

The UX factors, as displayed in Figure 2.7, are: 1) the user, which includes the following sub-factors: needs, resources, emotional state, experiences and expectations; 2) the system, which includes products involved, services involved, objects involved, infrastructure involved and people involved; 3) the context, which comprises of the physical, social, temporal and task environment. These sub-factors have an influence on the user interaction with the system in a certain context. The sub-factors evoke how the user perceives the interaction with the system which results in UX.

2.3.1.5 UX factors framework

As presented in the above frameworks, the common factors of UX are the user, the system and the context or environment. Hassenzahl and Tractinsky (2006), in support of these frameworks, stated that UX results from a user and system interaction in the context where the interaction happens.

Therefore, the current study adopted this perspective on UX. However, there are other UX studies that came up with the same concept (Roto *et al.*, 2011; Botha *et al.*, 2012; Berni & Yuri, 2021). The literature review for this research identified UX factors as the

user with characteristics such as needs, perception, motivation, expectations and past experiences; system with characteristics such as the pragmatic quality and hedonic quality; and the social, physical, tasks, temporal, the technical and information as context (Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021). These factors of UX laid the main foundation for this research structure.

Azizi and Khatony (2019) stated that the successful implementation of an efficient and effective system needs to identify the factors that influence the UX. As adopted by the current study, the factors of UX in the context of this study are represented as:

- User: Student
- System: Mobile learning application
- Context: Higher education institution

The next section discusses the factors as identified from different frameworks of UX.

2.3.2 Discussion of the factors identified from UX frameworks

Kaasinen *et al.*'s (2015) framework in Figure 2.4 identified the influential factors of UX as the individual, product, situation and time. The identified factors (individual, product, situation and time) in Kaasinen *et al.*'s (2015) framework are adaptable and useful in the UX framework for students at HEIs. In the current study, the individual (user), product (system) and situation (context) are identified as the factors for the UX of students using an MLA at an HEI.

Newbold's (2018) Framework as illustrated in Figure 2.5 proposed the sub-factors of the system that can contribute to provide a positive UX, namely: functionality, reliability, usability, convenience, pleasure and meaningful. These sub-factors have an influence on the UX. In the current research, some of the sub-factors in Newbold's (2018) framework were relevant to the study, and therefore, adopted.

Mahlke's (2008) Framework stated the UX factors as the emotional user reaction, perception of instrumental quality and perception of non-instrumental quality, as presented in Figure 2.6. These three factors take place when a user interacts with the system (product), and that influences the UX. Additionally, the UX research framework identified sub-factors such as usefulness, learnability, usability, efficiency, effectiveness, motivational, and behaviour aspects. The current study employed the applicable characteristics from the framework by Mahlke (2008).

Roto's (2007) Framework in Figure 2.7 illustrated the UX of a user during an interaction with the system in a certain context. The framework illustrated the user, system and context as factors of UX. These factors were adopted in the current study, as well as their sub-factors which were identified to influence the UX.

2.3.3 The theoretical framework

This chapter aimed to answer SRQ1: *What are the factors of user experience that affect students when using mobile learning applications?* Section 2.3 discussed the UX factors as identified in the frameworks presented.

The current study identified the user, system and context as relevant factors for this study. These factors may have an influence when students are using the MLA. This chapter contributed to the theoretical framework as illustrated in Figure 2.8.

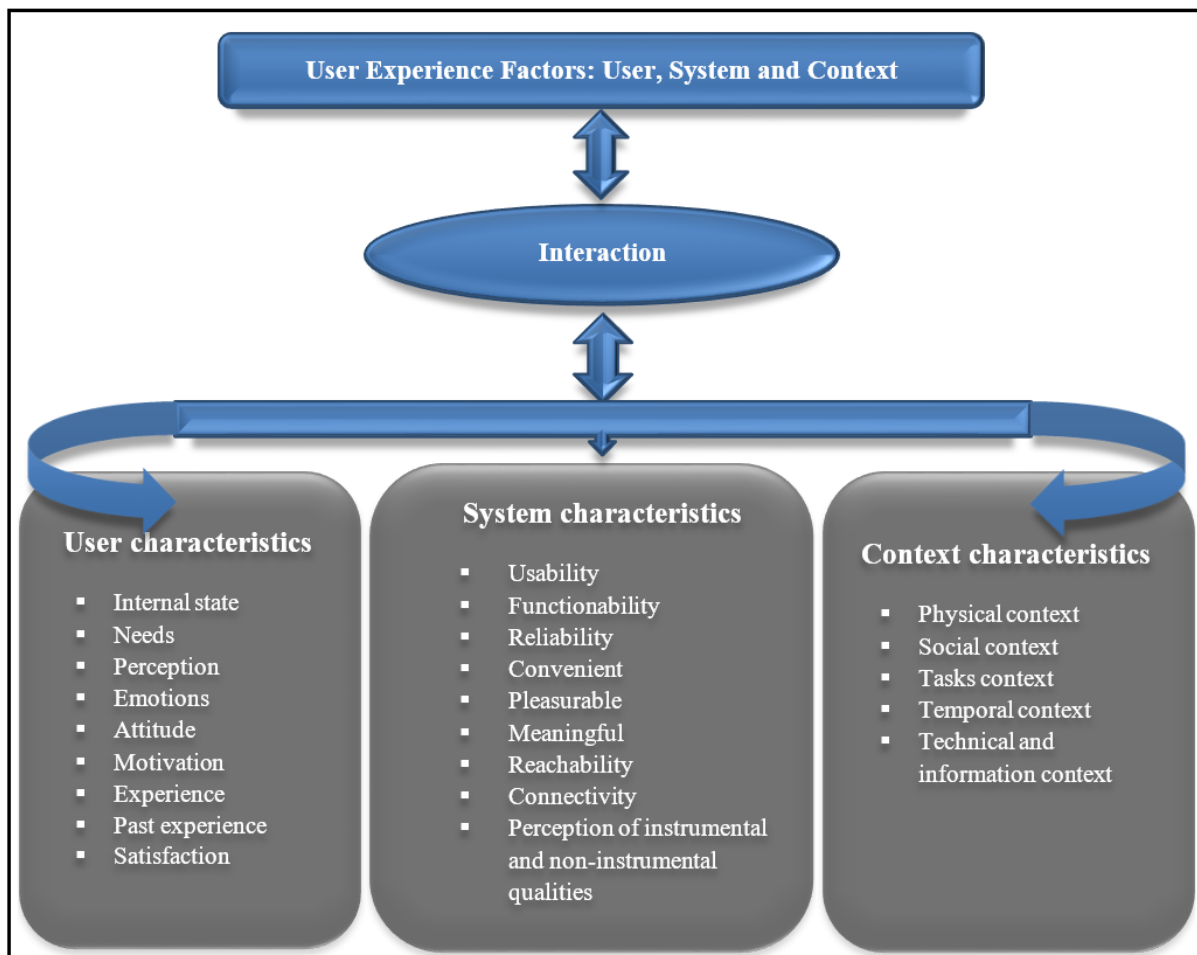


Figure 2.8: Theoretical framework of factors that may influence the UX of students

2.4 SUMMARY OF THE CHAPTER

Chapter Two of the current study conducted a literature review to identify the factors of UX. This study adopted the high-level categorisation by Hassenzahl and Tractinsky (2006); Berni and Yuri (2021) to identify the factors affecting UX (user, system and context) when using a system. It has been stated that UX is a result of the interaction between the user, the system and the context where the interaction takes place. The literature study resulted in the theoretical framework of the factors that may influence the UX of students at HEIs (Figure 2.8).

The next chapter further discusses the factors of user experience as applicable to this study.

CHAPTER 3: FACTORS OF USER EXPERIENCE IN THE CONTEXT OF THIS STUDY

3.1 INTRODUCTION

This section presents the factors of UX as identified in the literature review. The factors are the user, the system and context (Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021) and are discussed as applicable to the current study. Berni and Yuri (2021) emphasised that UX evaluation is incomplete without these three factors. Section 3.2 discusses the user factor, Section 3.3 discusses the system factor, and Section 3.4 discusses the context of use factor. The conceptual framework of this study is presented in Section 3.5, and Section 3.6 presents the summary of the chapter.

3.2 USER FACTOR: STUDENT

The user is a high-level UX factor that is described as a person manipulating or interacting with the system. Users have characteristics such as needs, motivation, perceptions, expectations, past experiences, predispositions, and their mental and physical state (Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021). Berni and Yuri (2021) stated that user's characteristics can influence the felt experiences.

In the context of the current study, the user is a student, as students are the main users of the system (the MLA) under study. Rodríguez-Arancón, Hita and Cristina (2013) indicated that at HEIs, students are not inactive recipients of learning anymore, but are patrons who are making selections in the learning market. Amir *et al.* (2022) agreed that it is the student who takes the main responsibility and control regarding their learning process, which include the actions of setting goals and evaluating UX. Amir *et al.* (2022) highlighted that for a successful and positive UX, students crucially need an interaction that is easy, enjoyable and effective.

The section below discusses the sub-factors of the user as a UX factor. Section 3.2.1 discusses the system needs of the user, Section 3.2.2 discusses user perceptions towards the system, Section 3.2.3 covers the user's emotions resulting from the interaction with the system, Section 3.2.4 discusses the motivation to use a system,

and Section 3.2.5 discusses user expectations and experiences regarding the system usage.

3.2.1 Needs of the user

It is significant to know who users are, what their needs are, and how they operate to provide a good UX (Norman & Nielsen, 2022). Ssemugabi (2019) emphasised the importance of system designers and service providers to clearly identify the needs of users when developing a system that not only meets but exceeds the expectations.

UX goes above and beyond the good functionality and usability of the system, it is also concerned about the true needs of the users (Manandhar, 2019). User's needs must be evaluated to identify what is needed to provide positive UX when using a system (John, 2022). Understanding and acknowledging the users' needs have an influence on the users' satisfaction with the system and the motivation of the user to use the system (Andreas *et al.*, 2022).

Users are motivated by internal needs (Souders, 2021), such as psychological needs that users need to accept a system. As stated by Berni and Yuri (2021), the user's interaction with the system and the acceptance of the system depends on the user's mind. Therefore, the psychological needs of the student have an influence on the student's acceptance of the MLA, which contributes to the UX. Souders (2021) maintained that to fully understand the users, the users' needs should be identified in the context in which the interaction happens. Berni and Yuri (2021) argued that the user's needs are determined by the place and time in which the interaction occurs, and that needs to be considered.

MLAs meet the educational needs of students, irrespective of place and time limitations (Venkataraman & Ramasamy, 2018). Therefore, the student's interaction with the MLA requires the effortless use by students anywhere and anytime (Amir *et al.*, 2022; Norman & Nielsen, 2022). Souders (2021) indicated that users' needs have an influence on the interaction with the system; the type of system determines how the system will be interacted with, and the specific situation influences the interaction which affects the UX. Therefore, for a successful implementation of any system (MLA), it must be highly prioritised that users (students) have a positive UX when interacting with a system (MLA) and this can only be achieved if user (student) needs are prioritised (Andreas *et al.*, 2022).

3.2.2 Perceptions of the user

The use and conduct when interacting with a system can be influenced by how a user perceives a system (Andreas *et al.*, 2022). The ISO (2019) definition of UX stipulates that UX relates to how a user perceives an interaction with a system, service or product. Hence, a strong insight into the characteristics of the user, system and interactions is necessary when designing effective UXs (Berni & Yuri, 2021). However, as mentioned in Section 2.2.4, the current study focused on UX and not system design. In a mobile phone context, perception is a determining factor in how students adopt and use MLAs (ISO, 2019).

Pragmatic qualities (usability), such as perceived usefulness and perceived ease of use are factors that influence the use of the system (Amir *et al.*, 2022). Davis (1989) stated that the perceived ease of use refers to a user's belief that the interaction with a certain system would be effortless, while perceived usefulness refers to the amount of trust that a user has in a system, and how using the system can improve their performance. The importance of perceived usefulness is that students are motivated to use the MLA when they feel it would be beneficial to them (Amir *et al.*, 2022). Therefore, the perceived pragmatic qualities influence the usage and conduct of students while interacting with the MLA (Hassenzahl & Tractinsky, 2006), consequently impacting the student's acceptance of the MLA (Almaiah & Mulhem, 2019).

The hedonic qualities (pleasure and attractiveness) of the system are the user's identification and expression when using the system (Claire, 2020). Riedmann-Streitz (2018) stated that the hedonic quality focuses on the system's perceived capacity to be used with enjoyability. Therefore, the perceived enjoyment is also an important factor because students will accept and use the MLA if it is enjoyable and can make academic life easy (Amir *et al.*, 2022). Hassenzahl *et al.* (2018) added that hedonic qualities include providing a user with pleasure, satisfaction, and other perceptions such as motivation. Therefore, hedonic qualities such as pleasure, satisfaction and motivation influence the student's satisfaction with the system. Additionally, Berni and Yuri (2021) indicated that the influence of the perceived visual attractiveness as a hedonic quality is a main factor for the user's (student) satisfaction with the system (MLA). Consequently, the student's acceptance of the system can be influenced by

their hedonic perceptions (Andreas *et al.* 2022), and the perception of a student influences the use and conduct when interacting with the MLA (ISO, 2019).

The user's need for pragmatic qualities influences the user's acceptance, while the user's need for hedonic qualities influences the user's satisfaction. A correlation with this is a definition of satisfaction formulated by Tian, Hou and Yuan (2008) which described satisfaction as the personal stage where a user reaches acceptance and satisfaction while interacting with a system. Blythe and Wright (2003) agreed that in learning, the focus of students using MLAs has changed to be on pragmatic (usefulness) and hedonic (enjoyment).

Amir *et al.* (2022) stated that perceived usefulness is a crucial factor influencing UX, and that perceived enjoyment is a central factor influencing UX. The satisfaction factor is determined by the user's feedback that the system is easy to use and useful (Andreas *et al.*, 2022). Therefore, it is necessary to provide students with easy to use, useful and attractive features when developing MLAs. While considering these qualities, it is important to remember that the UX of a system is bound to change over time, for example, how a user perceives an interaction with the system on the first encounter will surely be different from that of a regular user of the same system (De Kock, 2017).

3.2.3 Emotions of the user

The reality of UX has developed into a broad notion which comprehensively delivers a perspective on the interaction of users with technology. This notion is considered to be a multidimensional phenomenon, and includes how users perceive different qualities of a system and their arising emotions as a consequence of interacting with a system (Minge & Thüring, 2018). The emotions are also influenced by external factors such as the space and time where the interaction takes place (Berni & Yuri, 2021).

Berni and Yuri (2021) stated that the functional and non-functional needs of the user influence the emotions of the user. Emotions are a vital part of life, are created on an occurred experience, and have an influence on users' feelings, behaviour and thoughts, and have been recognised as significant in interaction design (Amir *et al.*, 2022). Amir *et al.* (2022) conveyed that UX involves a range of crucial dimensions, such as emotions, which are one of the main measurements in determining the UX of

interactive systems. As stated by Berni and Yuri (2021), emotions can affect how users intend to interact with a system, can affect the actual user interaction with a system, and the results and user perceptions that are encompassing those interactions.

Amir *et al.* (2022) indicated that emotions include moods that are pleasing, displeasing, satisfactory or unsatisfactory. Berni and Yuri (2021) stated that positive or negative feelings can influence how users interact with a system. Claire (2020) indicated that positive emotions can be invoked in the user by the look (appearance) of the system. Therefore, it is recommended that the user's emotional state as an influencer of UX be understood prior to evaluating the UX and after the user's interaction with the system (Berni & Yuri, 2021).

UX evolves depending on the user, the system and the context in which the interaction occurs (Muditha, 2020). The user exposure to a different system or new situation can invoke certain user emotions. The emotion of the user in various states influences the UX (Berni & Yuri, 2021).

The current study adopted the definition stating that UX is a consequence of the user's internal state, the designed system aspects, as well as the context in which the interaction happens (Hassenzahl & Tractinsky, 2006). The internal state is a consequence of the user's needs, perception, expectations, past experience, motivation and mood (Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021). The emotional state of the student when interacting with the MLA will influence the UX. For instance, an interaction of the student with the MLA in a positive mood may result in positive UX, and an interaction of the student with the MLA in a negative mood may result in negative UX (Langenhoven, 2016). Kelvin (2022) stated that negative UX causes numerous unexpected issues and emotions such as irritation and frustration among users (students). Amir *et al.* (2022) indicated that irritated and frustrated users (students) are strained and demotivated.

3.2.4 Motivation of the user

As stated by Hassenzahl and Tractinsky (2006); Berni and Yuri (2021), interaction with the system can invoke characteristics, such as needs, motivations, emotions, expectations, past experiences, predispositions, user's internal state and resources. Hassenzahl and Tractinsky (2006) explained that the user's internal state is where users have expectations about the system, which potentially changes the user's mood

resulting in an alteration of the motivation to interact with the system, and expectation when interacting with the system. Berni and Yuri (2021) agreed that an evaluation is taking place when the user is interacting with the system, and based on the results of the evaluation, the user's emotions, perception, motivation and opinions regarding the system are determined. Users are demotivated by a system that provides a negative UX (Amir *et al.*, 2022).

Berni and Yuri (2021) defined the user (student) in the context of UX as a person interacting with the system (MLA), in which user's (student) characteristics such as motivation and expectation are induced during the interaction and afterwards. Therefore, when the UX of a system (MLA) is positive, users (students) are motivated to use the system (MLA) because of an improved experience, resulting in motivation to achieve and perform better being accentuated (Amir *et al.*, 2022).

3.2.5 Expectations and past experiences of the user

Expectations have an influence on UX and result from the interaction with the system (Andreas *et al.*, 2022). To provide positive UX, it is recommended to evaluate the expectations in the initial phases, as user and system design expectations may differ (Amir *et al.*, 2022). To design MLAs for students, the design should be aligned with the student's expectations of the system. Students have expectations such as usability, satisfaction and positive UX when interacting with the system (Andreas *et al.*, 2022). Therefore, student expectations influence the constant use of the MLA (Amir *et al.*, 2022), which depends on the satisfaction with the system's performance (Andreas *et al.*, 2022). Satisfaction is achieved when the user's (student) expectations are met (Andreas *et al.*, 2022). Student satisfaction can be determined by the students' views based on their expectations of what the MLA should provide or how it ought to behave and respond (Andreas *et al.*, 2022). The experience is associated with prospects for good expectations or uncertainties and fear of bad experiences, and it occurs after the user's interaction with the system (Amir *et al.*, 2022), and considers more than the usability and functionality of the system (Berni & Yuri, 2021).

Hassenzahl and Tractinsky (2006) mentioned personal expectations and past experiences as two critical factors affecting the UX of a system. High expectations and negative experiences are the most uncontrollable factors affecting the success of a system. They vary based on past experiences and result in a negative influence when

a user interacts with the system. As advised by Brown, Venkatesh and Goyal (2012) users (students) need to set and maintain realistic expectations to avoid negative consequences from unmet or high expectations. Amir *et al.* (2022) added that it is also important that user expectations are understood to be able to match them with business goals and all other factors.

Therefore, to deliver positive UX, the student's expectations are that the MLA has the required pragmatic and hedonic qualities to execute tasks effectively and efficiently. Amir *et al.* (2022) indicated that users' expectations of a system's functionality result from the pragmatic quality of UX. Karapanos (2010) highlighted that even though systems may change over time, past experiences mostly relate to the hedonic side, but with persistent usage, the experiences serve to reveal how users become emotionally attached and systems develop to become more significant in life.

3.3 SYSTEM FACTOR: MOBILE LEARNING APPLICATION

A system can be referred to as the required structure of the subject under study to be seen as functional, easy to use and robust (Amir *et al.*, 2022). The system is the product, service and infrastructure that a user interacts with. Some of the characteristics of the system are flexibility, stability, learnability, availability, functionality, robust, reliability and information security (Hassenzahl & Tractinsky, 2006). Berni and Yuri (2021) stated these characteristics produce emotions that are negative or positive, and that subsequently result in the UX of the system.

The computing and wireless communication development and the implementation of mobile technologies have translated into huge opportunities in the field of mobile learning (Khampirat, 2021). According to Amir *et al.* (2022), mobile learning refers to an information systems approach where mobile devices are used to conduct learning procedures. Khampirat (2021) highlighted that these procedures offer the rapid availability of learning activities, study materials and student information anytime, anywhere and anyhow. Kar, Kar and Gupta (2021) indicated that mobile learning permits unlimited channels for communication between students and lecturers. Shen *et al.* (2018) added that mobile learning also provides the opportunity for interaction between students and the institution, such as administrative services (registration and paying fees).

Higher education institutions have adopted the use of MLAs worldwide. Particularly, since the inception of Covid-19 in 2020. In SA, there are many initiatives that are aimed at improving student performance by continuously investing in modern technology (International Trade Administration, 2021). In the Gauteng province, the department of Education introduced mobile technologies in education (Patel, 2018). The city of Joburg launched a website to provide access to digital content and information for learning through the use of mobile devices (City of Joburg, 2021). Unisa adopted digital technologies with the provision of myUnisa. myUnisa is a platform (mobile learning application or MLA) that provides the needed information and services to students (Unisa, 2022).

However, there are factors influencing the use of digital technologies that must be addressed (Criollo-C *et al.*, 2021). Factors such as quality, which influences the UX (Althunibat *et al.*, 2021). The current study focused on the UX of students when interacting with MLAs at HEIs. Thus, the aim is to obtain feedback and perceptions regarding the MLA (namely, myUnisa) from students as the primary users of the app (MLA).

3.3.1 Background of mobile learning application

In 1968, a computer scientist, named Ian Kay, envisioned the first mobile learning; this was before phones became digitalised (O'Connell, 2021). Ian Kay proposed a portable computer (Dynabook) that would enable children to learn anywhere and anytime. Kay's proposal outlined the requirements for the portable learning device and it would offer similar functionality as to what is now known as a laptop or tablet (O'Connell, 2021). The Dynabook was the foundation of mobile learning, even though it never materialised.



Figure 3.1: The Dynabook, shown here in use, has a keyboard and a screen

Mobile learning emerged and took centre stage following the development of smartphones that enabled the use of learning management systems (LMSes) to provide the availability of content across mobile platforms (O'Connell, 2021). However, not all institutions instantly embraced the mobile learning initiative, until 2012 when MLAs emerged with a 45% implementation in top learning institutions, while 70% of other institutions had plans to implement mobile learning (O'Connell, 2021). Operating systems like Microsoft windows, Android and Apple's iOS have become more advanced and have dramatically transformed mobile technologies (Rodríguez-Arancón *et al.*, 2013). Mobile technologies are now used in numerous areas in daily life (Redmond and Macfadyen, 2020), and have transformed the learning model and provision of information by offering a complete set of applications (MLAs) to support and help learning institutions (Criollo-C *et al.*, 2021).

HEIs have not been exempted from adopting MLAs to cater for the constantly changing needs of students (Baharum *et al.*, 2020). While there are numerous descriptions of MLAs that are based on their characteristics, having access to educational content without time and place limitation is one of the common definitions (Serin, 2012). Criollo-C *et al.* (2021) stated that the learning of students anytime and anywhere with the use of MLAs support and help learning institutions. Chavoshi and Hamidi (2019) indicated that the portability and accessibility of MLAs support and help learning institutions by making it possible to facilitate active and self-regulatory learning by motivating students, and promoting individual or collaborative learning and communication among students.

The global emergence of Covid-19 resulted in the increased rapid adoption of the use of MLAs, and has motivated many HEIs to adopt MLAs to conduct the process of teaching and learning (Althunibat *et al.*, 2021). The crucial role that MLAs played during the Covid-19 pandemic has increased the popularity and interest among students. This is mainly due to the benefits and effectiveness that it adds (Althunibat *et al.*, 2021). Romero-Rodríguez, Aznar-Díaz, Hinojo-Lucena and Gómez-García (2017) pointed out that the increased popularity and interest from the students have noted a highlighted improvement in learning.

Although MLAs are widely used these days, they are not yet being used to their full potential (O'Connell, 2021). The characteristics of mobile phones, such as battery capacity, screen size, ram and data capacities may limit the mobile device usage in

the learning context (Chen, Chang & Wang, 2008). Currently, the limitations have been on the factors of UX influencing the MLAs.

3.3.2 User experience in mobile learning application

The capacity of providing a diversity of administrative and learning services which can be developed using various kinds of mobile devices, without time and geographical limitations is the main reason for MLAs (Amir *et al.*, 2022). According to Khan, Abdou, Kettunen and Gregory (2019), MLAs also provide students with the ability to facilitate skills development, such as self-regulation of learning.

HEIs use MLAs to satisfy the requirements of students and to provide high quality services (Gharaibeh & Gharaibeh, 2020). Criollo-C *et al.* (2021) stated that the development of MLAs is to improve the students' overall experience. Since UX changes depending on the user, circumstances, system and environmental factors where the interaction takes place, Amir *et al.* (2022) recommended that UX need to be considered and monitored when developing efficient and effective systems. Almaiah, Alamri and Al-Rahmi (2020) emphasised that for students to use MLAs, HEIs need to provide a UX that is unique and high in quality. Amir *et al.* (2022) stated that the characteristics of system quality are the flexibility of the system, ease of use, enjoyment, information-system reliability and security. Amir *et al.* (2022) indicated that the user displays appreciation through positive feedback when a system is perceived easy to use.

The system refers to the required structure of the subject under study to be regarded as functional, easy to use and robust (Amir *et al.*, 2022). Norman and Nielsen (2022) stated that user's (student's) interaction with the system (MLA) may influence the UX of the user. UX involves every aspect of end-users when interacting directly with an institution, its products and its services (Norman & Nielsen, 2022). Ssemugabi (2019) stated that UX is a personal, subjective feeling about the product (MLA) which focuses on the user (student), and which goes further than customary usability by considering characteristics such as fun, pleasing appearance, pleasure, and personal development related to the interaction with the system. Amir *et al.* (2022), similarly, defined UX as the feeling of pleasure and satisfaction felt by users while using a product, or the opposite feeling. Hassenzahl (2018) expanded that the good or bad feeling users get when using a system or product, explains how users feel about a

product, how enjoyable and satisfactory an interactive product is, and comprises of every aspect of the product's desirability and usability from the perspective of the users.

Outside of learning, Saavedra and Opfer (2012) stated that the innovation of MLAs can potentially enhance additional skills such as communication, reasoning and problem-solving. Hence, the study of learning innovations and UX has become increasingly important in educational research (Criollo-C *et al.*, 2021).

3.3.3 Factors influencing mobile learning applications

Many HEIs have adopted the initiatives and have realised the importance of mobile learning initiatives. This has inevitably resulted in the provision of learning services being offered by mobile technologies (Criollo-C *et al.*, 2021). Similar to any other technology initiative, the implementation of mobile learning is still facing some critical challenges (Azizi & Khatony, 2019). To implement successful and effective MLAs involves the identification of factors that influence MLAs (Berni & Yuri, 2021).

A study by Azizi and Khatony (2019), indicated the important and positive influence on the intent of students to use MLAs. Since students are willing to use MLAs, efficient MLAs can be implemented by investigating the factors influencing MLAs (Criollo-C *et al.*, 2021). Hence, various studies have investigated the factors influencing MLAs (Sophonhiranrak, 2021). In the current research, students use the MLA for learning purposes at an HEI. Therefore, it seemed appropriate to specify the factors that may influence students when using the MLA in the current study.

Previous studies indicated that the main motivation for the use of mobile devices in learning was compatibility (Parsazadeh, Ali & Rezaei, 2018). Some studies indicated that the attitudes of students and lecturers was regarded as the second most commonly stated factor influencing mobile learning (Alghazi, Wong, Kamsin, Yadegaridehkordi & Shuib, 2020). A study by Sophonhiranrak (2021) indicated that both compatibility and attitudes towards MLAs were identified as key factors in terms of why they are being used as learning tools.

A study by Azizi and Khatony (2019) identified the factors influencing the use of MLAs as pedagogical and psychological factors. This refers to a pedagogical factor such as the learning content design that needs to be compatible with mobile learning (Azizi & Khatony, 2019), while psychological factors are related to the mind of the student. In

this regard, Berni and Yuri (2021) stated that the ability of the student to interact with the system relies on the mind, hence, students must be psychologically ready for the adoption and usage of a system (Berni & Yuri, 2021).

Almaiah, Al-Khasawneh, Althunibat and Almomani (2021) found that psychological factors may negatively influence the actual use of an MLA. Almaiah and Al Mulhem (2019) indicated that organisational factors such as cultural factors, technology readiness, and resistance to change can influence the experience of MLAs. In addition, Althunibat *et al.* (2021) added that organisational factors, such as change management, top management's support and institutional policy, are factors that influence MLAs, and that these factors are mediated by quality factors (quality of system, of service and of content).

A recent study by Almaiah *et al.* (2021) indicated that factors of technology, such as compatibility, security, privacy, trust, and relative advantage, can also influence MLAs. Furthermore, the results also showed that the factors of technology have an important role to play in solving the psychological issues amongst students (Almaiah *et al.*, 2021).

Abeywardhane, Lutzhoft and Ghosh (2021) stated that identifying the factors that influence the MLA potentially increases the students' use of the MLA. Moreover, Azizi and Khatony (2019) stated that the identification of factors that influence the MLA play an important role in the design and implementation of effective MLAs. Al-Emran, Elsherif and Shaalan (2016) maintained that despite the aforementioned factors, the use of MLAs is still widely considered.

The next sub-section discusses the pragmatic and hedonic qualities of the system.

Pragmatic and hedonic qualities of the system

These are the pragmatic and hedonic qualities of the system that are required for students to efficiently and effectively use the system, and which may influence the UX (Berni & Yuri, 2021; Andreas *et al.*, 2022) as adopted by this study.

1. Pragmatic quality: Usability of the system

The pragmatic quality is the systems' perceived capability of enabling the accomplishment of a specific objective (Hassenzahl, Diefenbach & Göritz, 2011). The pragmatic quality focuses on the system's usefulness and usability as related to

potential tasks (Amir *et al.*, 2022). According to the ISO (2019), usability is the degree to which certain users are able to use a system, product or service to accomplish certain objectives with efficiency, effectiveness and satisfaction in a certain context. Efficiency and effectiveness are objective measures that are used to measure pragmatic quality (Berni & Yuri, 2021) through testing the completion rate, number of errors and time on certain tasks. User satisfaction as a subjective measure, and is mainly concerned with the user's perceptions and experiences concerning the efficiency and effectiveness and of the system, and it is measured by post-test questionnaires.

Amir *et al.*'s (2022) study found that a system ought to be easy to use, and ought to focus mainly on the criteria of usability, for instance, efficiency, effectiveness, usefulness, learnability, safety, flexibility and robustness, which are pragmatic qualities or the usability aims for the system. Amir *et al.* (2022) indicated that for a system to be regarded as satisfying, the focus should not wholly be on efficiency and effectiveness, but it should also consider satisfaction as a pragmatic quality influencing the UX. In addition, the pragmatic aspect of a system does not only focus on usability, but it also includes users' expectations, users' need (Hassenzahl *et al.* 2011), and the user's need for control and security (Redmond & Macfadyen, 2020; Amir *et al.*, 2022).

According to Pengnate and Sarathy (2018), the goal of HCI goal is to certify the overall efficiency, safety (security) and effectiveness of a system, without exclusion of computer software and hardware systems. Software and hardware are the reliable functioning of a system which can influence the pragmatic quality of a system. Tuch and Hornbæk (2015) referred to pragmatic quality as a technical quality that refers to the basic functioning and performance of the system. Botha, Herselman and Van Greunen (2010) and Amir *et al.* (2022) indicated that reliability, stability, network availability and power supply are pragmatic qualities that have also been found to influence the felt experience. For their part, Hassenzahl and Tractinsky (2006) indicated usability, functionality, flexibility, stability, learnability, availability, robustness, reliability and information security as the pragmatic qualities of the system that users need. Berni and Yuri (2021) stated these characteristics produce emotions that are negative or positive, and subsequently, result in the UX of the system.

Experience is different and is dependent on a user and a certain situation. Pragmatic quality refers to the capacity of a system to enable the achievement of specified tasks

(Hassenzahl *et al.*, 2011). When the student is using an MLA for learning purposes, that could be regarded as being goal-oriented, as the purpose of the student is to accomplish the task efficiently and effectively. Although the usability of the MLA is excluded from this research, the research does explore usability as a factor that is incorporated in UX.

2. Hedonic quality: Pleasure and attractiveness

Hedonic qualities are mainly associated with the users' identification and self-expression when using a system (Amir *et al.*, 2022). Riedmann-Streitz (2018) stated that the hedonic quality focuses on the system's perceived capability of supporting the success of *be*-goals and enjoyability, such as being social, being admired and being competent.

The system must consider the hedonic qualities which include providing the user with pleasure, satisfaction and other perceptions like motivation (Hassenzahl *et al.*, 2018). Hassenzahl and Tractinsky (2006) and Claire (2020) added visual attractiveness as an important hedonic factor that should also be considered in system. Hassenzahl (2018) motivated the inclusion of attractiveness by indicating that users are motivated by an attractive system.

The concept of hedonic quality leads to an improved understanding of the system qualities that are related to positive UX. UX allows an improved predictive influence of preference, attitude, acceptance and motivation of a system (Hassenzahl *et al.*, 2011). Andreas *et al.* (2022) indicated that the hedonic quality of a system may influence the emotions of satisfaction or excitement which contribute to the felt experience. UX studies stated that users perceive systems in terms of pleasure, affect, aesthetics and fun (Amir *et al.*, 2022). Andreas *et al.* (2022) stated that hedonic qualities contribute directly to the core of positive experience.

In systems, pragmatic and hedonic qualities are both key dimensions of UX (Minge & Thüring, 2018; Riedmann-Streitz, 2018). Berni and Yuri (2021) stated that combining the pragmatic quality and hedonic quality produces emotions that are negative or positive, and subsequently, result in the UX of the system. As specified by Amir *et al.* (2022), the hedonic quality focuses on the user's experience of excitement and pleasure, while the pragmatic quality focuses on the user's expectations of how usable and functional the system is. The current study focuses on pragmatic qualities such

as efficiency, effectiveness, usefulness, functionality, learnability, reliability, stability, network availability, security, flexibility, robustness, and hedonic qualities of the system such as satisfaction and visual attractiveness.

3.3.4 Characteristics of the mobile learning application that influence the UX

Usability, functionality, purpose and complexity are some of the characteristics that a system must have (Hassenzahl & Tractinsky, 2006). Amir *et al.* (2022) added efficiency, effectiveness, usefulness, learnability, safety, flexibility and robustness as system features. Pragmatic quality focuses on the system's usefulness and usability concerning potential tasks (Amir *et al.*, 2022), but it should also consider satisfaction as a pragmatic quality. In addition, the pragmatic aspect of a system does not only focus on usability, but it also includes the users' expectations, users' needs (Hassenzahl *et al.* 2011), and the users' need for control and security (Redmond & Macfadyen, 2020; Amir *et al.*, 2022).

Figure 3.2 presents the general mobile application characteristics as identified by Elkhair and Mutalib (2019).

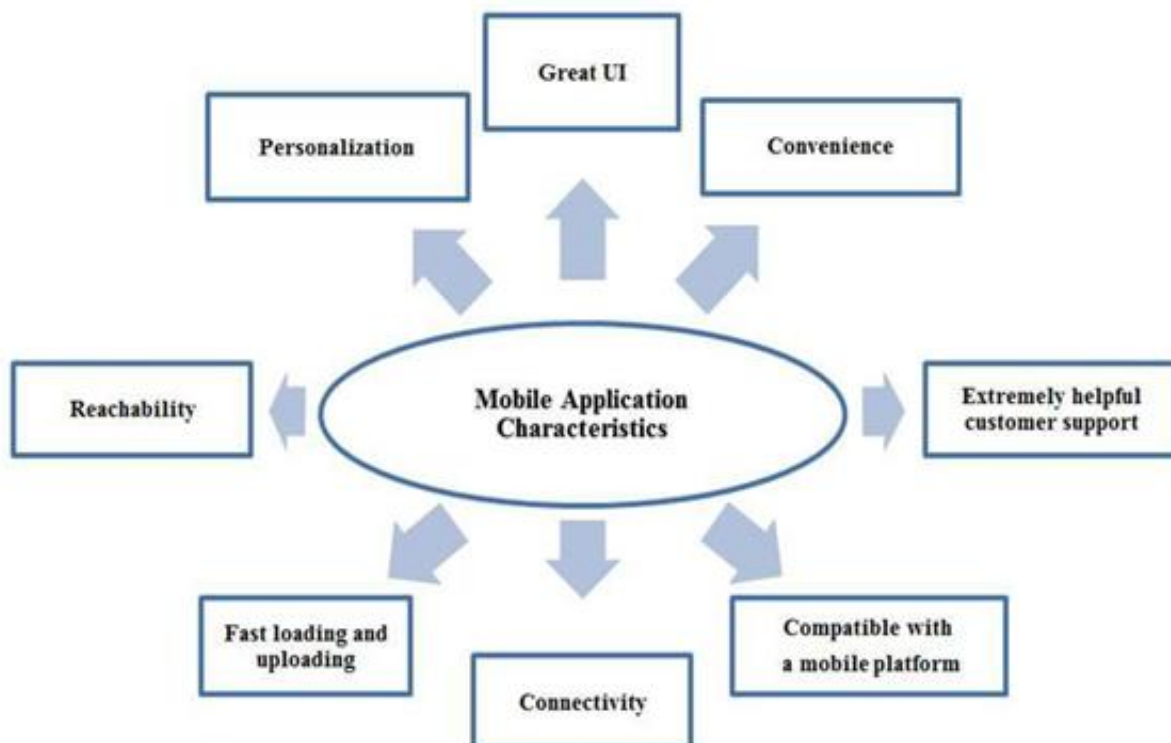


Figure 3.2: General mobile application characteristics

Source: Elkhair & Mutalib (2019)

Figure 3.2 presents the characteristics of a high-quality mobile application. There are two categories of mobile characteristics: category one is called the multimedia category and comprises of convenience, user interface and the personalisation option; category two is the applications of performance that comprises of the application's connectivity, support, reachability, compatibility and fast loading and uploading. According to Elkhair and Mutalib (2019), a high quality mobile application should consider these characteristics. Moreover, Amir *et al.* (2022) stated that these characteristics influence the UX. The next section discusses the context factor of UX.

3.4 CONTEXT FACTOR: UNIVERSITY OF SOUTH AFRICA, MYUNISA

Users with particular characteristics interact with systems in a particular context to achieve a particular goal. Context refers to a space, condition and time in which an activity can occur (Berni & Yuri, 2021). Amir *et al.* (2022) referred to context as the physical environment in which the user's interaction with the system occurs. According to Berni and Yuri (2021), context is evidence that is utilised to characterise the entity of the situation, where an entity is considered any relevant location, person, or object related to the interaction between an application and a user. Jumisko-Pyykkö and Vainio (2010); Amir *et al.* (2022) stated that context is a significant factor of UX.

The context in which learning takes place comprises of a complex collection of factors that influence student achievement and satisfaction (Amir *et al.*, 2022). In HCI, there are small differences when categorising the context factor. Berni and Yuri (2021) categorised and proposed the physical, temporal, task and social as factors of context. Roto (2006) came up with a proposition of a similar categorisation specifically formed for the mobile browsing context. Numerous context researches feature technical and information factors in addition to physical, temporal, task and social as factors of context (Väänänen & Ruuska, 2000; Berni & Yuri, 2021).

A study by Norman and Nielsen (2022) indicated that when a user interacts with a system, the context in which the interaction takes place can have an influence on the UX. Roto (2006) indicated that the context factor in which interaction occurs may contain objects and systems that may not form part of the system but which may influence the UX. UX refers to all aspect subsequent to the interaction between a user and a system within a specified context. UX evolves depending on the user, the system and context where the interaction occurs (Karapanos, 2010; Muditha, 2020).

The current study investigated the factors (user, system and context) that could influence students when using an MLA. Figure 3.3 presents the context of use factors and sub-factors in a mobile system (Jumisko-Pyykkö & Vainio, 2010).

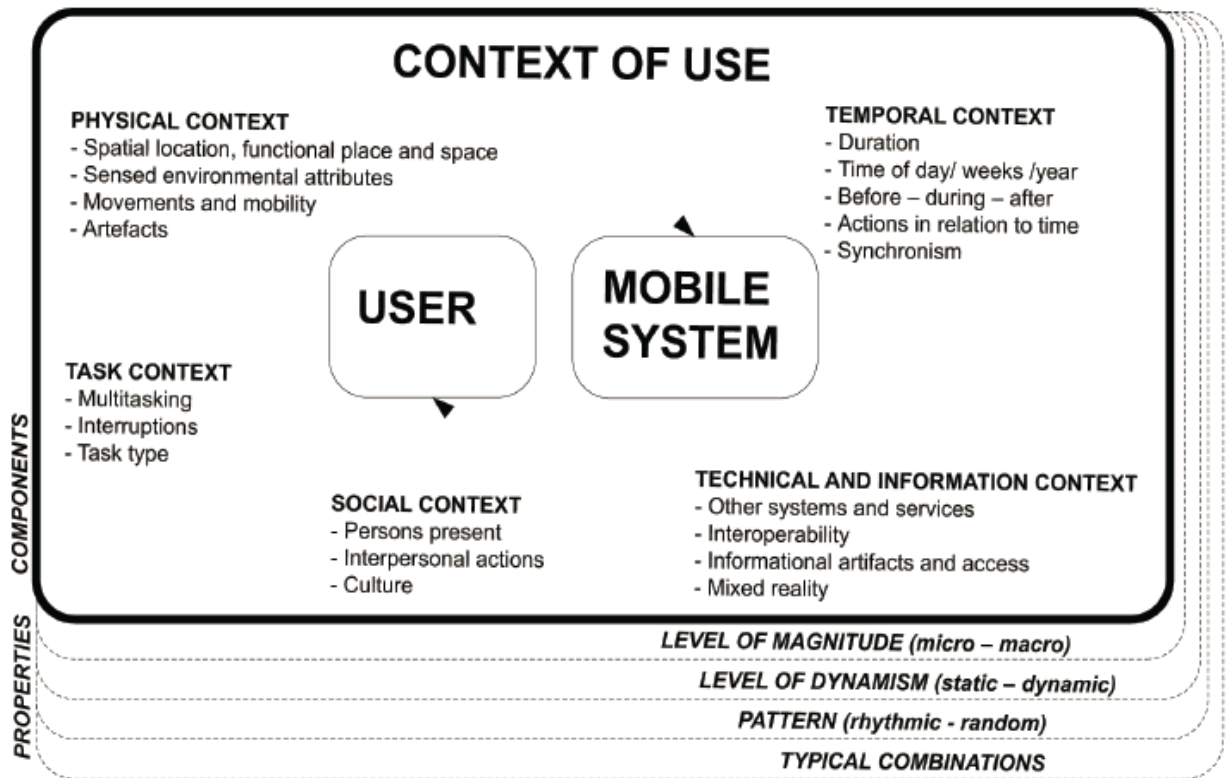


Figure 3.3: Context of use framework in a mobile system

Source: Jumisko-Pyykkö & Vainio (2010)

The context of use framework in a mobile system, as illustrated in Figure 3.3, defines the environments where users interact with the mobile system, and contains the main factors of context (physical, task, temporal, social, technical and information), associated sub-factors and context properties (level of dynamism, pattern, magnitude and typical combinations). These factors may influence the UX.

As indicated by Berni and Yuri (2021); Amir *et al.* (2022), the context where the interaction takes place is the biggest concern when the users interact with the system. According to Amir *et al.* (2022), the context in which learning happens includes factors that influence student achievement and satisfaction. When the student achievement and satisfaction with an MLA is compromised, UX becomes compromised too. Berni and Yuri (2021) indicated that UX varies depending on the environment where the interaction occurs. When the context of use evolves, UX evolves also, while the

system does not evolve (Amir *et al.*, 2022). To improve the UX, systems (MLAs) must align to the existing context (Law *et al.*, 2009; Berni & Yuri, 2021).

For the purposes of the current study, the physical context where the interaction occurs is a higher learning institution in Gauteng. The social context comprises of the stakeholder's cultures, opinions of stakeholders and other people, as well as the user's lack of knowledge. The task context comprises the use of MLAs by stakeholders (students, lecturers and HEI staff). The temporal context includes the user's interaction with the system at a specific time. These factors can influence the UX of a student interacting with the MLA.

The next section discusses the sub-factors relevant to the context factor. Section 3.4.1 discusses the physical context, Section 3.4.2 discusses the social context, Section 3.4.3 discusses the temporal context, Section 3.4.4 discusses the task context, and Section 3.4.5 discusses the technical and information context. Furthermore, this section discusses the influence of using MLAs at HEIs and the challenges related to MLAs at HEIs.

3.4.1 Physical context

The physical context is when and where a user interaction with the system, referring to the place and the time of the interaction. Jumisko-Pyykkö and Vainio (2010) defined it as features of situation that are apparent where the human-mobile computer interaction is taking place. Berni and Yuri (2021) described it as a physical environmental constraint in which mobile technologies are functioning. Kiljander (2004) added that the physical constraint in environmental usage is either seen or felt, and includes the tangible and intangible physical surroundings, and their movement in which the interaction occurs (Berni & Yuri, 2021).

The constraints are factors such as perceived environmental attributes, functional place and space, movements and mobility (Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021). The tangible surroundings refer to aspects such as the current location, time of the day, noise and crowdedness. The intangible physical factors include weather conditions, for instance, rain, storm, thunder, lightning, wind and light intensity. Additionally, the physical context relates to the constraints that users cannot control, foresee or avoid, and which can influence the UX (Arhipainen, 2009).

The physical space of the students at Unisa can be anywhere on the premises. Unisa is an ODeL institution, therefore, students can interact with the MLA at home or in any other physical environment. Amir *et al.* (2022) stated that the system requirement is to provide functionality to the user without limitations related to the place where the interaction occurs.

3.4.2 Social context

The social context is the effect on, expectations of and influences that other people have on a user, or the user's participation in an interpersonal interaction or social situation. The use of a system in a social context may expose the user to disturbances that would require divided attention between the user and the social environment. Jumisko-Pyykkö and Vainio (2010) defined the social context as additional people that are present, their roles and characteristics, surrounding culture and social situations that influence the interaction of a user with an MLA. Arhipainen (2009); Berni and Yuri (2021) indicated that the social, cultural, temporal, technological situations and environment of the institution (Unisa) and other people regarding the use of the MLA (namely, myUnisa) have an influence on the user's (student) interaction with the MLA.

3.4.3 Temporal context

The temporal context defines the interaction of a user with the system as related to the timing of activities in numerous ways, such as the duration, time of day, week, year, during earlier situation, and after use (Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021). It refers to the time that the user sets aside for interaction with the system in a context-restricted situation, and relates to the user's general goals, engaged tasks and spontaneous activity when using the system (Schmidt, Beigl & Gellersen, 1999).

In a temporal context, there are two different aspects of good UX, namely, the action and the goal mode (Hassenzahl, 2018). In goal mode, the user primarily wishes to accomplish a certain goal, for instance, find out about the assignment due date or assessment time before missing it. In action mode, the user desires to find stimulation, such as interacting with a system while waiting. The demands of these two cases in terms of a positive UX are different. Berni and Yuri (2021) stated that it is possible that the system is used in both modes, so both effectiveness and stimulation should continuously be available for users to have good UX.

The user's situation evolves over time, resulting in UX evolving (Muditha, 2020). As indicated by Jumisko-Pyykkö and Vainio (2010), the context of the system can be influenced by a circumstance that occurred prior and post the interaction, thus influencing the UX. Karapanos (2010); Berni and Yuri (2021) stated that in the temporal context, UX is influenced by the time of an activity's occurrence before and after an interaction. Andreas *et al.* (2022) indicated that an activity's occurrence before, during and after an interaction influences the UX. Therefore, it is recommended to evaluate the UX before, during and after use of an MLA (Berni & Yuri, 2021).

Figure 3.4 presents the proposed stages (four) or UX time spans, as anticipated, momentary, episodic or cumulative stages of UX, as proposed by Roto *et al.* (2011).

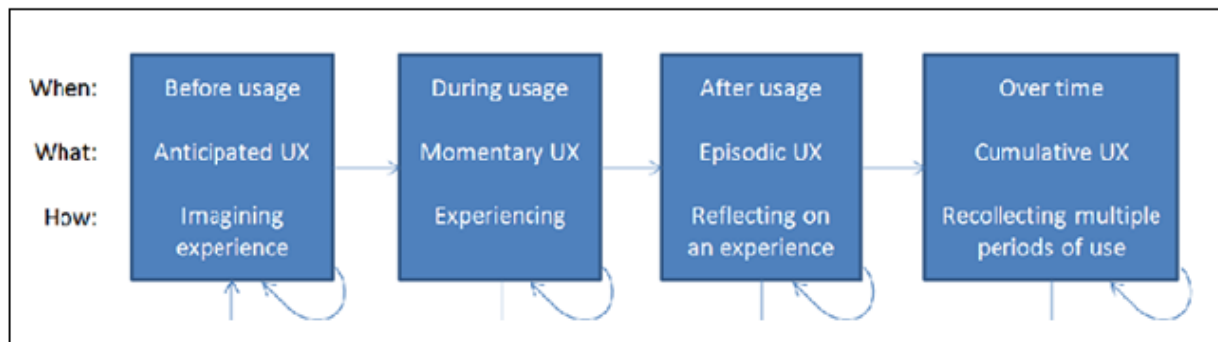


Figure 3.4: User experience of time spans

Source: Roto *et al.* (2011)

3.4.4 Task context

This is the process of eliciting descriptions of students' activities, representing those descriptions, predicting problems and evaluating the systems against measures, such as the functional requirements or usability (Preece *et al.*, 2015). It is the role of a system in a user's high-level goal and is concerned with the user's activities to accomplish tasks. It defines the surrounding tasks in connection with the user's mission of using the system to achieve a certain goal.

The task context refers to additional tasks that need urgent attention and interruptions while a student is interacting with an MLA (Roto *et al.*, 2010). The task context comprises of multitasking, interruptions and the task domain (Muditha, 2020). To accomplish a certain goal, students must focus on a task and need to manage other unplanned factors and multitasking (Preece *et al.*, 2015).

At HEIs, students use MLAs for other tasks, such as enquiries, communication, socialising and administration, which results in multitasking while interacting with the MLA. In addition, unplanned activities, such as managing their personal life, while interacting with the MLA results in an interruption. Arhipainen (2009); Berni and Yuri (2021) stated that interaction with the MLA in these task contexts may influence the UX. Amir *et al.* (2022) added that even in these task contexts, the user need to complete a task without effort to show satisfaction.

3.4.5 Technical and information context

The technical and information context defines the connection of systems that are relevant to the interaction of a user with the system, and other services such as applications, devices, infrastructure and networks (Berni & Yuri, 2021). Berni and Yuri (2021) emphasised that users depend on the availability and functioning of these services. Economides and Οικονομίδης (2021) indicated that an MLA requires functional technical features.

The malfunctioning of technical and information services such as network issues, connectivity issues or system sluggishness may influence the UX of the students (De Kock, 2017). Amir *et al.* (2022) indicated that users start searching for alternative MLAs with more technological functionalities and competences. Therefore, it is essential that the technical infrastructure, network and MyUnisa remain stable and constantly available to the students. Internet service providers are required to reliably and continuously support the constant internet services of Unisa (De Kock, 2017). Additionally, Eskom also needs to be constant and reliable in supplying electricity so that internet services are available to internet providers.

The current study adopted the physical, social, temporal, task, and technical and information context to formulate the conceptual framework of this study. These context factors have an influence on the student when interacting with the MLA. For an improved UX, Economides and Οικονομίδης (2021) advised that an MLA must be functional in all the context sub-factors. In the current study, the words context and context in use are used interchangeably.

The sub-section below discusses the influence of using MLAs at HEIs.

3.4.6 Influence of using mobile learning applications at higher education institutions

The HCI focuses on the computer technology design and how users interact with it (Amato, 2021). The HCI uses computers as an instrument for supporting, simplifying or performing the necessary tasks in business and in learning (Hassenzahl, 2008). Globally, the use of mobile phones for learning purposes in HCI has been widely adopted. With the use of MLAs, the possibility for effective learning and teaching continues to grow (Abidin & Tho, 2018). Even Google has proclaimed the intention to launch its own learning platform (Lamberti, 2020). In the Gauteng province, the City of Joburg has provided access to digital content and information for learning development using mobile devices (City of Joburg, 2021). Grant (2019) identified an MLA as a student's interaction with mobile computing devices within a learning environment. MLAs have become the main tools in general use for students, lecturers, employees and HEIs (Kam, Wong, Yau & Wong, 2017).

Nikolopoulou, Gialamas and Lavidas (2020) stated that MLAs at HEIs have been associated with several benefits such as the influence it has on student learning performance. A study by Kaliisa and Picard (2017), regarding the mobile learning in higher learning systems of Africa, found that mobile learning at HEIs in Africa influences the collaboration between students and lecturers. Additionally, MLAs influence skills development in terms of self-regulation and participatory learning (Khan *et al.*, 2019).

Outside of the learning environment, MLAs have the ability to influence the improvement of lifelong communication skills, the development of critical thinking, and problem solving skills (Abidin & Tho, 2018). Mamba and Isabirye (2015) indicated that communication and information sharing amongst government and learning institutions have also been influenced. Research on UX has gained momentum within the HCI community (Hassenzahl, 2018), as an influential factor in the successful use and acceptance of MLAs (Amir *et al.*, 2022). Hence, the evolving needs and goals of users that influence the change in UX need to be evaluated (Muditha, 2020).

The sub-section below discusses the challenges related to MLAs at HEIs.

3.4.7 Challenges related to mobile learning applications at higher education institutions

The development of the interactive systems has presented new challenges to the implementation of HCI and user experience (Amir *et al.*, 2022). Based on the low level of acceptance, accessibility, awareness and technological skills amongst students and lecturers, numerous countries have been unsuccessful in implementing MLAs (Chen, 2016). A study by Kaliisa and Picard (2017) highlighted that the main challenges facing the HEIs in Africa with regard to the integration of mobile learning consist of the following: lack of access to advanced mobile devices, poor technological infrastructures, poor attitudes amongst lectures and students, lack of mobile learning pedagogical skills among lecturers, lack of policies to guide the implementation of MLA, and mobile devices being incompatible with the institutions' online management systems.

Although smartphone usage has surpassed the 90% mark in SA, and developments in mobile applications are rapidly becoming more powerful learning tools (Lamberti, 2020), many African countries, including SA, are challenged because of students' lack of access to broadband internet (McNulty, 2021).

As a distance learning institution in South Africa, Unisa is grounded on the ODeL model. Unisa is diverse with many local and international students, students from urban areas, rural areas, disadvantaged backgrounds and different cultural backgrounds. The availability of technology permits Unisa students, employees and other stakeholders to interact with Unisa without time and geographic limitations (Unisa-Policy). There are many services and facilities offered by myUnisa for students and Unisa staff members. Student services include the student portal (MLA), which students can use for applications, registration, assignments submission, tuition fees payment, discussion forums and library books.

Although there are many advantages of MLAs, there are also challenges that need to be addressed. Challenges such as inequality and lack of infrastructure, as mentioned by Evans (2021). The Covid-19 pandemic created many challenges across the globe. In SA, however, it was not the first time that the education system has been tested. In 2016, South African HEIs went through disruptive protests (SABC, 2016). The fees

must fall protest disrupted the whole higher education system and resulted in serious consequences.

The lockdown imposed in 2020 due to Covid-19 revealed the poor state of readiness of the South African education system, even for Unisa as a distance learning institution. As an ODeL institution, Unisa students are required to have access to computers or smartphones, a stable network and wifi/data to connect to the MLA. Since South African higher education students come from a range of diverse backgrounds and cultures (Howe, Tsela & Kekwaletswe, 2010), full online migration remains a disadvantage for some.

Giannini (2020) indicated that this is the right time to improve the learning environment. It is essential to successfully implement appropriate mobile learning methods to address the challenges (Amir *et al.*, 2022). Therefore, it is important that the quality of an MLA is enhanced and that every user is accommodated, particularly when there are a lot of users, and this contributes to the complexity (Pinho, Franco & Mendes, 2018). Additionally, Li and Lalani (2020) advised against the rapid, improper and unplanned move to online learning, stating that it results in negative UX.

The next section presents the conceptual framework of the factors that may influence the UX of the student when interacting with an MLA. Table 3.1 presents the factors of UX in a table form and Figure 3.5 is a diagrammatic illustration of Table 3.1.

3.5 THE CONCEPTUAL FRAMEWORK

This section aimed to use the possible influential factors of UX identified by the literature to develop a conceptual framework of students using MLAs at HEIs. Miles and Huberman (1994) defined the conceptual framework as the researchers' map of the phenomenon under study. Yin (2003) recommended that when undertaking a study, it is important to study theory development before data collection. Gregor (2006) stated that theory is when predictions and explanations are provided that are actually testable. Theory development includes the related theory or theories which support the information underpinning the phenomenon being explored. Hence, it is recommended that relevant theories be studied when conducting research (Yin, 2003).

The following table represents the conceptual framework which demonstrates the factors that may influence the UX when a user interacts with the system. These factors

have been adopted by the current study as the user, system and context. In this study, the user is the student, the system is an MLA, and the context is the HEI.

The conceptual framework aims to answer SRQ1: *Which user experience factors affect students when using mobile learning applications?*

Table 3.1: Conceptual framework of factors influencing UX when students interact with mobile learning applications

UX Factors	UX sub-factors	Factors that may influence students' UX	Literature support and references
User: the student	✓ Needs	The student requires <i>motivation</i> to interact with the MLA.	Andreas <i>et al.</i> , 2022 - Section 3.2.1
		The student needs <i>satisfaction</i> when using the MLA.	Andreas <i>et al.</i> , 2022 - Section 3.2.1
		The student needs a positive <i>experience</i> when using the MLA.	Andreas <i>et al.</i> , 2022 - Section 3.2.1
	✓ Emotional status	<i>Emotional status</i> of students may have an influence on the UX.	Langenhoven, 2016; Berni & Yuri, 2021; Amir <i>et al.</i> , 2022 - Section 3.2.3
	✓ Perceptions	Perceptions of non-instrumental (<i>fun, aesthetic and pleasure</i>) qualities of the system may influence the UX.	Mahlke, 2008 - Section 2.3.2
		Student's perception of the MLA needs to be <i>useful</i> .	Amir <i>et al.</i> , 2022; Andreas <i>et al.</i> , 2022 - Section 3.2.2
		Student's perception of the MLA needs to be <i>easy to use</i> .	Amir <i>et al.</i> , 2022; Andreas <i>et al.</i> , 2022 - Section 3.2.2
		Student's perception of the MLA needs to be <i>enjoyable</i> .	Amir <i>et al.</i> , 2022 - Section 3.2.2
		The student needs to perceive the MLA as <i>visually attractive</i> .	Ssemugabi, 2019; Claire, 2020; Berni & Yuri, 2021 - Section 3.2.2
	✓ Expectations and past experiences	The students' <i>expectations</i> and <i>past experiences</i> of the MLA's <i>functionality</i> could influence the UX.	Hassenzahl & Tractinsky, 2006; Karapanos, 2010; Berni & Yuri, 2021; Andreas <i>et al.</i> , 2022 – Section 3.2.5

UX Factors	UX sub-factors	Factors that may influence students' UX	Literature support and references
	✓ Attitude	The students' <i>attitude</i> towards the MLA could influence the UX.	Alghazi <i>et al.</i> , 2020; Sophonhiranrak, 2021 - Section 3.3.3
	✓ Psychological factors	The <i>mind of the student</i> could affect the UX.	Azizi & Khatony, 2019; Almaiah <i>et al.</i> , 2021; Berni & Yuri, 2021 - Section 3.3.3
System: the MLA	✓ System's Pragmatic quality	The experience with the <i>efficiency</i> and <i>effectiveness</i> of the student's interaction with the MLA may influence the UX.	Pengnate & Sarathy, 2018; Amir <i>et al.</i> , 2022 - Section 3.3.3
		<i>Functionality</i> of the MLA may influence the UX.	Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021 - Section 3.3.3
		<i>Reliability</i> of the MLA may influence the UX.	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022 - Section 3.3.3
		<i>Learnability</i> of the MLA may influence the UX.	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022 - Section 3.3.3
		<i>Flexibility</i> of the MLA may influence the UX.	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022 - Section 3.3.3
		<i>Stability</i> of the MLA may influence the UX.	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022 - Section 3.3.3
		<i>Robustness</i> such as the recoverability and responsiveness of the system may influence the UX.	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022 - Section 3.3.3
		The <i>constant availability</i> of the MLA as well as the power supply may influence the UX.	Hassenzahl & Tractinsky, 2006 - Section 3.3.3

UX Factors	UX sub-factors	Factors that may influence students' UX	Literature support and references
		The MLA's <i>information security</i> (misuse or loss of information).	Hassenzahl & Tractinsky, 2006; Pengnate & Sarathy, 2018; Redmond & Macfadyen, 2020; Almaiah <i>et al.</i> , 2021; Amir <i>et al.</i> , 2022 - Section 3.3.3
		The <i>compatibility</i> of the MLA may influence the UX.	Parsazadeh <i>et al.</i> , 2018; Almaiah <i>et al.</i> , 2021 - Section 3.3.3
	✓ Hedonic quality	Perception of non-instrumental (<i>fun, pleasure and aesthetics</i>) qualities of the system.	Mahlke, 2008 - Section 2.3.2
		The student's <i>satisfaction</i> with the MLA could affect the UX.	Hassenzahl <i>et al.</i> , 2018; Andreas <i>et al.</i> , 2022 – Section 3.3.3
		The <i>visual attractiveness</i> of the MLA is important.	Ssemugabi, 2019; Claire, 2020; Berni & Yuri, 2021 - Section 3.3.3
	✓ Pedagogical factor	The <i>design of educational content</i> of the MLA could affect the UX.	Azizi & Khatony, 2019 - Section 3.3.3
	✓ Quality factors	The <i>quality of the MLA</i> could affect the UX.	Althunibat <i>et al.</i> , 2021 - Section 3.3.3
		The <i>quality of content</i> of the MLA could affect the UX.	Althunibat <i>et al.</i> , 2021 - Section 3.3.3
		The <i>quality of service</i> of the MLA could affect the UX.	Althunibat <i>et al.</i> , 2021 - Section 3.3.3
	✓ Technology factors	<i>Security</i> of the MLA could affect the UX.	Almaiah <i>et al.</i> , 2021 - Section 3.3.3
		<i>Privacy</i> of the MLA could affect the UX.	Almaiah <i>et al.</i> , 2021 - Section 3.3.3

UX Factors	UX sub-factors	Factors that may influence students' UX	Literature support and references
		<i>Compatibility</i> of the MLA could affect the UX.	Parsazadeh <i>et al.</i> , 2018; Almaiah <i>et al.</i> , 2021 - Section 3.3.3
		<i>Relative advantage</i> of the MLA could affect the UX.	Almaiah <i>et al.</i> , 2021 - Section 3.3.3
		<i>Trust</i> with the MLA could affect the UX.	Almaiah <i>et al.</i> , 2021 - Section 3.3.3
Context: the HEI	✓ Physical context	The <i>functional place and space</i> could affect the UX of an MLA.	Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021; Norman & Nielsen, 2022 - Section 3.4.1
		The <i>movements and mobility</i> could affect the UX of an MLA.	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010 - Section 3.4.1
		The perceived <i>environmental attributes</i> could affect the UX of an MLA.	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010 - Section 3.4.1
	✓ Social context	The <i>social context</i> of the MLA could influence the UX.	Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021 - Section 3.4.2
		<i>Persons present</i> could affect the UX of an MLA.	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021 - Section 3.4.2
		<i>Interpersonal interaction</i> could affect the UX of an MLA.	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021 - Section 3.4.2
	✓ Temporal context	Actions in relation to <i>time</i> could affect the UX of an MLA.	Karapanos, 2010; Muditha, 2020; Berni & Yuri, 2021 - Section 3.4.3

UX Factors	UX sub-factors	Factors that may influence students' UX	Literature support and references
		<i>Duration</i> of an interaction session could affect the UX of an MLA.	Jumisko-Pyykkö & Vainio, 2010; Roto <i>et al.</i> , 2011; Berni & Yuri, 2021 - Section 3.4.3
		<i>Time of day, week, and year</i> could affect the UX of an MLA.	Karapanos, 2010; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021 - Section 3.4.3
		Interaction <i>before – during – after – over time</i> could affect the UX of an MLA.	Jumisko-Pyykkö & Vainio, 2010; Roto <i>et al.</i> , 2011; Muditha, 2020; Berni & Yuri, 2021 - Section 3.4.3
	✓ Task context	<i>Multitasking</i> could affect the UX of an MLA.	Preece <i>et al.</i> , 2015; Muditha, 2020 - Section 3.4.4
		<i>Interruptions</i> could affect the UX of an MLA.	Preece <i>et al.</i> , 2015; Muditha, 2020 - Section 3.4.4
		<i>Task domain</i> could affect the UX of the MLA.	Preece <i>et al.</i> , 2015; Muditha, 2020 - Section 3.4.4
	✓ Technical and information context	<i>Other systems and services</i> could affect the UX of an MLA.	Berni & Yuri, 2021; Economides & Οικονομίδης, 2021 - Section 3.4.5
	✓ Organisational factors	<i>Resistance to change</i> could affect the UX of the MLA.	Almaiah & Al Mulhem, 2019 - Section 3.3.3
		<i>Technology readiness</i> could affect the UX of the MLA.	Almaiah & Al Mulhem, 2019 - Section 3.3.3
		<i>Cultural factors</i> could affect the UX of the MLA.	Almaiah & Al Mulhem, 2019; Berni & Yuri, 2021 - Section 3.3.3

UX Factors	UX sub-factors	Factors that may influence students' UX	Literature support and references
		<i>Institutional policy</i> could affect the UX of the MLA.	Althunibat <i>et al.</i> , 2021 - Section 3.3.3
		<i>Change management</i> could affect the UX of the MLA.	Althunibat <i>et al.</i> , 2021 - Section 3.3.3
		<i>Top management's support</i> could affect the UX of the MLA.	Althunibat <i>et al.</i> , 2021 - Section 3.3.3

Figure 3.5 (on the next page) presents a diagrammatic illustration of the conceptual framework of UX factors as the user (the students), the system (MLA) and the context (HEI), as displayed in Table 3.1. The purpose of this section is to present the conceptual framework structurally. The conceptual framework presents the identified factors that could influence the UX when a student interacts with the MLA.

The conceptual framework answers SRQ1: *Which user experience factors affect students when using mobile learning applications?* to contribute to the development of the proposed framework of this study. The development of the proposed framework is aimed to answer the main research question: *What are user experiences (UX) of students when using mobile learning applications?*

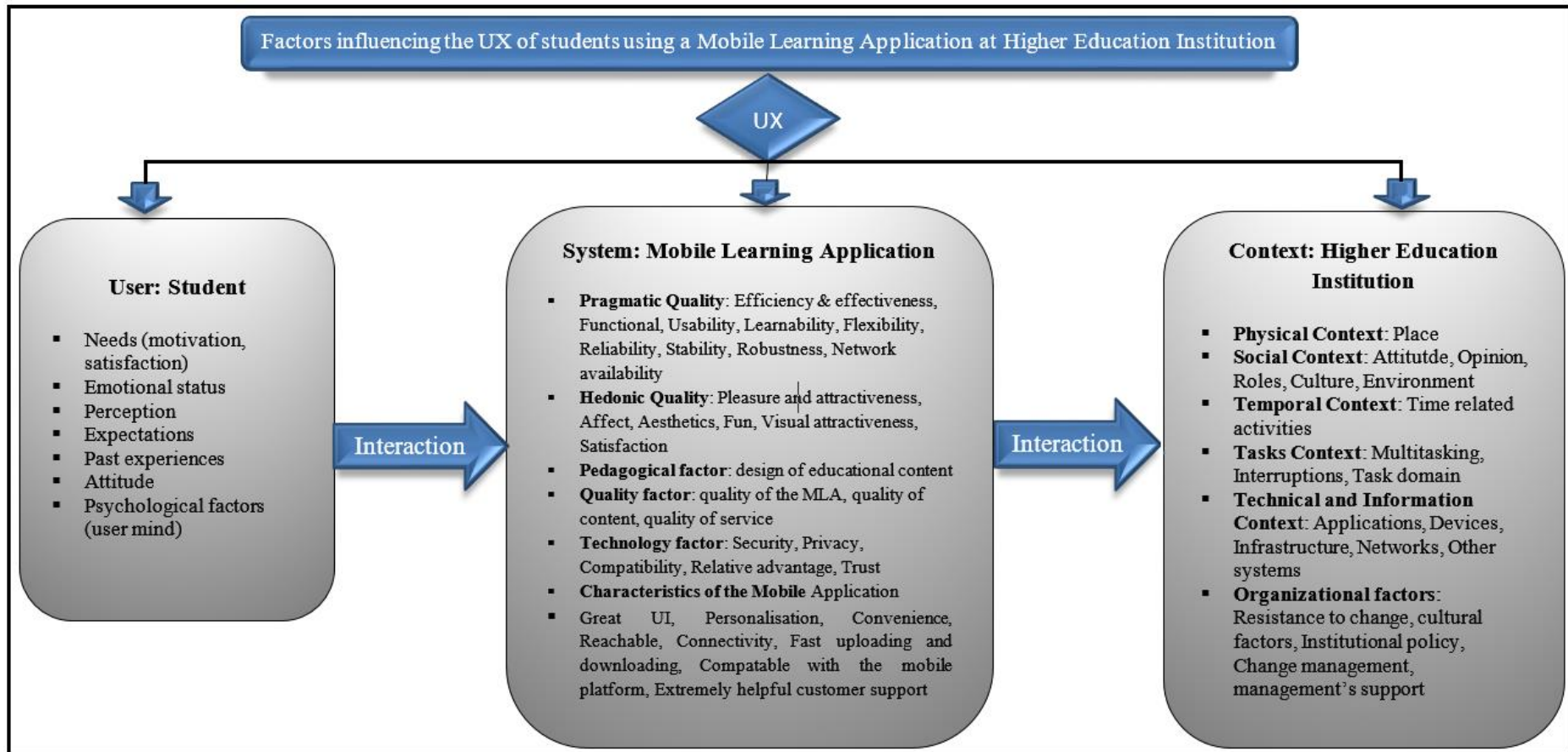


Figure 3.5: Conceptual framework of the factors that may influence the UX of the student

3.6 SUMMARY OF THE CHAPTER

This study investigated the factors that may influence the UX of students while interacting with the MLAs at HEIs. The literature study was used to develop a conceptual framework, which presents the factors that may influence the UX of the student when interacting with the MLA, and thus answering SRQ1: *Which user experience factors affect students when using mobile learning applications?*

The UX factors that were identified in Section 2.3 of Chapter Two were the *user*, *system* and *context*. The user sub-factors that could influence the UX when interacting with the system as adopted by this study are user needs, perception, motivation, expectations and past experience; the system factors as the pragmatic and hedonic qualities of the system; and the context are the physical, social, temporal, task and technical and information context.

The next chapter discusses the research design and methodology that this study adopted.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

This chapter discusses the research methodology adopted for this study, which was an adaptation of the research onion by Saunders, Lewis, Thornhill and Bristow (2019). According to Saunders *et al.* (2019), the research onion is a process of discussing the different techniques used during the data collection and analysis procedures while conducting a research study.

Figure 4.1 presents the different phases that were followed to develop a methodology for the current research. This is a qualitative study adopting an interpretative paradigm to explore the social context of the study through the interpretation of the qualitative data. Oates (2006) stated that the interpretative paradigm explores the phenomenon to create an understanding of the real social problem, as opposed to focusing on producing a hypothesis. As a result, this research adopted an inductive approach to create an understanding of the social problem this study was exploring. Inductive approach collects the data to explore the phenomenon before establishing a theory in a form of a framework, as applied in this study. As a qualitative study, qualitative interviews were used to collect the data for the study.

The study chose purposeful sampling to select the participants, used open-ended questioning to conduct semi-structured interviews and adopted thematic analysis to analyse the qualitative data. Additionally, the study adhered to the standard and appropriate ethical considerations.

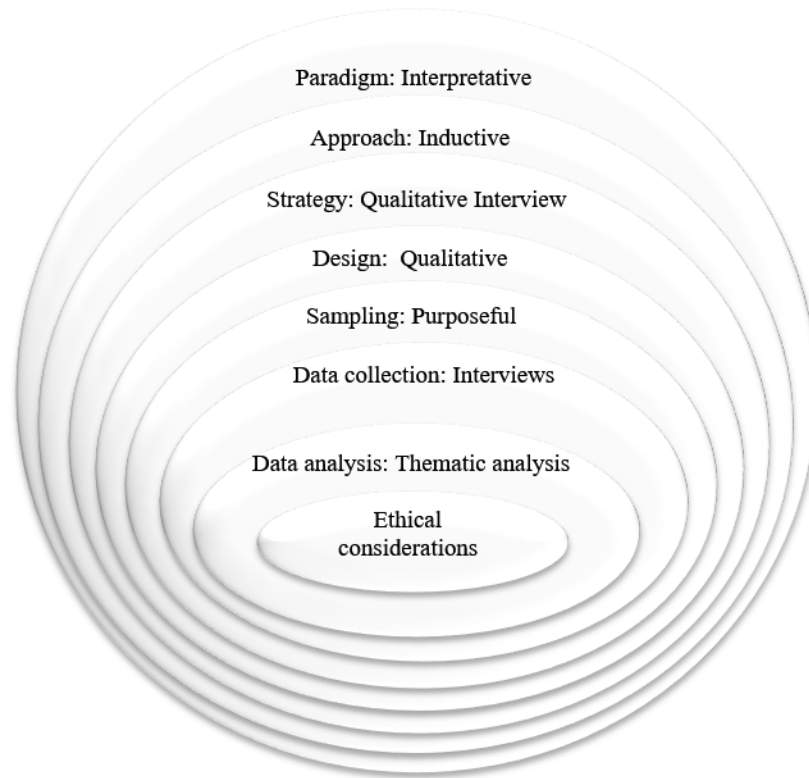


Figure 4.1: Research onion

Source: Adapted from Saunders *et al.* (2019)

The research onion in Figure 4.1 presents the research methodology adopted in the study.

The research design as adopted by the study is discussed in the next session. The research paradigm is discussed in Section 4.2, research approach in Section 4.3, research strategy in Section 4.4 and research design in Section 4.5. Ethical considerations are discussed in Section 4.6. Lastly, Section 4.7 presents a summary underlining and presenting the fundamentals of the research methodology implemented in the study.

4.2 RESEARCH PARADIGM

According to Saunders *et al.* (2019), pragmatism, positivism, realism and interpretivism are the four paradigms that are commonly used in research. The current study adopted the interpretative paradigm. In the context of this study, the interpretative approach was suitable as the study attempted to explore the factors that influence the user experience

(UX) of students, and to understand the perceptions and realities of students when using MLAs. The perceptions and realities of students using MLAs were analysed to provide an understanding of the way in which students made sense of the phenomenon.

Interpretivists have a particular way of understanding the diverse kinds of philosophical assumptions consisting of axiology, ontology, methodology and epistemology (Creswell, 2018). Ontology defines the nature of reality and how reality is perceived; epistemology is the theory of knowledge; methodology refers to research processes; and axiology refers to the research values (Creswell, 2018).

The current study employed the interpretative paradigm to investigate the student experiences of using the MLA at HEIs in an effort to interpret their knowledge, belief systems, perceptions and motivation based on their experience. The next section discusses the ontological, epistemological, methodological and axiological view of the current study.

4.2.1 Philosophical assumptions

The ontological question relates to the researcher's assumptions concerning the nature of reality, and how and what can be investigated about it (Saunders *et al.*, 2019). This study investigated the UX of students when using the MLA at HEIs. The study acknowledged that the phenomenon that was being investigated was what students lived through (their reality). The focus was on students' individual and multiple experiences with the MLA. The focus on the individual experience was because the students had differing experiences with the MLA, and therefore, they could not be treated the same or generalised. Consequently, this study used data collected from students to gain an understanding of what was real in the phenomenon, and that provided evidence based on individual experiences. Moreover, the study perceived what students shared during the data collection as factual and real as it came from their individual, lived experiences with the MLA.

The epistemological question is concerned with a person's beliefs about generating, understanding, using and communicating knowledge, meaning, and how researchers pursue the truth and beliefs (Saunders *et al.*, 2019). The researcher in the current study

employed an inductive approach to build a theory to acquire knowledge for the context of this research. Qualitative interview questions were formulated and used to collect and assess the knowledge in the specified context. The researcher interviewed the participants of the study (students who were using the MLA) to gain knowledge about their experiences of the MLA. Furthermore, students were in their natural settings, therefore, the researcher did not impose on them her understanding of their experiences with the MLA.

The methodological assumption is concerned with the theory processes and principles that need to be followed when conducting a research study (Saunders *et al.*, 2016). The current study applied for and was granted permission to conduct the study and to use Unisa students as participants. This qualitative study adopted a qualitative strategy to collect and analyse the data. The participants of the study were provided with an information sheet pertaining to the study before they signed a consent form for participation. The researcher collaborated with the participants to gain knowledge about the phenomenon before generalisations were made.

Axiology is concerned about how the character, values and beliefs of the researcher, such as religion, ethics and aesthetics, affect the research (Saunders *et al.*, 2019). Saunders *et al.* (2019) acknowledged that the researcher's values, such as principles and standards, are important considerations. Therefore, this research used the interpretive paradigm and acknowledged that the researcher's values could be influential and that biases do exist.

Therefore, the study ensured trustworthiness through the use of an evidence-based inductive approach. Furthermore, the researcher applied self-reflection which led to her acknowledging that her influence might lead to unfairness when conducting the interviews or interpreting data. Consequently, researchers have to apply self-reflection by ensuring that their religion, beliefs, values, experiences and personal views do not influence the research process and interpretation of the results. Moreover, the researcher in the current study acknowledged the value of the participants as holders of the information needed for the study and treating them as such. Additionally, the research relied on the

participant's information and avoided assumptions and attempts to change the participant's mind.

4.3 RESEARCH APPROACH

The research approach can be deductive or inductive. An inductive approach was applied to conduct this research. An inductive approach is the construction of new theory that occurs from the data. An inductive approach seemed suitable for this study as it is frequently used in the interpretative paradigm and qualitative research as adopted by this study. Qualitative research also uses the inductive approach to generate new knowledge, and it permits participants to share details concerning how they perceive the phenomenon and their encountered experiences based on their individual subjective interpretations (Saunders *et al.*, 2016).

As applied in this study, data was collected to investigate the perceptions and experiences of students when interacting with the MLA, in efforts to generate new theory resulting from the data analysis (Saunders *et al.*, 2019).

The research strategy used for the data collection and analysis of this study are presented below.

4.4 RESEARCH STRATEGY

The research strategy is an idea of how the researcher plans to answer the research questions (Saunders *et al.*, 2019). According to Creswell and Creswell (2018), in qualitative research there are four basic kinds of data collection procedures, namely, qualitative documents, qualitative interviews, qualitative observation and qualitative visual and audio materials.

The current study adopted qualitative interviews to collect data. A qualitative interview is a process that researchers use to collect data by applying techniques such as telephone interviews, face-to-face interviews or focus groups interviews (Creswell & Creswell, 2018). For the purpose of the current study, the qualitative interviews involved open-ended questioning in the semi-structured interviews with a small number of participants

(students) to elicit the students' perceptions and experiences with the use of the MLA (Creswell & Creswell, 2018).

4.5 RESEARCH DESIGN

A research design can be qualitative, quantitative or mixed methods. The choice of method is determined by the nature of the research and the problem that the research attempts to answer. The current study adopted the inductive approach which used qualitative research to generate new knowledge (Saunders *et al.*, 2019). Qualitative research was aligned with the research methodology of this study which used the interpretative paradigm and qualitative interviews for data collection. Saunders *et al.* (2016) indicated that qualitative design is non-numeric, uses words, pictures and videos instead of numbers (quantitative). Qualitative research focuses on human experiences, behaviours and social activities (Creswell & Creswell, 2018) to enable the research to investigate the phenomenon and collect data towards answering the questions of the research (Busetto, Wick & Gumbinger, 2020).

The qualitative design was suitable for the current study because of its ability to discover more meaning and depth regarding the student's personal experiences with the MLA, contrary to a highly structured, wider in scale and more numerically based quantitative design. The qualitative design allows the collection of general, text and multimedia data such as audio recordings and visual recording (Creswell & Creswell, 2018). Saunders *et al.* (2019) stated that qualitative design is used to investigate different views (perceptions, opinions, emotions, feelings and beliefs) about the phenomena. As applied in this study, the qualitative approach focused on students' individual experiences as the source of knowledge for data collection. It allowed the study to investigate and understand the students' perceptions and experiences when interacting with the MLA.

This study investigated the factors influencing the UX of students using an MLA at an HEI. The literature study that was conducted to investigate the phenomenon identified the user, system and context as factors that may influence the UX of students when using the MLA. The focus of the research was on discovering new knowledge about the phenomenon by collecting data from the students who have had experience with the MLA

and analysing the qualitative data. A qualitative design was used to gain knowledge regarding the problem of the study through semi-structured interviews to investigate the students' needs, perceptions, motivations, expectations and past experiences regarding the MLA.

The next section discusses the sampling technique, data collection techniques and data analysis *as used in the current study*.

4.5.1 Sampling technique

The sampling technique can either be a probability or non-probability technique, depending on the nature of the study (Saunders *et al.*, 2016). This study used purposeful sampling to select targeted participants for data collection purposes. Targeted participants are people, records or events that possess the information required for the study (Cooper & Schindler, 2014). Purposive sampling is often used in qualitative research and focuses more on understanding the phenomenon and research questions than on the generalisability of the findings (Creswell & Creswell, 2018). According to Creswell and Clark (2011), purposeful sampling refers to the kind of a technique where a researcher deliberately selects participants who have the most experience with the phenomenon, or the main concepts under investigation.

In the purposeful technique, the individual unit in a population has no identifiable probability of being selected (Creswell & Creswell, 2018). This means that units are not mathematically selected from the population in a random way. As a result, it typically produces samples that do not represent the population and means that the capability of generalising from them is very limited. This study relied on students to participate and share their experiences regarding the use of the MLA at HEIs. Etikan, Musa and Alkassim (2016) indicated that in purposeful sampling, participants must be available and be keen to participate in the study. Hence, only willing and available students participated in the study. The following presents the process of sampling applied in this study:

1. Site

The study selected Unisa as the HEI from which the data for this study was collected. Unisa is the largest ODeL university in SA and has a number of campuses and study

centres that are used by students. Unisa in the Gauteng province has just over 100 000 students and was chosen as a data collection site because the researcher is registered at Unisa, it is where the researcher's supervisors are, and from where participants for the study were sought. Students from different colleges were invited to participate in the study.

2. Inclusion criteria

This research selected Unisa students as participants of the study. The students had to be registered Unisa students, who had used myUnisa for a least a year and more. Consequently, these were students who had a username and password to log in to myUnisa. Students who had experience of at least a year and more with the MLA were selected as knowledgeable informants. The experience that these students had allowed them to have a basis from which to have an opinion about myUnisa, compared to students who had been exposed to an MLA for a shorter time, or who had not been exposed to an MLA at all.

3. Sample size

In qualitative interview studies, methodologists in the context of educational environments (Adler & Adler, 2012), recommend a sample size of six to 12 participants (or any number they can get), and a reasonable sample size of 30 to 60 participants, when there is good accessibility (Mocanasu, 2020). Creswell and Creswell (2018) stated that a number of three to 10 participants is adequate. Rosala (2021) added that for UX studies, six interviews are adequate. This research targeted 12 students to participate in the interviews, although only nine students ended up participating in the study. The study considered different ages, genders, levels of study, faculties and courses. In this way the study attempted to ensure that the student experience was not based on the age, gender, level of study, faculty or course.

4. Data collection process

The Unisa College of Science, Engineering and Technology's Ethics Review Committee approved the researcher's request to conduct the study (Appendix B). Approval was

granted by the Unisa Research Permission Subcommittee (RPSC) to use Unisa students as participants of this study (Appendix C).

Student participants were sought through the Unisa Information and Communication Technology Department (ICT). The study targeted 12 students for participation. The researcher sent out an email request to ICT to request that a communication be sent out to students for voluntary participation in the study. An email to 2 982 students was sent by the ICT, targeting different ages, genders, levels of study, faculties and courses. The study interviewed nine students. The email included a google forms link which had the participant information sheet about the study and a consent form. The reason why an email was sent to 2 982 students was to ensure that the targeted number was reached, considering that the data collection of the study was conducted during Covid_19 and during exams. Additionally, potential participants included underprivileged students, fully employed students, family oriented students and international students.

The participant information contained a brief summary about the researcher, purpose of the study, potential benefits of the study, how long the study would take, how participants would be chosen, the reason for being chosen, how the researcher would protect the security of data, and that permission to conduct the study had been granted. After reading through the participant information sheet, interested students signed the consent form which was attached at the end of the participation information sheet. The consent form had a name, surname and email field for students to fill in so that the researcher would contact them and organise interviews.

Upon receiving the consent form, the researcher sent individual and personalised emails to willing students to arrange interviews. There were close to 30 students who showed interest in participating in the research, however, the researcher managed to secure interviews with only seven students. A couple of reminders were sent to students who signed the consent form in an attempt to set up interviews but there was no response from these students. Based on that outcome, the researcher requested the ICT to send a second email to another batch of students. The outcome from the second request ended up with two more students who agreed to interviews. The study proceeded with nine students who volunteered to participate.

4.5.2 Data collection technique

There are different techniques that can be used for data collection in a research study. According to Creswell and Creswell (2018), these techniques consist of questionnaires, document reviews, observations and interviews. This qualitative study used semi-structured and open-ended questioning interviews as the means of collecting data. Interviews were the best technique to gain an understanding of the students’ experiences and perceptions when using MLAs. Experiences are things that cannot be directly observed, and these are things that are not felt, intentional and thought through (Merriam, 1998).

Table 4.1 provides the mapping between the research questions, objectives, factors of the conceptual framework and the interview questions.

Table 4.1: Research questions map

Factors of the conceptual framework	Objective	Research sub question	Research interview questions
UX Factors	To investigate the user experience factors that affect students when using mobile learning applications.	SRQ1: Which user experience factors affect students when using mobile learning applications?	User, System, Context identified from the literature review.
User	To identify the user variables affecting student user experience of myUnisa.	SRQ2: What user variables affect student user experience of myUnisa?	What motivates you to use myUnisa? (What makes you keep on using it?) How satisfied are you with myUnisa? (and why?) What is your perception of myUnisa? (What do you think of it?) What are your functionality expectations when using myUnisa? (positive/negative)
System	To identify the system characteristics desired for a mobile learning application.	SRQ3: Which system characteristics of a mobile learning application are desired by students?	How effective and efficient is it to perform a task on myUnisa? (To successfully produce desired or intended result) How reliable is myUnisa? (Accomplish tasks without

Factors of the conceptual framework	Objective	Research sub question	Research interview questions
			<p>network, connectivity, timeout, etc. problems?)</p> <p>How learnable is myUnisa? (How easy is it to learn?)</p> <p>How stable is myUnisa?</p> <p>How is myUnisa's robustness? (Responsiveness and recoverability - response to commands, user interface such as buttons, etc.)</p> <p>How is the availability of myUnisa?</p> <p>How is the information security of myUnisa? (Information loss/misuse)</p> <p>What do you find visually attractive about myUnisa? (The look and feel of myUnisa)</p>
Context	To identify the context variables affecting student user experience when using myUnisa.	SRQ4: How are students affected by mobile context variables when using a learning app?	<p>Device type</p> <p>What device do you use to access my Unisa? What is your experience?</p> <p>Browser experience</p> <p>Which browser are you using to access myUnisa? What is your experience?</p> <p>Task submission</p> <p>What time of day do you prefer to submit tasks on myUnisa? Why?</p> <p>Is the behaviour and task duration the same during the week and weekends? (Have you experienced any discrepancies in terms of how it functions)</p>
	To collect additional data for further improvement	Additional questions	<p>Describe your overall experience with myUnisa.</p> <p>Is there any reason that keeps you from using myUnisa?</p> <p>Are there any suggestions for improvement on myUnisa?</p>

Source: Researcher's own compilation

A researcher can use closed-ended (structured) or open-ended (unstructured) interview questions. Ahmad (2012) stated that when choosing between open-ended and closed-ended research questions, the selection is determined by the appointed strategy of the study, as well as the kind of data required for the study. The current study collected data through open-ended interview questions. In open-ended questioning, participants use their words when responding to questions, as opposed to closed-ended questioning where the researcher provides answers that participants can choose from (Abawi, 2013). Saunders *et al.* (2016) stated that even though researchers need to stick to the goal of the interview and time limitation, participants must be allowed to give developmental responses. Open-ended questions permit the collected data to be analysed qualitatively as used by the study.

The current study used a semi-structured interview approach to conduct conversations with the participants that would provoke the type of in-depth data that could assist in qualitative analysis (Saunders *et al.*, 2016). The study conducted semi-structured interviews to discuss the factors of UX as stated in the draft conceptual framework. George (2022) stated that a semi-structured interview asks the questions in a predetermined thematic framework. According to Saunders, Lewis and Thornhill (2007: 611), semi-structured interviews refer to a “Wide-ranging category of interview in which the interviewer commences with a set of interview themes but is prepared to vary the order in which questions are asked and to ask new questions in the context of the research situation”.

For participants, semi-structured interviews afforded a further opportunity to answer what was significant to them (Miles & Huberman, 1994), and to discuss individual experiences and opinions in a reliable and flexible manner (George, 2022).

This study used the interview schedule in Appendix D that was developed at the hand of the conceptual framework, which was developed from the literature study in Chapter Two.

An interview can be conducted face-to-face, by telephone or email (Nilsen, 2012). As a result of the Covid-19 pandemic, face-to-face interviews could not be considered. Instead, all interviews for this study were conducted on Microsoft teams. The interviews were also recorded and downloaded on Microsoft teams. Microsoft teams was an efficient way of

conducting the interviews in terms of social distancing in an effort to minimise the virus from spreading. As such, Microsoft teams was one of the methods that the researcher could use to communicate with participants without physical interaction to protect both the participants and the researcher.

The interview schedule consisted of two sections. Section A of the interview consisted of demographic questions. Section B contained the main open-ended interview questions about the user, system and context factors of UX. The interviews were estimated to last for approximately 60 minutes and were recorded to ensure that a complete transcript of the interviews could be done. The interviews were conducted over a period of two months.

4.5.2.1 Data protection

The audio-recorded interviews were stored on the researcher's computer without tracing evidence and information about which recording belongs to which participant. To identify the recordings on the researcher's computer, the interviews were stored in a folder that was renamed to Data Collection Interviews. The recorded interviews were named as Participant 1, Participant 2, Participant 3, and so forth. The computer was used to store recordings so that the collected data could be checked for authenticity and be transcribed.

Data stored online and on a computer can be reachable to hackers, therefore, that may be an important concern when conducting studies that contain personal and sensitive information (McGuirk & O'Neill, 2016). For this study, the researcher's computer was password-protected to prevent unauthorised access and to keep the data safe, even though the data contained no personal or sensitive information. For back-up purposes, the data collected and transcripts were stored on an external hard drive.

4.5.2.2 Transcription of verbal data

The data that was collected through the audio-recorded interviews was transcribed in four weeks, and captured into an MS Word document. The researcher reviewed the interview transcript numerous times to check for correctness (Merriam, 1998), as truthful transcripts are a necessity to validate the analysis and to interpret the interview data (Mishler, 1986).

4.5.3 Data analysis

This study collected data through open-ended questioning and semi-structured interviews. The participants considered for the study consisted of students at a higher learning institution (Unisa) interacting with the MLA (myUnisa). The students were invited to participate in the study as major stakeholders to share their experiences with the MLA. The study targeted 12 students for participation. However, the study ended up interviewing nine students. After the interview process, the audio-recorded interviews were transcribed verbatim into an MS Word document.

This study adopted the reflexive thematic analysis using the six-step process and Atlas.ti as a qualitative research instrument for coding purposes. This section discusses the analysis of the data collected from the study's participants. The interviews were divided into two sections as displayed in Appendix D. The first section consisted of the participant's demographical details. The second section consisted of the factors (user, system and context) that could influence the UX of students when using the MLAs at an HEI, as identified in Chapter Two of this study.

Creswell and Creswell (2018) stated that after the collection of the qualitative data, the researcher should conduct thematic analysis and present the results in verbatim form such as a story or a narrative. To analyse the transcribed textual data, thematic analysis used codes and themes that resulted from the conceptual framework. Thematic analysis was suitable for this study as it is a practical technique that reports about the meanings, reality and experiences of participants. As stated by Evers (2016), thematic analysis comprises of the process of familiarisation with the collected data, fragmenting the data into components and categorising the data into themes and codes.

This study used the software program Atlas.ti to analyse and organise the data collected. Atlas.ti is a qualitative data analysis instrument mostly used to support researchers to systematically discover and analyse complicated phenomena that are concealed in unstructured data such as texts, audio and visual data (Creswell & Creswell, 2018). Atlas.ti uses coding and interpreting activities to analyse, interpret texts and present the data graphically. Coding is a method used to organise data into sections, to categorise the information and to give names to the categories (Creswell & Creswell, 2018).

For the purpose of the current study, Atlas.ti was used to find, code and to interpret the results. The transcribed data was read, and words were segregated before the data was sorted by themes and codes for interpretation and understanding. The MS Word document of the transcriptions from the recorded interviews was organised and prepared for analysis. The next step was familiarisation with data in which data was read repeatedly to get to general sense of it and the overall meaning before the process of detailed analysis through coding began. Following that, the data was fragmented into components and analysed through Atlas.ti to generate a description of the themes and categories. Chapter Five presents the results from data analysis in a textual format.

The next section discusses the detailed thematic analysis as it was applied in this study.

4.5.4 Thematic analysis

Clarke and Bruan (2013) explained that thematic analysis as a technique that is used in qualitative research to identify and analyse patterns found in data. The current study used thematic analysis and the Atlas.ti instrument to analyse the qualitative data. Qualitative data analysis mostly uses Atlas.ti to help support researchers to discover and analyse the complicated phenomena that are hidden in unstructured data such as texts, geospatial and multimedia. Clarke and Braun (2013) recommended six phases when applying thematic analysis, as illustrated in Figure 4.2.

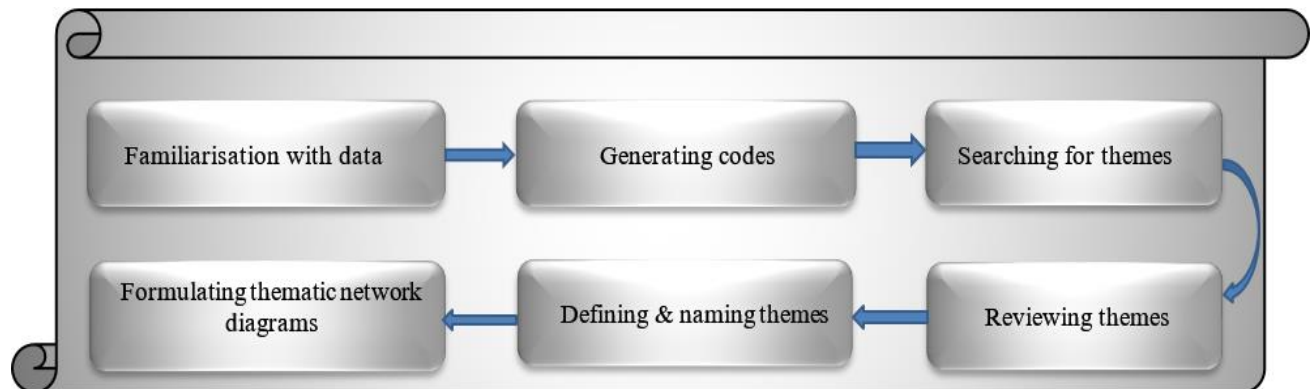


Figure 4.2: Thematic analysis phases

Source: Braun & Clarke (2006)

These phases are discussed below. The third phase (searching for themes), fourth phase (reviewing themes) and fifth phase (defining and naming themes) are grouped and discussed together under themes.

Familiarisation with data

This study collected data through audio-recorded interviews which need to be transcribed for data analysis. The transcription of the interviews into an MS Word document was used as a foundation phase for familiarisation with the data in this study. As the first phase when analysing data, Braun and Clarke, (2006) recommended that the researcher be submerged in the data by reading and re-reading the data to the degree that the breadth and depth of the content is familiar. Even though the process of submerging can be as time consuming as transcription, the researcher applied it as a second phase to become familiar with the data. This was conducted to have a general sense of the information and the overall meaning to ensure complete understanding of the data.

Coding

This phase follows after the researcher has become familiar with the data, and when a list of ideas has been created about what is contained by the data, and what is interesting about the ideas. The method of coding forms part of the analysis (Miles & Huberman, 1994), where meaningful groups of data are organised and named to grow a general sense of the data (Creswell & Creswell, 2018).

In the current study, the coding process was completed by Atlas.ti code manager as a qualitative research instrument for coding purposes. The MS Word documents containing the transcribed data were passed through the Atlas.ti code manager to create a task for data analysis and were used to produce codes. Clarke and Bruan (2013) described codes as a method of constructing the analysis where every feature of data is considered important. The coding process encompasses paying equal attention to individual items of data throughout the data set, and identifying relevant characteristics of data items that form the foundation of recurring themes through the data set.

Themes

This phase typically starts with an investigation into the themes that are suitable for the codes and it ends when the codes are organised into themes (Clarke & Braun, 2013). Themes are patterns that identify interesting characteristics about the research question or data (Maguire & Delahunt, 2017). As recommended by Braun and Clarke (2006), the generation of themes starts after the data has been identified, coded and organised across the data set. At this stage, the analysis re-focuses at a broader level on the themes, instead of codes.

In terms of the current study, themes were generated from the data that originated from the arranged feedback using the Atlas.ti code manager, before linking the themes to the codes and before the quality-checking phase began. The quality-checking phase attempts to refine the themes to ensure that the generated themes articulate a narrative about the data, and if this is not achieved, the process of generating themes is repeated (Clarke & Braun, 2013).

For this study, the coded data extracts were reviewed by reading all the organised extracts for individual themes and measuring if they produce a comprehensible pattern. Unsuitable themes were not coded, while suitable themes were defined and refined, and the data within the themes was analysed. Defining and refining themes recognises the core of the importance of each theme, what the overall themes are about, and to determine what feature of the data each individual theme catches.

Formulating thematic network diagrams

This is the last phase of the thematic analysis that starts when a set of satisfying themes exists. This phase covers the formulating of the thematic network diagrams and the closing analysis that assisted in the interpretation of the analysed data.

In the current study, thematic network diagrams provide a narrative from the data expressed within and through themes. Clarke and Bruan (2013) stated that in this phase, the narrative is formulated to provide an argument that answers and supports the research question of the study. The data analysis and results chapter presents the thematic network diagrams for this study as illustrated in Chapter Five.

The next section discusses the ethical considerations relevant to this study, and comprises of permission to conduct the study, trustworthiness, privacy, anonymity, confidentiality, informed consent, voluntary participation, honesty, trust, harm and risk.

4.6 ETHICAL CONSIDERATIONS

Resnik (2020) described research ethics as the standards for conduct that differentiate proper and improper behaviour. Research ethics enforces the researcher's proper behaviour to ensure that the subject's rights are protected or are not affected (Saunders *et al.*, 2019), and is concerned with the participants' rights such as: dignity, privacy, equality, security and freedom of expression. When conducting a research study, the researcher needs to be continuously aware of the influence that the research can have on the entire society and the participants, and therefore, they need to perform accordingly to intensify the reliability of the data collected (Saunders *et al.*, 2016).

Permission to conduct the study

Unisa policy requires that researchers comply with ethical consideration to protect the right of the subjects. As a result, Unisa requires that researchers apply for ethical clearance to conduct a study involving human participants. This study involved human participants, therefore, the researcher obtained approval to conduct the study from the Unisa's College of Science, Engineering and Technology's Ethics Review Committee (Appendix B). To use Unisa students as participants in a study, an application needs to be submitted to the relevant department within Unisa. Hence, this study requested permission from the Unisa Research Permission Subcommittee (RPSC) to collect data from students. The study was granted permission to use Unisa students as participants as seen in Appendix C.

Trustworthiness

According to Oates (2006), the criteria that determine the quality of research interpretivism include trustworthiness. Trustworthiness in interpretivism focuses on how trustworthy a research study can be. Guba and Lincoln (1989) referred to trustworthiness as a goal that research attempts to achieve. Yin (1994) described trustworthiness as the criterion of testing the quality of the research design. Guba and Lincoln (1981) expressed

that in qualitative research, there are specific criteria that are recommended to be used to attain trustworthiness, and include criteria such as confirmability, credibility, auditability and fittingness. The current study employed the identified criteria as the process of interpretivist research to prevent bias. This study refined these criteria to confirmability, credibility, dependability and transferability as briefly discussed below.

Credibility evaluates whether the problem of the research is clearly defined and that the results of the research are precise. As recommended by Saunders *et al.* (2016), the current study ensured credibility by employing reflexivity as an approach used in qualitative research to question own thoughts and actions. Reflexivity helps qualitative researchers acknowledge their role in the research. Reflexivity is a self-reflection approach that involves the researcher's examination of their own judgement, practices and belief system to ensure that prior experiences, views, assumptions and beliefs do not influence the research during the collection of data or determination of the results of the research.

The researcher in the current study used additional data, such as transcripts and recordings, to intensively illustrate understanding links when interpreting the data. The current study further increased credibility by the involvement of the research supervisors in reviewing the results to determine the accuracy of the interpretations concluded by the researcher and to determine the correctness of conclusions drawn from the data (Leedy & Ormrod, 2005).

Confirmability involves confirming the research results from the data that was collected and analysed. In research, a study is considered to have confirmability if it demonstrates specific features such as trustworthiness, authenticity and credibility (Creswell & Miller, 2000). Confirmability occurs with credibility, hence, this research ensured confirmability by reflexivity (Creswell & Miller, 2000). As explained, reflexivity is a self-reflection approach that involves the researcher's examination of their own judgement, assumptions, views, practices and belief system to ensure that prior experiences do not influence the research during the collection of data or determination of the results of the research (Saunders *et al.*, 2019).

The current research ensured reflexivity by ensuring that the researcher's position and background did not influence the research process, such as during the data analysis, and during the interpretation and presentation of the conclusions. Additionally, the research increased confirmability for this study by monitoring for bias by constantly checking and re-checking data to ensure that the data findings and interpretations were not fabrications of imagination but were evidently resultant from the established findings.

Transferability confirms that the research findings are transferrable from a certain case or situation to another (Saunders *et al.*, 2016). For instance, as the current research was conducted at one campus, transferability would, in this case, confirm that the research findings are meaningful to the other participants at other campuses in the same setting. In the context of this study, to achieve transferability, the researcher employed strategies such as purposive sampling and rigorous descriptions to ensure the provision of in-depth and comprehensive descriptions of data.

A comprehensive research methodology outlining the data collection technique, analysis and sampling criteria was also used in the study as recommended by Lincoln and Guba, (1985). Merriam (1998) stated that this can be implemented by a researcher providing good, solid, thick and rich detailed descriptions, as demonstrated in this chapter. Creswell and Miller (2000) added that the descriptions about the participants can be obtained from the research contexts, data and settings to enable others to make informed decisions about transferability. It is essential to provide proof that the results of the research can be related to other populations, situations, contexts and times. Carminati (2018) stated that transferability in qualitative research is fundamentally synonymous with generalisation. However, this does not guarantee that the findings of the research would be applicable, but it provides evidence that it could be applicable.

According to Saunders *et al.* (2016), the researcher should be conscious of numerous diverse ethical considerations. Ethical considerations like privacy, anonymity, confidentiality, informed consent, voluntary participation, honesty, trust, harm and risk. These measurements are discussed in the following section.

Privacy, anonymity and confidentiality

Anonymity is guaranteed when no one, including the researcher, could identify or link a response to a certain participant during data collection and coding (Creswell & Creswell, 2018). Confidentiality is guaranteed when a researcher could identify a given participant's response but promised not to expose the participant or distribute the information (Creswell & Creswell, 2018). Creswell and Creswell (2018) warned against the immoral use of information without the participant's knowledge, and encouraged that participants be informed should they be included in the report.

Consequently, the current study guaranteed that privacy, anonymity and confidentiality of the participants would be retained by removing any recognisable characteristics of participants or any other identifiers of the participants. The participants were known to the researcher during the interview, therefore, the audio recordings were not saved by the participant's name to ensure anonymity. The researcher used names such as Participant 1, Participant 2, Participant 3, and so forth, to save the recordings. In the participant information sheet, participants were assured that any information given during the interview would solely be used and kept for the purpose that the data was being collected for. Data collected would not be shared or distributed and the participants' names would not appear anywhere in the research.

Informed consent

Participants of the research were informed about the nature, benefits and purpose of the study before commencement. The participants were not rewarded or given prizes for participating. Creswell and Creswell (2018) acknowledged that willingness from participants must be expressed and not forced. Therefore, for participation in this study, the researcher obtained consent from participants. A consent form was included in the Google form link that contained the participant information sheet. By signing the consent form the participant indicated willingness to participate in the study. Participants were permitted to withdraw the consent at any time. However, once the data was collected, participants could not withdraw from the study.

Voluntary participation

The participants were assured that participation in the study was unconditionally voluntary and that the research was for academic purposes only. There would be no consequences, penalties or benefit loss as a result of not participating. No one was forced, bribed, manipulated or threatened to participate in the study.

Harm and risk

No participant was directly or indirectly harmed as a result of the research. The participants in this study were not obligated to give responses to questions that made them feel unsafe and uncomfortable. The participants were not put in any danger or risk while participating in the study and after participating. Hence, there was no psychological or physical harm to the participants of the study.

Honesty and trust

The researcher strictly adhered to all the research ethical considerations as criteria concerning the trustworthiness and honesty of the collected data and the associated analysis of the data.

4.7 SUMMARY OF THE CHAPTER

This chapter presented a discussion of the design and methodology that the study adopted. This chapter discussed the research paradigm (interpretative), research approach (inductive), research design (qualitative), and research strategy (qualitative interview) as adopted and applied in the study. The chapter included the sampling technique, data collection technique, data analysis process and ethical considerations as applied in this study.

The next chapter discusses and presents the results of data analysis from the data collected.

CHAPTER 5: DATA ANALYSIS AND RESULTS

5.1 INTRODUCTION

This chapter presents the conduct of the methodological approach defined in the previous chapter and the analysis of the data. The chapter comprises of the demographics of the qualifications, user as student, system as MLA, and context as HEI. This chapter provides an answer to the research question of this study: *What are user experiences (UX) of students when using mobile learning applications?* and the research sub-questions that supported the research question which are:

- SRQ1: Which user experience factors affect students when using mobile learning applications?
- SRQ2: How are students affected by the user experience and mobile context variables when using a learning app?
- SRQ3: Which system characteristics of a mobile learning application are desired by students?
- SRQ4: How are students affected by mobile context variables when using a learning app?
- SRQ5: How can a conceptual framework be used to theorise about the student user experience of mobile learning applications at a higher education institution?

The data analysis of this study comprises of the demographical information presented in Section 5.2, user results in Section 5.3, system results in Section 5.4 and context results in Section 5.5. Section 5.6 provides the summary of the chapter.

5.2 DEMOGRAPHICS OF THE QUALITATIVE ANALYSIS

This section consists of the demographical details of the data collected from the participants as reported in Table 5.1. The demographical information was collected to determine if it contributed as a factor of User Experience (UX) that could influence the students when using the MLA at an HEI.

Table 5.1: Demographical information

College	Course	Year			Gender		Age (years)			
		1	2	3	F	M	19-30	31-35	36-40	40+
Economic and Management Sciences	Bachelor of Commerce Honours Business Management		1		1				1	
Human Sciences	Communication Science			1		1	1			
	Biotech			1	1		1			
Science, Engineering and Technology	MSc Computing			1	1			1		
	MSc Computing			1	1			1		
	PhD Information System		1		1				1	
Law	Higher Certificate in Criminal Justice	1			1		1			
	LLB			1	1				1	
	LLB		1			1	1			

According to Table 5.1, the participants came from the Colleges of Economic and Management Sciences (Bachelor of Commerce Honours Business Management), Human Sciences (Communication Science and Biotech), Science, Engineering and Technology (MSc Computing and PhD Information System), and Law (LLB and Higher Certificate in Criminal justice). The majority of students who participated in the study came from the Colleges of Science, Engineering and Technology (3), and Law (3). The majority of participants were third-year students (5), with one first-year participant. The highest number of participants fell in the age category of 36–40, with the lowest number of participants in the age category of 19–30. The study interviewed seven female students, and two male students.

The second section presents the data analysis results from the data collected. The participants of this study gave individual feedback on all the factors of UX. The students' responses are presented in tables and have not been altered. For the purposes of validity, the responses from the data collection are provided as given by the participants. The SRQ

“How are students affected by the user experience variables when using a learning app” was answered by the thematic network diagram in Figure 5.1.

5.3 USER: STUDENT DATA ANALYSIS RESULTS

This section presents the results of the data analysis (student feedback summary) related to the user in terms of all the sub-factors that were identified during the literature review.

5.3.1 User perceptions

Student’s feedback summary: Perception 1 is that myUnisa is useful as long as students have all the necessities (such as a smart device, network availability, internet coverage, and data bundles/wifi) to access the application. Students perceive the functionality of myUnisa to be working well on a smartphone and in areas with a good network coverage.

Perception 2 indicated that the MLA is useful in assisting students to improve their technological knowledge and skills.

Perception 3 stated that myUnisa is a good system and a great line of communication between the student and the institution.

Additionally, Perception 4 was that myUnisa is easy but there is still room for improvement in terms of user friendliness.

Perception 5 indicated that myUnisa is good and satisfactory when it comes to information availability and updates, as shown in Table 5.2.

Table 5.2: Perception of the user

User sub-factor theme	Student’s feedback: Verbatim transcriptions
Theme: Perception	Perception 1: <i>It is useful if you have data because you obviously cannot use it if you do not have data. And if you live in a place with good network and using a smartphone you won’t have problems.</i> Perception 2: <i>It seems to be user friendly.</i> Perception 3: <i>I think it’s useful, and it also assisting us in gaining knowledge when I look at it, technologically, I think it improves my technology skills.</i>

	<p>Perception 4: <i>It is a good system and great line of communication between the students and the institution.</i></p> <p>Perception 5: <i>It is easy to use, but I don't recall when I started using it, as to how it was.</i></p> <p>Perception 6: <i>I would prefer for it to be more user friendly.</i></p> <p>Perception 7: <i>I feel like to be honest I'm satisfied so far with the information I get, updates and all that, so for me it's okay, it's good. I am satisfied.</i></p>
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Code: Useful (Perception 1 and Perception 3)

According to the feedback presented in Table 5.2, seven students indicated that they have a good perception with the MLA. Perception 1 is that “... *is useful if you have data because you obviously cannot use it if you do not have data. And if you live in a place with good network and using a smartphone you won't have problems*”. This implies that students are able to use the system and it helps them achieve their academic goals.

This is in line with Amir *et al.*'s (2022) study that usefulness of the system is the perception that users need to have. However, some students added that the MLA is useful as long as an internet connection and network are available. The students perceive the lack of internet connection (data/wifi) as an obstacle, and network unavailability where they reside is an issue. If the network is unavailable where they reside, students are unable to complete tasks on the MLA. This is aligned with Newbold's (2018) study that if users cannot achieve their goals as a result of network problems, then the system is not usable. An unusable system has an influence on the UX.

Code: User friendly/user unfriendliness (Perception 2 and Perception 6)

One student indicated that the MLA “... *seems to be user friendly...*”, and one student highlighted that improvements can be made in terms of user friendliness “*I would prefer for it to be more user friendly*”.

Norman and Nielsen (2022) stated that the user's (student) interaction with the MLA needs to be effortless for students to use it. If the MLA is user unfriendly, it indicates that students might be struggling to perform tasks on the MLA, or might not be enjoying the interaction with the MLA. This is aligned with Newbold's (2018) study that the system is

perceived enjoyable if it is user friendly. Andreas *et al.* (2022) indicated that UX can be influenced by how a user perceives the system. Anindita (2020) indicated that user friendliness of the system is an iterative process.

Code: Great line of communication (Perception 4)

Students indicated that the MLA in question “...*is a good system and great line of communication between the students and the institution*”. This implies that communicating with lecturers on the MLA is important to students. However, communication from lecturers needs to improve. The lack of communication influences the use of the MLA, which affects the UX. This is aligned with a study by Andreas *et al.* (2022), that UX can be influenced by how a user perceives the system.

Code: Easy to use (Perception 5)

According to the feedback, the student indicated that the MLA “... *is easy to use*”. This implies that students are able to execute the tasks efficiently, effectively, and safely, while enjoying the experience.

This is aligned with a study by Newbold (2018) that the MLA needs to be as efficient and effective as possible to satisfy the user. If students cannot execute their tasks effectively and efficiently as a result of poor usability, then the MLA is not usable. If the system is not usable, then the UX is negative. Amir *et al.* (2022) emphasised that for a successful and positive UX, students crucially need an interaction that is easy, enjoyable and effective.

Code: Information availability (Perception 7)

Students indicated that “...*I’m satisfied so far with the information I get*”. Norman and Nielsen (2022) stated that the user’s (student) interaction with the MLA needs to be effortless for students to use it anywhere and anytime. If students do not have data/wifi, or there is a connection problem, students will not be able to get the required information on the MLA, even though Unisa has no control over connection problems. The unavailability of information influences the use, perception and UX of the MLA. This is aligned with a study by Andreas *et al.* (2022) that UX can be influenced by how a user perceives the system, and thus, the conclusion is that perception has an influence on the UX when interacting with the MLA.

5.3.2 User expectations

Student's feedback summary: Students expect an efficient submission link for the examination, and fewer steps on the functionality of the MLA, as shown in Table 5.3. These expectations resulted in students' UX with the MLA.

Table 5.3: Expectations of the user

User sub-factor theme	Student's feedback: Verbatim transcriptions
Expectations theme	<p>Expectation 1: Eight students felt that there are <i>many steps needed on the functionality of the system</i>.</p> <p>Expectation 2: One student mentioned that <i>the submission of exam links is not efficient</i>.</p>

Code: Lack of functionality of the system (Expectation 1)

According to the feedback presented in Table 5.3, students have differing expectations from the MLA. Students expect the MLA to meet their functional and non-functional requirements.

Expectation 1 is that eight students expect fewer steps on the functionality of the MLA, as indicated in Table 5.3: "... *many steps needed on the functionality of the system*". The functionality of the MLA is important to students. The lack of functionality of the system influences the use and the UX of the MLA.

Code: Inefficient exams submission link (Expectation 2)

Expectation 2 is that one student expressed frustration with the exam submission link which results in failure to submit exams, as indicated in Table 5.3 "*Submission of exam links is not efficient*". The student expects an efficient process of submitting exams. Inefficient exam link influences the UX of the MLA.

To deliver positive UX, the student's expectations are that the MLA has the required pragmatic and hedonic qualities to efficiently execute tasks. These results confirm Andreas *et al.*'s (2022) study that users (students) depend on the availability and functioning of these services (functionality of the system and efficient exam link) to complete goals. Andreas *et al.*'s (2022) study indicates that expectations have an

influence on user experiences and results from the interaction with the system. Amir *et al.* (2022) stated that to create a positive UX, user’s expectations be constantly considered when creating MLAs. According to the literature review, the user expectations sub-factor has an influence on the UX when interacting with the MLA.

5.3.3 User past experiences

Student’s feedback summary: Students’ past experiences are that the graphics during registration is problematic and students often experience network issues. Students indicated their inability to submit their work on time as a result of network issues, as shown in Table 5.4. These past experiences that students have had with the MLA result in the UX.

Table 5.4: Past experience of the user

User factor theme	Student’s feedback: Verbatim transcriptions
Past experience theme	Past experience 1: Graphic on the side during registration that makes it a bit wonky. Past experience 2: Experienced network problems and ended up not submitting. Past experience 3: <i>Sometimes it happens that maybe the problem is on their side, maybe they are updating the system, or you can try logging in and maybe they are updating the system.</i>

Code: Unfriendly registration graphics (Past experience 1)

According to the feedback presented in Table 5.4, students have differing past experiences with the MLA.

Past experience 1 of students with the MLA is that the “*Graphic on the side during registration that makes it a bit wonky*“. The graphic on the side during registration implies the functionality of the MLA might not be user friendly and students might not be enjoying using the MLA.

Newbold’s (2018) study stated that the system is enjoyable if it is user friendly. A study by Amir *et al.* (2022); Berni and Yuri (2021) indicated that users’ past experiences of a system’s functionality result in the UX of the MLA. Anindita (2020) stated that to provide

positive UX, the functionality, needs and user friendliness of the system need to be considered when designing the system.

Code: Network problems during exams (Past experience 2)

Past experience 2 is that students “*experienced network problems and ended up not submitting*”. Students expressed frustration with the exam submission link and with the network problems often experienced, which result in failure to submit exams. Students require an efficient and effective process to submit exams. To deliver positive UX, the required pragmatic and hedonic qualities (effectively and efficiently) should be considered.

Amir *et al.* (2022) agreed that UX need to be considered when developing efficient and effective systems. This also confirms Berni and Yuri’s (2021) study that users (students) depend on the availability and functioning of these services (network) to execute tasks. According to the literature review, users’ past experiences with the MLA have an influence on the UX when interacting with the MLA.

Code: Issues during system update (Past experience)

Students expressed that **Past experience 3** is that “*Sometimes it happens that maybe the problem is on their side, maybe they are updating the system*”. Students suspected that the problem may sometimes result from a system update, if there has been no communication from Unisa about the system update. Nonetheless, this results in students not executing tasks.

This aligns with Berni and Yuri’s (2021) study highlighting that users (students) depend on the availability and functioning of these services (network) to perform tasks, even though students are notified when there is a system update. Newbold (2018) indicated that if users (students) are unable to achieve their goals as a result the lack of network (system update), then the system is not usable.

5.3.4 User satisfaction

Student’s feedback summary: The students indicated satisfaction with the overall quality of myUnisa, apart from the challenging network problems. The MLA provides

satisfactory and adequate materials in terms of the basic requirements needed to complete studies but fails to meet the same standard when it comes to research materials. The MLA provides most of the things needed for studies, except where there is human interaction. Students wait for answers after requesting information from lectures or other students as shown in Table 5.5.

Table 5.5: Satisfaction of the user

User sub-factor theme	Student's feedback: Verbatim transcriptions
Satisfaction theme	<p>Satisfaction 1: <i>I am highly satisfied because it's of great quality when I look at it, I've never experienced any challenges. Dissatisfaction 1: The only challenges I've experienced is network problems which is not technical problem, so in all I would say it's great quality.</i></p> <p>Satisfaction 2: <i>In terms of the basic requirements that I need to complete my studies, myUnisa adequately provides the required materials. Dissatisfaction 2: In terms of researching, I do not always find what I need on myUnisa.</i></p> <p>Satisfaction 3: <i>I am satisfied with myUnisa. I think because most of the things that you need for your studies are there on myUnisa. Dissatisfaction 3: Other times where there's human interaction when I have to wait for an answer, that's where I really have a problem, where I need an information from other people.</i></p>

Code: Look and feel (Satisfaction 1)

According to the feedback presented in Table 5.5, five students expressed their satisfaction and dissatisfaction with the MLA. Students expressed their **satisfaction** in terms of quality (look and feel). Students indicated that “*I am highly satisfied because it's of great quality when I look at it*”. This is aligned with a study by Preece *et al.* (2015) that UX is the feeling of pleasure and satisfaction felt by users while using a system, or the opposite feeling (dissatisfaction).

Students expressed **dissatisfaction** when it comes to network problems: “*The only challenges I've experienced is network problems*”. This implies that students are unable to achieve their goals if the network has problems. This is in line with Berni and Yuri's (2021) study which highlighted that users (students) depend on the availability and functioning of these services (network) to perform tasks, even though network issues are

out of Unisa's control. Newbold (2018) argued that if users cannot achieve their goals as a result of network problems, then the system is not usable. Zhang *et al.* (1999) indicated that understanding and acknowledging the users' needs have an influence on the users' satisfaction with the system and the motivation of the user to use the system.

Code: Study material (Satisfaction 2)

Students expressed their **satisfaction** with the availability of required study materials: "*In terms of the basic requirements that I need to complete my studies, myUnisa adequately provides the required materials*". This implies that the basic requirements that are provided enable students to complete their studies. This is in line with Berni and Yuri's (2021) study indicating that users (students) depend on the availability of services (such as study material) to complete tasks (studies).

Students expressed **dissatisfaction** when it comes to research materials: "*In terms of researching, I do not have always find it what I need on myUnisa*". This implies that students have other needs such as relevant resource materials. This aligns with Amir *et al.*'s (2022); John's (2022) study that usability is not the only focus of a system, but user's needs (such as resource materials) should be considered.

Code: Student's needs (Satisfaction 3)

Students expressed their **satisfaction** in terms of basic needs as follows: "*I am satisfied with myUnisa. I think because most of the things that you need for your studies are there on myUnisa*". However, apart from the functionality and usability of the system, students have other needs and expectations, such as effective human interaction. Amir *et al.* (2022); John (2022) indicated that the system does not only focus on usability, but it also includes users' expectations and users' need.

Students expressed dissatisfaction when it comes to human interaction as follows: "*Other times where there's human interaction when I have to wait for an answer, that's where I really have a problem, where I need an information from other people*". This implies that students cannot complete tasks that are dependent on other people. This is aligned with Newbold's (2018) study that users cannot achieve their goals as a result of the unavailability of the information. Apart from functionality and usability of the MLA, students

have other needs, such as relevant resource materials, and expectations, such as effective human interaction.

Amir *et al.* (2022); John (2022) agreed that the pragmatic aspect of a system does not only focus on usability, but it also includes users' expectations and users' need. Additionally, Manandhar (2019) stated that UX goes above and beyond the good functionality and usability of the system, and it is also concerned about the true needs of the users. Hassenzahl (2018) stated that how enjoyable and satisfactory a system is perceived to be, is comprised of every aspect of the system's desirability and usability from the perspective of the users. According to the results, the user satisfaction sub-factor has an influence on the UX when interacting with the MLA.

5.3.5 User motivation

Student's feedback summary: Students are motivated to use myUnisa. The motivation includes staying updated with what is going on in the student's studies, to checking announcements and resources on the library and interacting with other students, as shown in Table 5.6.

Table 5.6: Motivation of the user

User sub-factor theme	Student's feedback: Verbatim transcriptions
Motivation theme	Motivation 1: <i>To stay updated with what's going on in my studies, not to be left out.</i> Motivation 2: <i>Check announcements on myUnisa, and resources that I get via the library.</i> Motivation 3: <i>Interaction that I can do with other students on myUnisa.</i>

Code: Updates regarding studies (Motivation 1)

According to the feedback presented in Table 5.6, students are motivated to use the MLA. Students indicated that they are motivated to use the MLA in order "*To stay updated with what's going on in my studies, not to be left out*". Students imply that the motivation comes from the information they get about their studies.

Code: Availability of announcements and resources (Motivation 2): Students indicated the announcements they receive on the MLA as motivational “...*check announcements on myUnisa, and resources that I get via the library*”.

Code: Student interaction (Motivation 3): Students indicated that the interaction with other students is a motivation to use the MLA: “...*interaction that I can do with other students on myUnisa*”.

When students are motivated to use the MLA, it implies that the students have a positive experience regarding the motivation to use the MLA. This is in line with the study by Amir *et al.* (2022), that there is an evaluation taking place when the user is interacting with the system, and based on the results of the evaluation, the user’s motivation and reflection about the system are determined. Therefore, when the UX of a system (MLA) is positive, users (students) are motivated to use the system (MLA). Amir *et al.* (2022) agreed that when users are satisfied with the system, they are motivated to use the system. User emotions (motivation) influence the UX (Newbold, 2018). According to this feedback, the motivation sub-factor has an influence on the UX when interacting with the MLA.

The following section presents the user network diagram.

5.3.6 UX factor: User thematic network diagram

The user thematic network diagram illustrated in Figure 5.1 presents the user as a factor and all of the user sub-factors (themes) discussed in Sections 5.3.1 – 5.3.5.

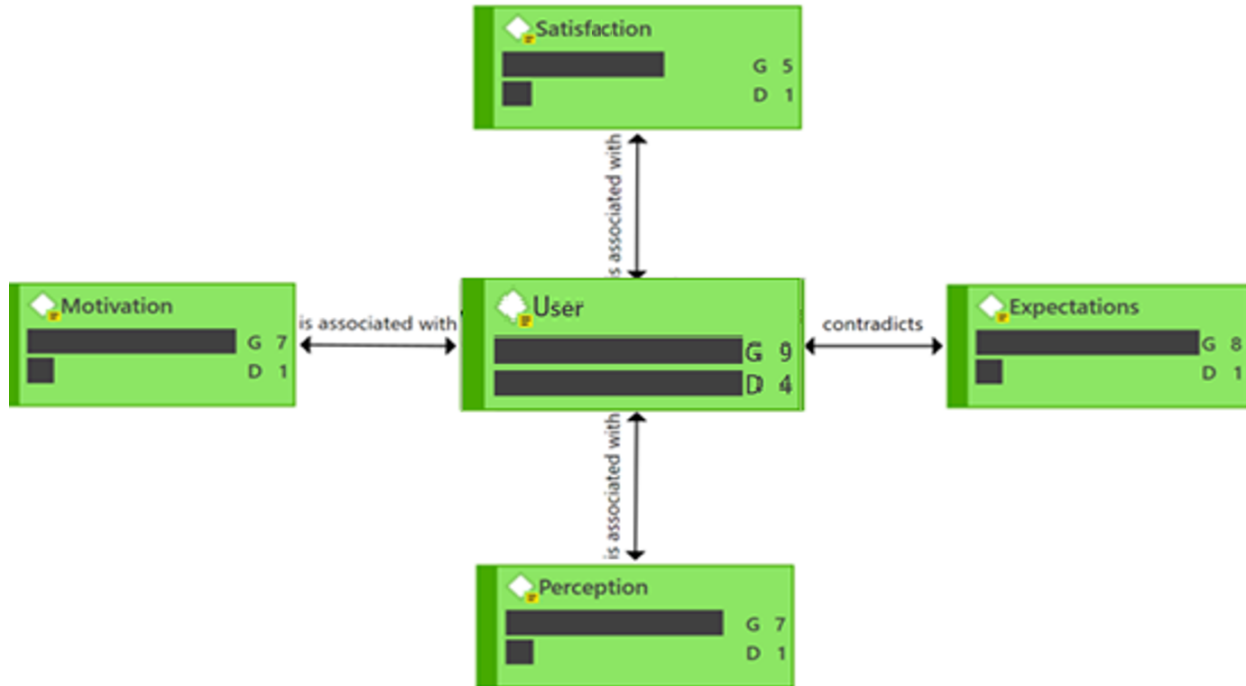


Figure 5.1: Thematic network diagram: User

Source: Researcher’s own compilation

In this study, *satisfaction* as a theme is associated with user (represents all nine participants in this study) as a theme. *Motivation* and *Perception* are associated with user, as shown in Figure 5.1. In addition to that, *expectations* contradict user.

As shown in Figure 5.1, in this research, D represents density which is the number of the connection between the themes, and G represents gravity which is the number of people who supported that theme or themes. The highest number falls under expectations (G=8) and the second highest is motivation and perception supported by the value G=7. The lowest supported theme was satisfaction which was supported by five participants.

It can be assumed that the main reason why expectation was supported by the high value of eight participants was that South Africa was experiencing high numbers of Covid-19 cases. Many lecturers and students were affected, including the technicians who maintain the MyUnisa system, just to mention a few.

However, the issue with Eskom’s electricity supply was affecting many facets of life in South Africa. Network providers struggled with their boosters which were affected by electricity provided by Eskom. This led to students not submitting their work in time due

to lack of network connectivity. The reason why satisfaction was the least supported was because some students found the resources required to complete their studies on MyUnisa, even though research students were not satisfied. User past experience was not included in the final network diagram because it was answered by fewer than two participants.

The data analysis for the system factor is presented in the next section.

5.4 SYSTEM: MLA DATA ANALYSIS RESULTS

The SRQ “Which system characteristics of a mobile learning application are desired by students?” was answered by the thematic network diagram in Figure 5.2 at the end of this section.

Tables 5.7 to 5.14 present the feedback from the students as participants of this study. The feedback is based on the sub-factors: learnability, availability, reliability, stability, security, robustness, visual attractiveness, behaviour and task duration of the system factors as identified by the study.

5.4.1 System learnability

Student’s feedback summary: The system’s learnability for myUnisa includes that it is easy to learn to use, and provides a platform where students can help each other regarding the use of the MLA, as shown in Table 5.7.

Table 5.7: Learnability of the system

System sub-factor theme	Student’s feedback: Verbatim transcriptions
Learnability theme	<p>Learnability 1: <i>I think it is easy to learn because I think they do post all the study materials on myUnisa, and you can also discuss some issues with some students, or a tutor who is assigned to assist you, you can communicate with your tutor or students on myUnisa on a discussion forum.</i></p> <p><i>I think is quite helpful, maybe you don’t understand something and you need advice from other people who are doing the module as you.</i></p>

Code: Easy to learn

According to the feedback presented in Table 5.7, seven students indicated that the MLA is easy to learn to use and helpful. Students agree that the MLA “...it is easy to learn because I think they do post all the study materials on myUnisa, and you can also discuss some issues with some students, or a tutor who is assigned to assist you, you can communicate with your tutor or students on myUnisa on a discussion forum”, and that is helpful: “I think is quiet helpful...”. The students’ feedback indicated that the student finds MLA easy to learn and helpful, which makes it effective and make their academic life easy.

This implies that the effectiveness of the system was considered when designing the MLA, and it aligns with the study by Amir *et al.* (2022), that ease of use and effectiveness of the system should be considered. Amir *et al.*’s (2022) study agreed that users need to perceive the system as helpful and easy to use. Amir *et al.* (2022) added that an easy to learn system excite the users. According to the results, it can be decided that the sub-factor learnability has an influence on the UX when interacting with the MLA.

5.4.2 System availability

Student’s feedback summary: The system’s availability for myUnisa includes that it is always available. The only time that myUnisa is inaccessible is when it is offline due to network issues or system maintenance times as shown in Table 5.8.

Table 5.8: Availability of the system

System sub-factor theme	Student’s feedback: Verbatim transcriptions
Availability theme	Availability 1: ... always had them online , I’ve never really had a problem where I try to log in and they are offline, from my experience, no, they are always available. Availability 2: Generally, it’s available despite the times that it’s offline, generally you can access it. Availability 3: Pretty much available as long you got network connection, it’s really available, it’s there on my laptop, on my cell phone so as long as you got connection its fine.

Code: Main website availability

According to the feedback, eight students indicated that the MLA (website) is always available. Students need an MLA that is always available to achieve their goals.

Availability 1 is that *“I always have them online...they are always available”*, while

Availability 2 is that *“Generally, it’s available...”*, and **Availability 3** is that the MLA is

“Pretty much available as long as you got network connection”. This implies that students have a positive experience with the availability of the MLA, which allows them to perform the intended tasks timeously.

This is in line with Berni and Yuri’s (2021) study that users (students) depend on the availability and functioning of the system to achieve their goals. Students need a reliable network connection which enables the timeous availability of the MLA to achieve their goals. If the network is unavailable, it is assumed that students cannot use the functionality of the MLA. The UX of the MLA is affected negatively if students are unable to use the MLA because of network unavailability.

This is in line with Hassenzahl and Tractinsky (2006) study that network availability is a quality that has been found to have an influence on the felt experience. Newbold (2018) argued that if users (students) cannot achieve their goals as a result of connection problems and unavailability of the information or system, then the system is not usable. According to the results, the availability sub-factor of the system has an influence on the UX when interacting with the MLA.

5.4.3 System reliability

Student’s feedback summary: The system’s reliability for myUnisa includes that it is effective and reliable, although there are challenges once in a while. myUnisa is perceived as an application that can be used to connect with the lecturers, since Unisa is an ODeL institution, but myUnisa does not always close that communication gap, as shown in Table 5.9.

Table 5.9: Reliability of the system

System sub-factor theme	Student's feedback: Verbatim transcriptions
Reliability theme	<p>Reliability 1: <i>I think it's effectively reliable, in a good way. Personally I don't usually face challenges, it only happens once in a while.</i></p> <p>Reliability 2: <i>It's really reliable sometimes, not most of the time, like reliability for me, myUnisa I use it, I see it as an app that we can connect with the lecturers as Unisa is an ODeL institution right, so I thought it was something like that but then I was wrong.</i></p>

Code: Task execution and completion (Reliability 1)

According to the feedback presented in Table 5.9, nine students agreed that the MLA is reliable: “*I think it is effective reliable, in a good way*”. **Reliability 1** is that students are able to execute and finish tasks, even though they experience challenges with the MLA once in a while. This implies that students have a positive experience regarding the reliability of the MLA. This is in line with Hassenzahl and Tractinsky's (2006) study that reliability is a pragmatic quality that influences the felt experience. Newbold's (2018) study, similarly, indicates that the system in which the interaction takes place, needs to be reliable.

Code: Unreliable in terms of communication with lecturers (Reliability 2)

Reliability 2 is that some students feel that the MLA is unreliable when it comes to communication with the lecturers: “*Reliability for me, myUnisa I use it, I see it as an app that we can connect with the lecturers as Unisa is an ODeL institution right, so I thought it was something like that but then I was wrong*”. This implies that, even though students feel that the MLA is reliable, reliability has not been met in terms of connecting students with lecturers. This implies that students have other expectations such as effective communication with the lecturers.

This confirms Berni and Yuri's (2021) study that users (students) depend on the reliability of the system to achieve goals. Newbold's (2018) study indicated that an unreliable system is untrustworthy, lacks credibility, and affects the functionality. To provide a faster and reliable MLA, Amir *et al.* (2022) recommended the use of reliable and appropriate

technologies. According to the results, the reliability sub-factor of the system does have an influence on the UX when interacting with the MLA.

5.4.4 System stability

Student’s feedback summary: The system’s stability for myUnisa includes that the MLA freezes, becomes overloaded, difficult to use and slows when many students are doing the same thing simultaneously, for example, submitting assignments and during exams. Generally, the system malfunctions during exam time or when there are simultaneous activities, as shown in Table 5.10.

Table 5.10: Stability of the system

System sub-factor theme	Student’s feedback: Verbatim transcriptions
Stability theme	<p>Stability 1: <i>I think that maybe if there is a system overload, or something like that I don’t know, maybe if there are a lot of students maybe doing the same thing at the same time, maybe the system can be slow and you have difficulty using myUnisa. I’ve never really had real issues with freezing and things like that. Except for those two times.</i></p> <p>Stability 2: <i>...glitches that we go through during exams, generally it functions properly, even if there is a technical error here and there it would be like on that day, or for a few hours, and then it would be fine the next day or after a few hours.</i></p>

Code: System overload during assignment submission and exams (Stability 1)

According to the feedback presented in Table 5.10, five students agree that the MLA is stable and functions properly when it is not overloaded: “*I think that maybe if there is a system overload, or something like that I don’t know, maybe if there are a lot of students maybe doing the same thing at the same time, maybe the system can be slow and you have difficulty using myUnisa*”. Overload of the MLA results from a large volume of students performing tasks (uploading or submitting activities) simultaneously. This implies that the MLA is malfunctional if students are unable to perform tasks (uploading or submitting activities). Stability 1 is that student’s negative experiences with the MLA, such as system overload during assignment and exam submission, makes the MLA unusable.

Code: Glitches during exams (Stability 2)

Students indicated that MLA is stable, except for slowness and glitches that are seen during exams: “... *glitches that we go through exams, generally it functions property*”. This implies that students are unable to perform tasks when these issues occur. This is aligned with Newbold’s (2018) study that if users (students) are unable to achieve their goals as a result of the unavailability of the information or system (due to unstableness), then the system is unusable.

Furthermore, Amir *et al.*’s (2022) study states that users (students) are unable to perform tasks when a system is unstable. Students expect a stable and functional MLA to complete their intended tasks. An unstable MLA results in a negative experience. This is in line with Amir *et al.*’s (2022) study that stability is a pragmatic quality that influences the felt experience. According to the results, the stability sub-factor of the system has an influence on the UX when interacting with the MLA.

5.4.5 System security

Student’s feedback summary: The system’s security for myUnisa includes that Unisa has managed to keep student’s confidentiality protected as there have not been any information loss, misuse or security breaches experienced by students so far, as shown in Table 5.11.

Table 5.11: Security of the system

System security theme	Student’s feedback: Verbatim transcriptions
Security theme	Security 1: <i>I have never experienced any information or any security breach so far, so I’m good with that.</i> Security 2: <i>I have never received such, so I think they are able to keep our confidentiality protected.</i>

Code: Information loss or breach

The information security sub-factor is important in interactive systems. According to the feedback presented in Table 5.11, eight students agreed that the MLA is secure. **Security 1** is that “*I have never experienced any information or any security breach so far*”. **Security 2** is that “... *I think they are able to keep our confidentiality protected*”. The

students showed their positive experience regarding security measures of the MLA. This indicates that students have a positive experience with the security of the MLA, which protects their information and confidentiality.

This is in line with a study by Redmond and Macfadyen (2020) that a system should not only focus on usability, but should also focus on the user’s need for security. Amir *et al.* (2022) indicated that to deliver a successful MLA, security factor needs to be constant and stable. Hassenzahl and Tractinsky (2006) stated that security is a pragmatic quality that influences the felt experience. To delivery positive UX, Redmond and Macfadyen (2020) recommended that security should be prioritized when developing MLAs. According to the results, the security sub-factor of the system has an influence on the UX when interacting with the MLA.

5.4.6 System robustness

Student’s feedback summary: The system’s robustness for myUnisa includes that the MLA randomly logs students in and out, it becomes extremely slow during online exams and assignment submission times. In addition, it does not close the communication gap between students and lectures and fails to provide certain resource materials, as shown in Table 5.12.

Table 5.12: Robustness of the system

System sub-factor theme	Student’s feedback: Verbatim transcriptions
<p>Robustness theme</p>	<p>Robustness 1: ...<i>sometimes if you try to log out it won’t log out, it will say logged out, but then it will log in again, and I will log out again, it will log in again, I don’t know what causes that, and I will switch off my phone, get back on the internet and go to myUnisa, and it’s still logged in again, and I will try to log out again, until after it will be fine.</i></p> <p>Robustness 2: <i>I think the robustness becomes questionable during online exams and assignment submission times. Often the system becomes very slow, probably jammed due to volumes of students trying to submit documents at the same time.</i></p> <p>Robustness 3: ...<i>with communication right to the lecturers, it’s really bad. I avoid using myUnisa because if the lecturers don’t answer on the server, someone must answer. If I don’t get answers, I’m assuming there is no one available.</i></p> <p>Robustness 4: ...<i>there are resources that they don’t have access to, which I think they should, so that is one thing, there is also a long way to go regarding robustness. I think they should do more regarding access to resource materials, resources generally, eBook, eJournals, etc.</i></p>

Code: Random issues with logging in and out (Robustness 1)

According to the feedback presented in Table 5.12, seven students indicated that the system is not robust. **Robustness 1** is the random occurrences of being logged out while using the MLA or remaining logged in after logging out: “*Sometimes if you try to log out it won’t log out, it will say logged out, but then it will log in again, and I will log out again, it will log in again*”. Students expect the MLA to perform according to the basic logging requirements. These random occurrences influence how students feel about the MLA, which results in a negative experience. This is aligned with Amir *et al.*’s (2022) study which confirms robustness as a pragmatic quality that can influence the felt experience.

Code: Lack of robustness during exams and assignment submission times (Robustness 2)

Robustness 2 is that “*I think the robustness becomes questionable during online exams and assignment submission times*”. This results in the system becoming extremely slow and jammed-up due to the high volumes of students trying to submit documents at the same time. The failure of the MLA to provide robust results during these events leads to students failing to achieve their goals. Students expect of the MLA to function smoothly whenever it is in use and to carry out tasks successfully. This is in line with Berni and Yuri’s (2021) study that users (students) depend on the availability and functioning of these services (robustness) to carry out tasks. Anindita (2020) indicated that improving the robustness of the MLA is an iterative process.

Code: Lack of robustness in student’s communication with lecturers (Robustness 3)

Robustness 3 is that “*...with communication right to the lecturers, it’s really bad*. The lack of communication from lecturers results in students avoiding using the MLA. This results in students’ dissatisfaction with the MLA, which, in turn, leads to students being demotivated to use the MLA. This is aligned with a study by Zhang *et al.* (1999) that when users are dissatisfied with the system, they are demotivated to use the system. Amir *et al.* (2022) indicated that to encourage the use of the MLA, robustness should be considered.

Code: Lack of access to resource materials (Robustness 4)

Robustness 4 regards the MLA as lacking certain resources: “...*there are resources that they don't have access to which I feel they should*”. Students expect the MLA to be robust in providing the required information to the students, particularly as an ODeL institution and under current circumstance (Covid-19). This implies that the MLA is not robust in terms of the availability of the desirable information, which causes the MLA to be unsatisfactory.

This is aligned with Newbold’s (2018) study that the unavailability of the required information (required resources), means that the system is not functional. Amir *et al.* (2022) indicated that to increase the functionality of the MLA and to provide a positive UX, robustness should be considered. According to the results, robustness of the system has an influence on the UX when interacting with the MLA.

5.4.7 System visual attractiveness

Student’s feedback summary: Visual attractiveness for myUnisa includes that it is just fine, it is not too bright or too dark. The newsletter containing news about myUnisa is attractive, as shown in Table 5.13.

Table 5.13: Visual attractiveness of the system

System sub-factor theme	Student’s feedback: Verbatim transcriptions
Visual attractiveness theme	<p>Visual attractiveness 1: <i>I think it is fine, uhm it represents most of colours I see on myUnisa, I think those are the colours that most of the time Unisa uses for it its brand, I think it's not too bright, it's not dark, I think the info there I think it is fine.</i></p> <p>Visual attractiveness 2: <i>The newsletter I think, the newsletter, you find the news about myUnisa. That is the only thing that attract me to myUnisa.</i></p>

Code: Look and feel (Visual attractiveness 1)

According to the feedback, visual attractiveness means that the MLA is attractive and relatable. Seven students indicated that *“I think it is fine, uhm it represents most of colours I see on myUnisa, I think those are the colours that most of the time Unisa uses for it its brand”*.

This implies that students feel positive about the visuals of the MLA, which leads to motivation. This is in line with Andreas *et al.* (2022) that the hedonic quality of the system (visual attractiveness) contributes directly to the core of positive experience, and that users are motivated by an attractive system (Amir *et al.*, 2022).

Code: Newsletter (Visual attractiveness 2)

Visual attractiveness 2 indicated that *“The newsletter on the MLA is the only thing that is attractive”*. Students need to feel positive about all the myUnisa features, not just the newsletter.

This implies that there is still a room for the visuals of the MLA to improve. This is in line with the study by Andreas *et al.* (2022) that the hedonic quality can produce emotions that are negative, and that subsequently result in the UX of the system. This indicates that the visual attributes of the MLA influence the UX of the students. According to the results, the visual attractiveness sub-factor of the system has an influence on the UX when interacting with the MLA.

5.4.8 System behaviour and task duration

Student’s feedback summary: The context’s behaviour and task duration for myUnisa include that it is the same throughout the day. However, myUnisa tends to be slower at night compared to noon or in the morning, as shown in Table 5.14.

Table 5.14: Behaviour and task duration of the system

System sub-factor theme	Student's feedback: Verbatim transcriptions
Behaviour and task duration theme	Behaviour and task duration 1: ... same during the morning and in the noon time. Behaviour and task duration 2: ... same during the early morning and towards the midnight. Behaviour and task duration 3: ... <i>it's the same</i> through the day. Behaviour and task duration 4: ... at night is slower than at noon or in the morning.

Code: Behaviour and task duration

According to the feedback, a majority of the students (behaviour and task duration 1, 2, 3) agreed that the MLA's behaviour and task duration is the same throughout the day except at night: "...*is the same through the day*". The student's feedback implied that the MLA is effective throughout the day, and that students have a positive experience with the behaviour and time duration of the MLA.

The results line up with Hassenzahl's (2003) study which highlighted that the system's effectiveness should continuously be available for users to have good UX. According to the results, it can be established that the factor behaviour and task duration have an influence on the UX when interacting with the MLA.

The section below presents the thematic network diagram of the system factor.

5.4.9 UX factor: System thematic network diagram

Figure 5.2 presents the system’s thematic network diagram

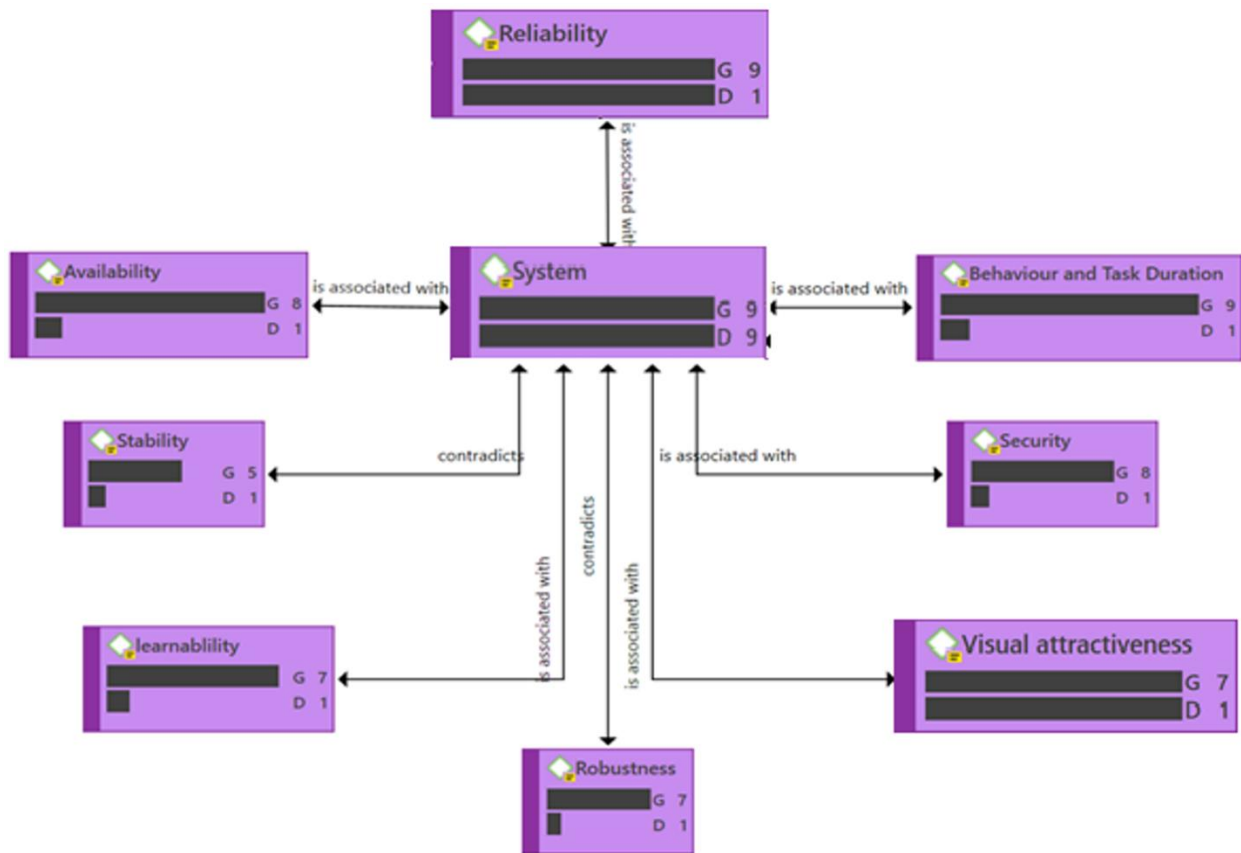


Figure 5.2: Thematic network diagram: System

Source: Researcher’s own compilation

In this study, reliability as a theme is associated with *system* (myUnisa) as a theme. Availability as a theme is associated with the system. Behaviour and task duration as a theme are associated with the system. Security as a theme is associated with the system. Visual attractiveness as a theme is associated with the system. Learnability as a theme is associated with the system. In addition to that, stability and robustness contradict the system, as illustrated in Figure 5.2.

In this research D represents density which is the number of the connections between the themes, and G represent gravity which is the number of people who supported that theme or themes. The highest number of participants in the interviews fell under reliability and behaviour and task duration (G=9), and the second highest was availability and security

supported by the value $G=8$. Learnability, robustness and visual attractiveness came third with the value of $G=7$. The lowest theme which supported system was stability which was supported by five participants.

According to the researcher's understanding, the main reason why reliability was supported by nine participants was because of the fact that it is indeed reliable because students only face reliability challenges once in a while. Behaviour and task duration were supported with the high value of nine participants because it is the same throughout the day. The reason why stability was the least supported was because students found the system difficult to use when many students were conducting tasks simultaneously, for example, submitting documents.

The data analysis for the context factor is presented in the following section.

5.5 CONTEXT: HEI DATA ANALYSIS RESULTS

The SRQ "*What context variables affect student user experience when using myUnisa?*" was answered by the thematic network diagram in Figure 5.3.

This section discusses the results of the sub-factors of the context factor. Section 5.5.1 discusses the different locations sub-factor, Section 5.5.2 discusses the connectivity browser sub-factor, Section 5.5.3 discusses the network interruption sub-factor, Section 5.5.4 discusses the task completion sub-factor, and Section 5.5.5 presents the context thematic network diagram.

5.5.1 Context: location

Student's feedback summary: The context's location for myUnisa includes that the network connectivity is efficient in urban areas, whereas there is a lack of network connectivity when students access the MLA in rural areas. Network connectivity is also more efficient when using the Unisa network than the home (residential area) network. Additionally, the home network performs better than the public network which tends to be slow, as shown in Table 5.15.

Table 5.15: Different locations

Context sub-factor theme	Student's feedback: Verbatim transcriptions
Location theme	Location 1: Urban area network is efficient but in rural there is lack of network connectivity. Location 2: Unisa area network is efficient than home network connectivity. Location 3: Home network connectivity is better than public network which is slow.

Code: Urban areas network

According to the feedback presented in Table 5.15, seven students indicated that the MLA operates differently depending on the location of use. Students indicated that the MLA is efficient in urban areas, and expressed a lack of network connectivity in rural areas. **Location 1** is that “*Urban area network is efficient but in rural there is lack of network connectivity*”. Students need the MLA to work well in both urban and rural areas.

Location 2 is that “*Unisa area network is efficient than home network connectivity*”, and **Location 3** which is that “*Home network connectivity is better than public network which is slow*”. The students expressed that while the home network may be bad, the public area network is worse. Students need the MLA to work well in all locations. The results from students imply that the UX of students with the MLA can either be negative or positive depending on the location.

Amir *et al.* (2022) stated that the system requirement is to provide functionality to the user without limitations in terms of the place where the interaction occurs. Amir *et al.* (2022) indicated that to improve the UX, functionality of the MLA without limitations should be considered. Anindita (2020) indicated that to improve the functionality of the MLA is an iterative process. According to the results, it is clear that the location sub-factor has an influence on the UX when interacting with the MLA, even though this sub-factor is out of Unisa's control.

5.5.2 Context: connectivity browser

Student's feedback summary: The context's connectivity browser includes that the MLA is different when using it on a mobile phones' pre-installed internet browser (i.e., Samsung

internet) compared to using it on the Chrome browser, as shown in Table 5.16. Additionally, students are advised to use the MLA on Chrome as it has been proven to be more efficient.

Table 5.16: Connectivity browser

Context sub-factor theme	Student's feedback: Verbatim transcriptions
Connectivity browser theme	<p>Connectivity browser 1: <i>Different if I use it on my normal internet, the normal internet there is actually delay or sometimes I get bad network, but if I use it on Chrome which I normally do, I don't have a problem on Chrome.</i></p> <p>Connectivity browser 2: <i>I think Chrome is much more efficient, I think they usually advise us to access myUnisa on Chrome if I'm not mistaken...</i></p>

Code: Normal internet (Connectivity browser 1)

According to feedback presented in Table 5.16, five students indicated satisfaction with the connectivity browser. Connectivity browser 1 is that the MLA is different when using it on different browsers: "...If I use it on my normal internet there is a delay or sometimes I get bad network..." This implies that the UX is negative when using the MLA on the pre-loaded internet browser. This aligns with De Kock's (2017) study that the malfunctioning of information and technical services such as connectivity, network issues or system sluggishness may influence the UX of the students.

Code: Chrome (Connectivity browser 2)

Connectivity browser 2 is that "*I think Chrome is much more efficient, I think they usually advise us to access myUnisa on Chrome*". Students indicated that the MLA works better on Chrome compared to the pre-installed mobile browsers. This is in line with De Kock's (2017) study that the malfunctioning of technical and information services, such as network issues, connectivity issues or system sluggishness, may influence the UX of the students. Amir *et al.* (2022) indicated that creating an engaging MLA, evolving technology should be considered. According to the results, it is clear that the connectivity sub-factor has an influence on the UX when interacting with the MLA.

5.5.3 Context: network interruption

Student's feedback summary: The context's network interruption for myUnisa includes that when the network was interrupted while executing a task on myUnisa, or the student ran out of data (wifi disconnection) while using myUnisa, myUnisa logs off, and after that interruption, the student must start the task all over again, as presented in Table 5.17.

Table 5.17: Network interruption

Context sub-factor theme	Student's feedback: Verbatim transcriptions
Network interruption theme	Network interruption 1: <i>It logs you off, usually it logs you off if you ran out of data while you were still online, and maybe when you try to come later, it would have log you off by then, maybe you start over...</i>

Code: Network interruption while interacting with the MLA (Network interruption 1)

According to the feedback, four students indicated that they do experience network issues. **Network interruption 1** is that the network interruption only happens when student ran out data/wifi while using the MLA "*...it logs you off, and maybe when you try to come later, ... you start over...*". The student expressed that after a network interruption, the MLA does not retain the information. Students are not keen on starting over after a network interruption, and that affects the UX. This is in line with the finding by Arhippainen (2009), that an interaction with the MLA in the tasks context may influence the UX. Amir *et al.* (2022) indicated that a task completion without network interruption results to happiness. According to the results, the connectivity sub-factor has an influence on the UX when interacting with the MLA.

5.5.4 Context: task completion

Student's feedback summary: The task completion for myUnisa includes that most of the time students are able to perform, complete tasks and get the intended results. This includes tasks such downloading, uploading, viewing, and so forth. Furthermore, myUnisa is efficient, except for days where the platform is inaccessible due to maintenance or network issues, as shown in Table 5.18.

Table 5.18: Task completion context

Context task completion theme	Student's feedback: Verbatim transcriptions
Task completion theme	<p>Context task completion 1: ...<i>most times I perform what I intend to do. I complete my task.</i></p> <p>Context task completion 2: ...<i>very successful in doing everything there, I get the results, that's the thing about it, what you want to do, you can do it on myUnisa.</i></p> <p>Context task completion 3: <i>Most of the time it does, it is more efficient to do what you are set out to do on myUnisa than on those days when you can't access the platform, uhm most of the time you go out there and do what you are supposed to do with minimum effort.</i></p>

Code: Downloading, uploading, and viewing

According to the feedback presented in Table 5.18, eight students indicated that they are able to complete their tasks. **Context task completion 1** is that "... *most times I perform what I intend to do. I complete my task*". **Context task completion 2** is that "...*very successful in doing everything there, I get the results...*", and **Context task completion 3** is that "*most of the time it does, it is more efficient to do what you are set out to do on myUnisa ...*".

Students need an MLA that is efficient to achieve their goals. This indicates that the students cannot complete tasks when the MLA is not accessible, resulting in unfinished tasks and their intended goals not being reached (negative UX). Berni and Yuri (2021) stated that the task factor focuses on the task that the user performs, and the intended goals reached when completing the task. Amir *et al.* (2022) indicated that an effortless and successful task completion results to happiness. According to the results, the task completion sub-factor has an influence on the UX when interacting with the MLA.

5.5.5 UX factor: Context thematic network diagram

Figure 5.3 presents the thematic network diagram of the context factor.

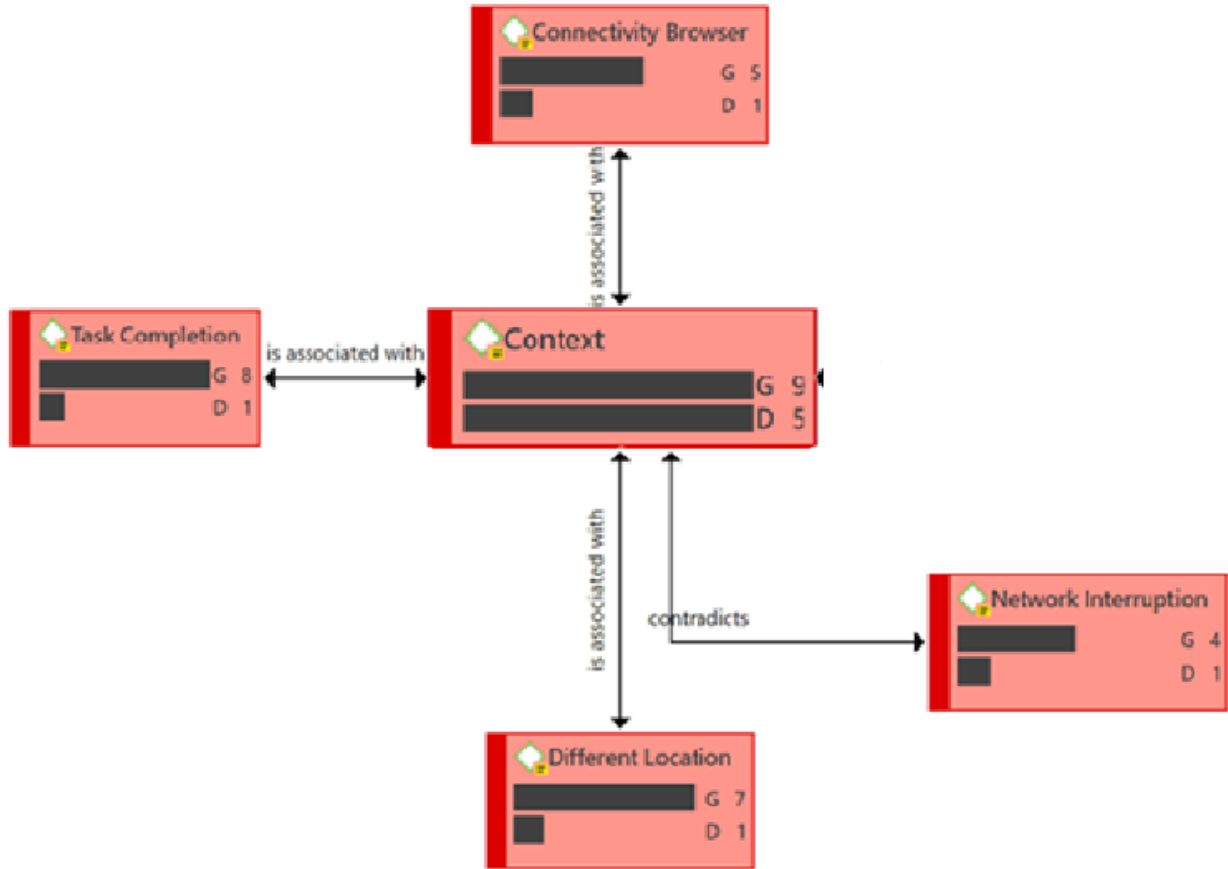


Figure 5.3: Thematic Network Diagram: Context

Source: Researcher’s own compilation

In this study, *connectivity browser* as a theme is associated with the context as a theme. Task completion as a theme is associated with the context. Different location as a theme is associated with the context. In addition to that, network interruption contradicts with context, as illustrated in Figure 5.3.

In this research, D represents density which is the number of the connections between the themes, and G represents gravity which is the number of people who supported that theme or themes. The highest number of participants in the interview fall under task completion which was supported by the value $G=8$. The lowest theme which supported context was network interruption which was supported by four participants ($G=4$).

According to the researcher's understanding, the main reason why task completion was supported with the high value of eight participants was because most of the time students are able to complete their intended tasks successfully, and with minimum effort. Different location was second highest with the value of seven participants because students are able to access the MLA in different locations. The students only indicated frustration when in the rural areas. The reason why network interruption was the least supported was because it logs students off when there is a network interruption. The MLA does not retain information.

5.6 SUMMARY OF THE CHAPTER

In this study, the literature review conducted in Chapter Two identified the factors that influence the UX of students while interacting with the MLA (myUnisa). The user, system, and context were the identified factors. Chapter Two was used to formulate the conceptual framework presented in Chapter Three. The conceptual framework was used to formulate the research questions for this study (see Appendix D). The data for this study was collected from semi-structured interviews using open-ended interview questions. Students from Unisa were participants of this qualitative study. The data was collected to understand the UX of students when using the MLA at an HEI. Thematic data analysis was used to interpret the qualitative data (Clarke & Braun, 2013). Atlas.ti was used for coding purposes. This chapter provided the discussions of the results from the analysed data collected from students through qualitative interviews. The chapter also presented the findings of the study, recommendations and suggested resolutions from students.

In this chapter, demographical variables were discussed briefly. The data analysis results of the user, system, and context factors were presented. The study used verbatim responses from students. Thematic network diagrams were used to present the themes and codes of the analysed data. The information gathered from the analysis provided an understanding of the students' experiences with the MLA. The qualitative analysis presented that the three identified factors (user, system, context) have an influence on the UX when students interact with the MLA.

The next chapter presents the proposed framework of the study.

CHAPTER 6: PROPOSED FRAMEWORK OF THE STUDY

6.1 CONTRIBUTION OF THE SUB-RESEARCH QUESTIONS

Chapter Five presented results towards answering the research question *What are the user experiences (UX) of students when using mobile learning applications?* and presented the results of the study after the factors were validated through analysis. From the analysed data, the identified factors were verified to have an influence on the UX of students when interacting with the MLA. This study needed to answer the five sub-research questions before answering the main research question. The sub-research questions that supported the study are:

- SRQ1: Which user experience factors affect students when using mobile learning applications?
- SRQ2: How are students affected by the user experience variables when using a learning app?
- SRQ3: Which system characteristics of a mobile learning application are desired by students?
- SRQ4: How are students affected by mobile context variables when using a learning app?
- SRQ5: How can a conceptual framework be used to theorise about student user experience of mobile learning applications at a higher education institution?

SRQ1 used the literature review in Chapter Two to attain an answer. The literature identified the factors that may influence the UX of student's interaction with the MLA as the user, the system, and context, as discussed in Section 2.3. A user is a person interacting with the system, system refers to the platform or infrastructure that a user interacts with, context is the environment where the interaction happens. The literature extended to identify and discuss the factors in the context of this study (Chapter Three). In the context of this study, user is the student, system is the MLA, and the context is the HEI.

After the identification of the factors that could influence the UX when students interact with the MLA, the next three SRQs (2, 3 and 4) needed to be answered.

The identified factors were illustrated in a conceptual framework, as seen in Table 3.1. The conceptual framework was used as a reference of the existing literature, to organise the literature and to connect it to the research problem to direct the data collection and data analysis. The purpose of collection of data and analysis in this study was to verify if the identified factors can have an influence on the UX of students when interacting with the MLA at an HEI.

From the analysis of the data, this study formulated the user experience framework of MLAs by students at an ODeL institution in the Gauteng province (UXFMLASO), as presented in Figure 6.1. The UXFMLASO is the proposed framework that answers SRQ5.

Table 6.1: Research questions with relevant chapters and sections that contributed to the study

Question	Research question	Chapter	Contributed section
Research question	What are user experiences (UX) of students when using mobile learning applications?	Chapter 2 - 6	Section 2.3: Factors as identified in the literature Table 3.1: The conceptual framework that propose factors that may have an influence on the UX at HEIs Section 4.5.2: The factors were presented as questions in qualitative interviews Chapter 5: Data analysis and results Figure 6.1: The proposed framework as presented
SRQ1	Which user experience factors affect students when using mobile learning applications?	Chapter 2 & 3	Section 2.3: Factors as identified in the literature Chapter 3: Factors of UX as applicable to this research
SRQ2	How are students affected by the user experience variables when using a learning app?	Chapter 2 & 3	Section 2.3: Factors as identified in literature Chapter 3: Factors of UX in the context of this study

Question	Research question	Chapter	Contributed section
SRQ3	Which system characteristics of a mobile learning application are desired by students?	Chapter 2 & 3	Section 2.3: Factors as identified in literature Chapter 3: Factors of UX as applicable in this research
Sub-research question 4	How are students affected by mobile context variables when using a learning app?	Chapter 2 & 3	Section 2.3: Factors as identified in literature Chapter 3: Factors of UX as applicable in this research
SRQ5	How can a conceptual framework be used to theorise about student user experience of mobile learning applications at higher education institutions?	Chapter 2-6	Section 2.3: Factors as identified in the literature Table 3.1: The conceptual framework presented the factors as identified Section 4.5.2: The qualitative interview questions were derived from factors identified in Table 3.1 Chapter 5: Data analysis and results Figure 6.1: Presentation of the proposed framework of the study

6.2 PROPOSED FRAMEWORK

This section discusses the factors of UX as identified in the literature as: the user, system, and context. The factors contributed towards the development of the framework for this study as presented in Figure 6.1. The conceptual framework formulated in Chapter Three (Table 3.1) comprises of factors identified by the study in Chapter Two. Chapter Two focuses on the UX and investigates factors of UX to determine the applicable sub-factors when using MLAs at a HEI, to answer SRQ1 “What are the factors of user experience that affect students when using mobile learning applications?”. Chapter Two provided different frameworks on UX. The frameworks presented factors and sub-factors that have an influence on the UX of students using MLA at a HEI. The contribution of Chapter Two was the theoretical framework of factors that may influence the UX of students as illustrated in Figure 2.8. Chapter Three focusses on the identified factors of UX (user, system and context) in the context of this study. The contribution of Chapter Three was the conceptual framework of factors that may influence the UX of students as illustrated

in Figure 3.5. Table 6.2 presents the factors (from the conceptual framework in Table 3.1) that were included in the proposed framework of the study. The sub-factors that were excluded from the study are highlighted in blue, as displayed in Table 6.2.

Table 6.2: Factors included in the proposed framework of this study

Factors	Sub-factors		References
Users	Needs	Motivation	Andreas <i>et al.</i> , 2022
		Satisfaction	Andreas <i>et al.</i> , 2022
		Positive experience	Andreas <i>et al.</i> , 2022
	Emotional status	Emotions	Langenhoven, 2016; Berni & Yuri, 2021; Amir <i>et al.</i> , 2022
	Perceptions	Useful	Amir <i>et al.</i> , 2022; Andreas <i>et al.</i> , 2022
		Easy to use	Amir <i>et al.</i> , 2022; Andreas <i>et al.</i> , 2022
		Enjoyable	Amir <i>et al.</i> , 2022
		Visually attractive	Ssemugabi, 2019; Claire, 2020; Berni & Yuri, 2021
	Expectations and past experiences	Expectations and past experiences	Hassenzahl & Tractinsky, 2006; Karapanos, 2010; Berni & Yuri, 2021; Andreas <i>et al.</i> , 2022
	Attitude	Attitude	Alghazi <i>et al.</i> , 2020; Sophonhiranrak, 2021
Psychological factors	Mind	Azizi & Khatony, 2019; Almaiah <i>et al.</i> , 2021; Berni & Yuri, 2021	
Systems	Pragmatic qualities	Functionality	Hassenzahl & Tractinsky, 2006; Berni & Yuri, 2021
		Reliability	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022
		Learnability	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022

Factors	Sub-factors	References	
	Flexibility	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022	
	Stability	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022	
	Robustness	Hassenzahl & Tractinsky, 2006; Amir <i>et al.</i> , 2022	
	Constant availability	Hassenzahl & Tractinsky, 2006	
	Information security	Hassenzahl & Tractinsky, 2006; Pengnate & Sarathy, 2018; Redmond & Macfadyen, 2020; Almaiah <i>et al.</i> , 2021; Amir <i>et al.</i> , 2022	
	Compatibility	Parsazadeh <i>et al.</i> , 2018; Almaiah <i>et al.</i> , 2021;	
	Hedonic qualities	Visual attractiveness	Hassenzahl <i>et al.</i> , 2018; Ssemugabi, 2019; Claire, 2020; Berni & Yuri, 2021
		Satisfaction	Andreas <i>et al.</i> , 2022
	Pedagogical factor	The design of educational content of the MLA	Azizi & Khatony, 2019
	Quality factors	Quality of the MLA	Althunibat <i>et al.</i> , 2021
		Quality of content of the MLA	Althunibat <i>et al.</i> , 2021
		Quality of service of the MLA	Althunibat <i>et al.</i> , 2021
	Technology factors	Security of the MLA	Almaiah <i>et al.</i> , 2021
		Privacy of the MLA	Almaiah <i>et al.</i> , 2021
		Compatibility of the MLA	Parsazadeh <i>et al.</i> , 2018; Almaiah <i>et al.</i> , 2021
Relative advantage of the MLA		Almaiah <i>et al.</i> , 2021	
Trust with the MLA		Almaiah <i>et al.</i> , 2021	

Factors	Sub-factors		References
Context	Physical context	Functional place and space	Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021; Norman & Nielsen, 2022
		Movements and mobility	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010
		Perceived environmental attributes	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010
	Social context	Social context	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021
		Person's present	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021
		Interpersonal interaction	Arhippainen, 2009; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021
	Temporal context	Duration (behaviour and task duration) of an interaction session	Jumisko-Pyykkö & Vainio, 2010; Roto <i>et al.</i> , 2011; Berni & Yuri, 2021
		Time of day, week and year	Karapanos, 2010; Jumisko-Pyykkö & Vainio, 2010; Berni & Yuri, 2021
		Interaction before – during – after – over time	Jumisko-Pyykkö & Vainio, 2010; Roto <i>et al.</i> , 2011; Muditha, 2020; Berni & Yuri, 2021
	Tasks context	Multitasking	Preece <i>et al.</i> , 2015; Muditha, 2020
		Interruptions	Preece <i>et al.</i> , 2015; Muditha, 2020
		Task domain	Preece <i>et al.</i> , 2015; Muditha, 2020
	Technical and information context	Other systems and services	Berni & Yuri, 2021; Economides & Οικονομίδης, 2021

Factors	Sub-factors		References
	Organisational factors	Resistance to change	Almaiah & Al Mulhem, 2019
		Technology readiness	Almaiah & Al Mulhem, 2019
		Cultural factors	Almaiah & Al Mulhem, 2019; Berni & Yuri, 2021
		Institutional policy	Althunibat <i>et al.</i> , 2021
		Change management	Althunibat <i>et al.</i> , 2021
		Top management's support	Althunibat <i>et al.</i> , 2021

6.2.1 User factor

User is the highest level UX factor which is described as a person manipulating or interacting with the system. The literature in Section 3.2 states that the user has characteristics such as needs, motivation, perceptions, experience, expectations, and a mental and physical state (Berni & Yuri, 2021). Andreas *et al.* (2022) stated that the sub-factors of a user refer to the internal state of the user, which stimulates the user's expectations about the system, resulting in change in the user's mood, motivation, perception, and expectations. Berni and Yuri (2021) stated that user's sub-factors can influence the felt experiences.

- In this study, **perception** refers to the way that a student thinks or expresses about the MLA. Students have a positive perception about the use of the MLA. Students perceive the MLA as useful and easy to use. Additionally, the students' perception is that the MLA helps them achieve their academic goals, improves their technological knowledge and skills, and it helps them communicate with the institution.
- In this study, **expectations** refer to a user having strong belief that something will manifest about the system. Students expect a user-friendly MLA, and an MLA that meets their expectations in terms of functionality, efficiency, and effectiveness. These expectations result from the students' past experience with the MLA.

- In this study, **satisfaction** refers to a particular point reached by a user where accomplishments, expectations or desires are met, causing the user to feel comfortable about the quality of the MLA to achieve goals. Students are satisfied with the basic services and study material that the MLA provides.
- In this study, **motivation** refers to the reason why a user acts in a certain manner regarding the MLA. Students are motivated to use myUnisa. The MLA often provides basic services and functionality to students.

6.2.2 System factor

The literature review in Section 3.3 refers to the system as the required structure for a subject under study to be seen as functional (Berni & Yuri, 2021). How the system looks and feels affects the success of a system (MLA) as stated by Ssemugabi (2019). The current study considered both the pragmatic and hedonic qualities of the system. As stated by Minge and Thüring, (2018); Riedmann-Streitz, (2018), in systems, the pragmatic and hedonic qualities are both key dimensions of UX. For the purposes of the current study, the system factor consisted of the following eight sub-factors: learnability, availability, reliability, stability, security, robustness, visual attractiveness and behaviour and task duration as taken from the literature. The following discusses the system sub-factors.

- In this study, **learnability** refers to the quality of the MLA to allow users to speedily familiarise themselves with the system and the ability to make positive use of the features and capabilities of the MLA. The MLA should be easy to learn, easy to navigate, and provide guidelines on usage and navigation.
- In this study, **availability** refers to the ability of the MLA to be available. The availability of the MLA is important to students. The HEI, as an ODeL environment, relies on the availability of the MLA for students to interact with the HEI.
- In this study, **reliability** refers to the MLA quality of being dependable or consistently performing well. The MLA should be reliable in performance, availability and connectivity. Students rely on the MLA to connect with lecturers and the HEI, since the HEI in question is an ODeL institution.

- In this study, **stability** refers to the MLAs' state of being stable or steady. The MLA is required to be stable. The stability of the MLA is important to students when interacting with the MLA. The MLA should not freeze, be slow, overloaded, and difficult to use when many students are performing simultaneous activities (submitting assignments or during exams).
- In this study, **security** refers to the MLAs' ability of being protected from harm, threat or danger. The MLA should keep student's confidentiality protected. Students feel that the MLA is secure, and no information loss, misuse or security breach have been experienced by students.
- In this study, **robustness** refers to the MLAs' condition or quality of being in good condition and strong in terms of responsiveness and recoverability. Robustness is very important to students when using the MLA. The MLA should be robust, particularly during online exams and assignment submission times, where it is inclined to cause problems.
- In this study, **visual attractiveness** refers to the pleasing look of the MLA. Visual attractiveness is an important feature to include when developing an MLA. The MLA should be pleasing to look at.
- In this study, **behaviour and task duration** refers to the way the MLA responds to commands and how long it takes. The MLA's behaviour and task duration is important to students when performing tasks on the MLA. The MLA should be the same throughout the day, every day. Students expect the MLA to operate well, even at night.

6.2.3 Context factor

The literature in Section 3.4 defines context as the conditions under which an activity can take place (Berni & Yuri, 2021). Research shows that UX is greatly influenced by the context in which it takes place (Hassenzahl, 2018). The current study discussed the contextual factors (physical, temporal, task and social) as categorised and proposed by (Berni & Yuri, 2021). Even though the social factor has been discussed, it is not part of the study. Technical and information factor has been adopted in this study as it is featured in numerous contextual factors in other research studies (Berni & Yuri, 2021).

The context factor for the current study consisted of the following four sub-factors: connectivity browser, task completion, network interruption and different location, as taken from the literature and used for the data collection of this study. These factors were taken from various context factors as identified in the study. Different locations were taken from the physical context, network interruption was taken from the task context, task completion was taken from the temporal context, and connectivity browser was taken from the technical and information context. The following discusses the context sub-factors.

- Physical context: in this study *different location* refers to the different places or change of places where a student is interacting with the MLA. The physical location where the student interacts with the MLA counts when a student performs tasks. The availability and reliability of the network where (location) the student is using the MLA is important to students.
- Technical and information context: *connectivity* is important to students. The MLA needs a stable connection and ability to connect without internet browser restrictions.
- Temporal context: *task completion* is important to students when performing tasks, to enable them to complete tasks and obtain the intended results.
- Task context: *network interruption* in this study refers to a network outage that results in the temporary unavailability by the relevant network provider and inability to supply students with the service. An uninterrupted network is important to students. In case of an interruption, students expect the MLA to retain the session or information.

6.2.4 Proposed framework

This section presents the proposed framework of the study. The answer to the research question *What are the user experiences (UX) of students when using mobile learning applications?* is displayed as the proposed framework of the study. The proposed framework is the user experience of mobile learning applications by students at an ODeL institution in the Gauteng province (UXFMLASO) framework.

The proposed framework was constructed from the conceptual framework (presented in Table 3.1) and the results of the study based on the students' feedback (presented in Chapter Five). The framework provides a broad view of all the UX factors (user, system and context) as identified in the literature review (Chapter Two, Section 2.3). As stated, in the context of this study, the user refers to the student, the system is the MLA (myUnisa), and the context represents the HEI (Unisa). The results from the qualitative data analysis of the study indicated that the identified factors as presented in Table 3.1 do have an influence on UX when students are using the MLA at an HEI. The double arrows in Figure 6.1 present the association and contradiction between the factors and sub-factors. The UXFMLASO framework is accessible as a recommendation to HEIs, researchers, investors and shareholders when utilising, improving and developing MLAs. The proposed framework (UXFMLASO) is presented in Figure 6.1.

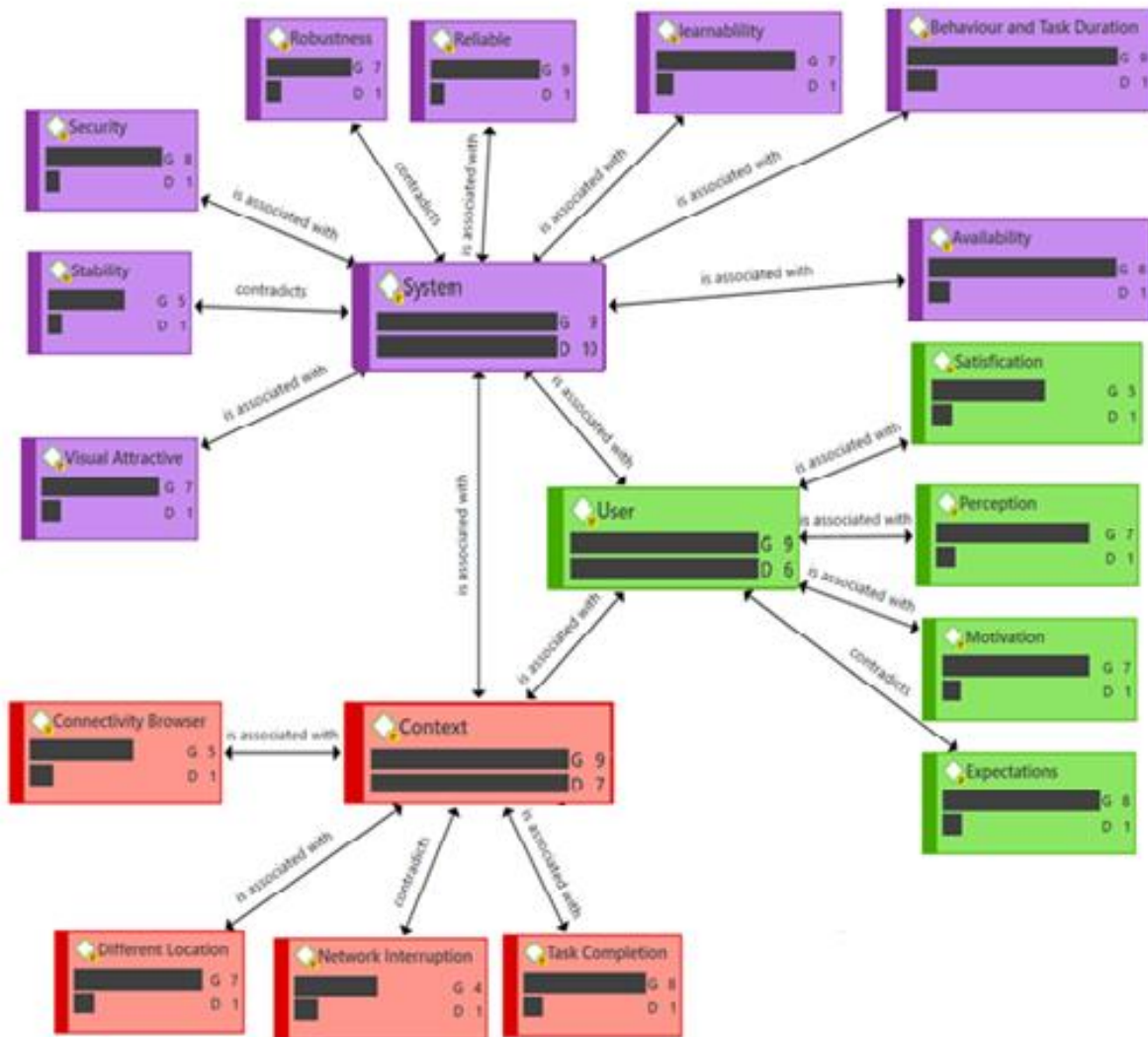


Figure 6.1: The user experience of mobile learning applications by students at an ODeL institution in the Gauteng Province (UXFMLASO) framework

Source: Researcher's own compilation

The main findings that contributed to the presented framework are from the conceptual framework developed in the literature study, and they were tested through interviews and presented as the proposed framework of this study. The proposed framework was not evaluated. The evaluation of the framework is proposed to be done as future work. The findings of the study are not different to current literature; they are similar in a sense that they confirmed the current literature through the results from the data collected in this study.

This section presented factors with the sub-factors identified in the literature study in Chapter Two. These factors and sub-factors contributed towards the formulation of the framework that this study proposes. In this study, *User* as a theme is associated with *System* and *Context* and represents all the participants in this study, which are the nine students as themes, as shown in Figure 6.1.

User is associated with satisfaction, perception, motivation, and contradicts expectations.

The identified sub-factors of the user factor are as follows:

- Perception: Students have a *positive perception* about the use of the MLA. Users perceive the MLA as a useful, easy to use, good line of communication, and improves the technology skills.
- Motivation: Students are motivated to use the MLA. Students feel that the MLA motivate them to stay updated with educational and social activities, with announcements, and with the interactions between students.
- Satisfaction: Students are satisfied with the LMA. The quality of the MLA is good, and students are provided with basic requirements and study materials to complete their studies and to increase performance.
- Expectations and past experience. The students contradict the expectations. Meaning that the expectations of the students with the MLA are not met. The past experience contributes to the expectations that students have with the MLA. Students *expect* the MLA to be user-friendly, they expect less steps needed on the functionality of the MLA, they expect an efficient exam link.

System is associated with availability, behaviour and task duration, learnability, reliability, security, visual attractiveness, and contradicts robustness and stability. The identified sub-factors of the system factor are as follows:

- Learnability: Students find the MLA easy to learn and helpful. An easy to learn and easy to navigate MLA is important to students.
- Availability: The availability of the MLA is important to students. Students need the availability of the MLA to complete their tasks.

- Reliability: The reliability of the MLA is important for students. Students need the MLA to be reliable to complete their goals.
- Security: The security of the MLA is important to students. The MLA should be secured and able to keep the confidentiality and information of the students protected.
- Visual attractiveness: The visual *appearance* and *features* of the MLA are important to the students.
- Behaviour and task duration: The behaviour and task duration of the MLA is important to students. Students need the behaviour and task duration to be the same throughout the day.
- Robustness: The MLA contradicts robustness. Students need robustness of the MLA during online exams and assignment submission times.
- Stability: The MLA contradicts stability. Students need the MLA to be stable during system overload, glitches that we go through during exams.

Context is associated with connectivity browser, different location, task completion, and contradicts network interruption, as illustrated in Figure 6.1.

- Location: The location where students use the MLA is important. Students need the MLA to be easily accessible everywhere.
- Connectivity browser: The connectivity browser is important to students. Reliable and stable connectivity browser enables students to connect with the HEI.
- Network interruption: The context contradicts network interruption. Students need the MLA to be able to retain sessions should a network interruption occur.
- Task completion: Task completion is important to students. Students need to complete their tasks when using the MLA.

6.3 SUMMARY OF THE CHAPTER

This chapter presents the proposed framework (UXFMLASO) of user experience of students when interacting with the MLAs at an HEI. Chapter Two of the study identified the factors influencing the UX of students when using the MLA. The factors were used to formulate the conceptual framework of the study in Table 3.1. The conceptual framework was used to formulate the open-ended interview questions for data collection during the semi-structured interviews.

The findings of the study were used to test the proposed framework for the study. This chapter also presented the network diagram of the identified factors of UX which are presented with their associations and contradictions. Additionally, this chapter also presented the contribution of the SRQs. As supported by the results of this study from the proposed framework (UXFMLASO) in Figure 6.1, it can be confirmed that the factors of the UX as identified in the literature have an influence on students when interacting with the MLA.

The next chapter presents the conclusion which includes the problem statement, research questions, contribution of this study, limitations of this study, possible future work, and the conclusion.

CHAPTER 7:

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

In this chapter, the problem statement is revisited in Section 7.2. Section 7.3 discusses how the questions and sub-questions of this research were answered. The contribution made by this study is listed as shown in Section 7.4. Section 7.5 presents the limitations that restricted the study. Section 7.6 suggests possible future work. The conclusion is provided in Section 7.7.

7.2 REVISITING THE PROBLEM STATEMENT

Although higher learning institutions (HEIs) have extended their learning platforms to mobile learning applications (MLAs), the user experience (UX) of students in terms of the MLAs is still unsatisfactory (Mohammadi *et al.* 2021), which is the problem statement of this study. Mohammadi *et al.* (2021) indicated the importance of understanding the factors influencing the user experience of students in the implementation of successful MLAs. Criollo-C *et al.* (2021) recommended an investigation into the factors influencing the UX of users to develop and implement high quality MLAs.

Therefore, this study investigated the UX of university students when using the MLA offered by the University of South Africa, an HEI in the Gauteng province of South Africa. The aim of the investigation was to find a solution for the problem outlined in this study. The results of the study from the data collected were used to test the proposed framework. The framework can serve as a guideline when using and developing MLA at HEIs.

7.3 RESEARCH QUESTIONS

The purpose of this study was to investigate how UX factors influence student satisfaction when using an MLA. The investigation into the UX of MLAs at higher education institutions was guided by one research question and five SRQs presented in Section 1.5 of Chapter One. This section briefly explains the process whereby the questions were answered.

The study aimed to address the research questions as follows:

Main research question: What are the user experiences (UX) of students when using mobile learning applications? The study investigated the UX of students when using the MLA to answer this research question. The investigation started with answering the following SRQs that guided the main research question.

SRQ1: Which user experience factors affect students when using mobile learning applications? This sub-research question was addressed in Chapter Two. Chapter Two identified the factors of user experience that influence students when using MLAs, as identified in Sections 2.3 and Chapter Three as the user, system and context.

SRQ2: How are students affected by the user experience variables when using a learning app?

SRQ3: Which system characteristics of a mobile learning application are desired by students?

SRQ4: How are students affected by mobile context variables when using a learning app?

SRQ5: How can a conceptual framework be used to theorise about the student user experience of mobile learning applications at higher education institutions?

To answer these research sub-questions, the literature review resulted in the conceptual framework of factors that may influence the UX of students when using the MLA, as seen in Table 3.1. The conceptual framework was used to formulate the semi-structured and open-ended interview questions that were used in the semi-structured interviews to collect qualitative data. The data was collected by interviewing Unisa students in the Gauteng province as participants of this study. The interviews collected demographical information and factors of UX as seen in Appendix D.

The study used thematic analysis to analyse the qualitative data and Atlas.ti code manager for coding purposes. The qualitative data collected from the interview research questions was analysed and reported in Chapter Five of this study. The factors were discovered to have an influence on the UX of students when interacting with the MLA at an HEI. From the analysis of data, this study formulated the user experience framework

of MLAs by students at an ODeL institution in the Gauteng province (UXFMLASO), as presented in Figure 6.1. UXFMLASO is the proposed framework that answers SRQ5.

7.4 CONTRIBUTION OF THE STUDY

This research aimed to provide deeper insight concerning the UX of students and trials encountered when using mobile applications in learning. The personal contribution is to support students who interact with the MLAs at higher learning institutions. The research can contribute towards the UX literature, as the research will be submitted, presented and published by the researcher as per the Unisa's requirements for all Master's students.

The practical contribution of the study was to develop guidelines that can be used as guidance to improve the utilisation of MLAs at HEIs. The proposed guidelines were organised in a framework (UXFMLASO) to support the developers and stakeholders of MLAs and researchers in the field of UX in terms of mobile applications in learning. It was found that the UX factors (user, system and context) have an influence on students who are interacting with the MLAs at a HEI, as shown in Figure 6.1.

Although the presented framework was developed for Unisa, it is not limited to Unisa. The framework can be adapted by any ODeL institution locally, in Africa or internationally. ODeL institutions can use the guidelines to gain more information regarding student's satisfaction and dissatisfaction when developing MLAs. It is also an opportunity for Unisa to make improvements for current and new students who are going to use the myUnisa platform. The guidelines can be used by lecturers to find areas where students are facing challenges and to avoid contradictions as reported by the study in Figure 6.1. The results of this research can also extend to inform the higher learning management when proposing, implementing and maintaining MLAs.

The study contributes to the body of knowledge on the UX of MLAs, as the results of the study can provide different viewpoints regarding the UX of higher learning institutions, while also proving cognisant about the factors of UX that may affect students when using the MLA. Additionally, the results of this study can be applied as the foundation for further exploration of user experience of students using MLAs in the context of this study or in other contexts. The results can also be used by HEIs when developing or investigation

the student UX. Furthermore, the findings can also be extended to provide input to the Sakai Open-Source to enhance the platform. The improvement of the Sakai platform can enhance the UX for students when interacting with the MLA.

Lastly, considering the Covid-19 pandemic that started in South Africa in 2020, South African universities are under more pressure to develop systems that not only enable students to connect with the universities but cater to all the needs of students remotely. It became evident that even for an ODeL at an HEI such as Unisa, there is still space for improvement in their online offerings, specifically in terms of information, support and turn-around time.

As indicated by research, the effects of the coronavirus might be permanent (Li & Lalani, 2020). Thus it is important that HEIs prioritise the full migration and improvement of their online services. Although the researcher in the current study is of the opinion that in the South African context, the opportunities for full migration to online learning and improvement of MLAs were unkindly affected by the Covid-19 pandemic. Similarly, to the Covid-19 disruptions, there was a disruption where students were protesting against fee increases and for government funding to be increased at HEIs (SABC, 2016), and the researcher in the present study believes that action towards the adoption of MLAs or full migration should have been initiated at that stage.

7.5 LIMITATIONS OF THE RESEARCH

The limitations of the current study are discussed as follows:

- This is research of limited scope. The study was only limited to the students. Students are the end-users of the MLA.
- This study investigated the MLA in one ODeL University (Unisa) because it is the only ODeL University in South Africa, therefore, there is a limited chance of generalising the results of the study across HEIs.
- Interviews of the study were conducted during exam time; students were focusing on exams.

- The study interviewed nine students because according to Creswell and Creswell (2018), a number of three to ten participants is adequate for qualitative studies. Therefore, the sample size was acceptable as it is within the recommended sample.
- The data collected for this study is mostly an indication of an interaction after using the MLA. Although student's expectations before an interaction with the MLA, and interactions while using the MLA were included, the study could have prioritised on them too to assess the overall UX.
- The study noted that UX evolves after some period of time. Therefore, it is important to note that the data collected for this study is the UX of the MLA at a particular time. The UX can evolve after some time.
- The supervisors who participated in reviewing this study are lecturers and not the end-users of the MLA. The shortcoming is that they are lecturers and not the students for whom the system has been designed. This means that they might not fully understand the experiences of students interacting with the MLA. However, as lecturers, that can be an eye opener in a sense that they can be more understanding and sympathetic with students because of the issues that were identified.

7.6 POSSIBLE FUTURE WORK

Suggestions for further research are listed as follows:

- In future, the proposed framework of the study can be tested by the researcher in or other researchers.
- This study only focused on students, in future the study can be extended to the staff members and the IT department.
- This study focused on certain age group categories and year of study. Similar studies can be conducted for other age groups and years of study.
- This study only interviewed nine students. The number of students can be increased in future.
- The study collected data at one ODeL institution. Future studies can collect data at other ODeLs or HEIs to validate the framework of this study.

- This research concentrated on user, system and context. Future research can also be extended to formulate other themes, rather than using user, system and context for future work.
- This research is a cross-sectional study. In future, a longitudinal study can be applied.
- More research needs to be done as systems change over time.

7.7 CONCLUSION

Although, there are system guidelines, the guidelines unaided cannot guarantee the success of a system. Interactive systems cater for different users, different user needs, different communities, different cultures, and at different times. Therefore, it is important to identify and understand the needs of the user for which it is intended. It is far more important to involve users as stakeholders in all the processes of system development. In a personal capacity, this study asserted that interactive systems cannot be planned for users that were not included from the inception stages. Even though there are user experience challenges with interactive systems, it is imperative to appreciate the role that technology plays in our lives. Technology has drastically improved the way things are done, how each person individually does things and when things are done. The adoption of technology in education has transformed the typical learning culture and enabled learning without geographical boundaries and time constraints.

Higher education institutions have adopted the use of mobile learning applications to improve the overall learning experience of students. Students need to have a positive experience when interacting with mobile learning applications. There are factors that may influence the UX when students interact with mobile learning applications. The literature review in this study identified the user, the system, and context as factors that influence the students when using mobile learning applications. According to the results of this study, the conclusion is that the factors (user, system, context) identified by this study have an influence on the UX when students use the mobile learning application.

The user experience of mobile learning applications by students at an ODeL institution in the Gauteng province (UXFMLASO) framework of this study can be used to understand the factors that may influence the use of mobile learning application at higher education institutions by students. The current study is confident that the framework can offer much necessary support in the development of mobile learning applications and can contribute to the development of customised mobile learning applications.

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APPENDIX A: CONSENT TO PARTICIPATE IN THE STUDY

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname.....

Participant Signature..... Date.....

Researcher's Name & Surname.....

Researcher's signature..... Date.....

APPENDIX B: UNISA ETHICAL CLEARANCE



UNISA COLLEGE OF SCIENCE, ENGINEERING AND TECHNOLOGY'S (CSET) ETHICS REVIEW COMMITTEE

2021/06/11

Dear Miss Babongile Meisie Mpungose

ERC Reference #: 2021/CSET/SOC/020

Name: Babongile Meisie Mpungose

Student #: 62229176

Staff #:

**Decision: Ethics Approval from
2021/06/11 for three years
Humans involved.**

Researcher(s): Babongile Meisie Mpungose
0791717308 62229176@mylife.unisa.ac.za

Supervisor (s): Prof. Bester Chimbo
chimbb@unisa.ac.za, 011 670 9105
Dr. Balreck Chipangura
Chipab@unisa.ac.za 011 670 9106

Working title of research:

**Student user experiences of mobile learning application at Higher Education
Institutions in the Gauteng Province**

Qualification: MTECH Information Technology: 98802

Thank you for the application for research ethics clearance by the Unisa College of Science, Engineering and Technology's (CSET) Ethics Review Committee for the above mentioned research. Ethics approval is granted for 3 years.

The low risk application was expedited by the College of Science, Engineering and Technology's (CSET) Ethics Review Committee on 2021/06/11 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment. The decision will be tabled at the next Committee meeting for ratification.



APPENDIX C: RPSC ETHICAL CLEARANCE



RESEARCH PERMISSION SUB-COMMITTEE (RPSC) OF THE SENATE RESEARCH, INNOVATION, POSTGRADUATE DEGREES AND COMMERCIALISATION COMMITTEE (SRIPCC)

10 August 2021

Decision: Permission approval 10
August 2021 to 31 January 2022

Ref #: 2021_RPSC_054
Ms. Babongile Meisie
Mpungose
Student #: 62229176
Employee #:

Principal Investigator:

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chipab@unisa.ac.za; 0791686690

STUDENT USER EXPERIENCES OF MOBILE LEARNING APPLICATION AT HIGHER EDUCATION INSTITUTIONS IN THE GAUTENG PROVINCE

Your request for permission to involve UNISA employees, students and data regarding the above study has been received and was considered by the Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) on 29 July 2021.

It is my pleasure to inform you that permission has been granted for the study. You may include thirty (30) students from the Florida campus who are registered, undergraduate, second year, and above and have used the myUnisa for more than a year. You may request ICT to select students on the Florida campus according to the inclusion criteria (different departments, courses, year of study, ages (19 – 40+), both females and males) and act as a gatekeeper in sending an e-mail request for voluntary participation in the interviews.



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APPENDIX D: INTERVIEW QUESTIONS

The user experience of mobile learning applications by students at an ODeI institution in the Gauteng Province.

The purpose of this study is to investigate the user experience of students when using mobile learning applications at a higher education institution. The interview is divided into two sections (section A and section B). Section A consists of the demographical information (Participants' details). Section B is the actual interview on user, system, and context. User is the student participating in the study, the system is the mobile learning application (myUnisa), and context is the higher education institution (Unisa).

SECTION A: Demographic questions

Please make a selection by putting an 'X' next to the option selected, and please provide an answer where appropriate, in the provided space. Please note that all questions are mandatory.

1. Name of your college

- College of Accounting Sciences
- College of Agriculture and Environmental Sciences
- College of Economic and Management Sciences
- College of Education
- College of Human Sciences
- College of Science, Engineering and Technology
- College of Law
- College of Graduate studies
- Other: -----

2. The course registered for

3. Year of study

- First year
- Second year
- Third year
- Fourth year

4. Gender

- Female
- Male
- Other

5. Age

19 – 30 years

31 – 35 years

36 – 40 years

Above 40years

6. Description of general level of computer skills

Novice: I battle to perform tasks expected of me

Average: I cope with general computer tasks

High: I perform specialised tasks and learn new skills by myself

Very high: I do complex computer programming or other specialised tasks and solve my own computer problems

7. How long have you been using myUnisa?

Less than one year

One to two years

Three to four years

More than four years

8. How often do you use myUnisa?

Less often

Often

More often

Other.....

9. When do you use myUnisa the most: At home, work or campus?

Home

Work

Campus

Other: -----

10. What features do you use the most on myUnisa?

Section B: Questionnaire on user (student): Students under description refers to the participants.

User

1. What motivates you to use myUnisa? (What makes you keep on using it?)
2. How satisfied are you with myUnisa? (and why?)
3. What is your perception of myUnisa? (What do you think of it?)
4. What are your functionality expectations when using myUnisa? (Positive/negative)

System

5. How effective and efficient is it to perform a task on myUnisa?
(effective - to successfully produce desired or intended results, efficient - to achieve maximum productivity with minimum wasted effort, expense or time)
6. How reliable is myUnisa? (Accomplish tasks without network, connectivity, timeout, etc. problems?)
7. How learnable is myUnisa? (How easy is it to learn?)
8. How stable is myUnisa? (Functionality, Connectivity, Usability)
9. How is myUnisa robustness? (Responsiveness and recoverability - response to commands, user interface such as buttons, etc.,)
10. How is the availability of myUnisa? (Connectivity, behaviour in terms of time)
11. How is the information security of myUnisa? (Information loss/misuse)
12. What do you find visually attractive about myUnisa? (The look and feel of myUnisa).

Context

13. Device type - what device do you use to access my Unisa? What is your experience?
14. Browser experience - which browser are you using to access myUnisa? What is your experience?
15. Task submission - what time of day do you prefer to submit tasks on myUnisa? Why?
16. Is the behaviour and task duration the same during the week and weekends? (Have you experienced any discrepancies in terms of how it functions)

Open questions for further improvements

17. Describe your overall experience with myUnisa?
18. Is there any reason that keeps you from using myUnisa?
19. Are there any suggestions for improvement on myUnisa?

APPENDIX E

DECLARATION OF PROFESSIONAL EDIT



Retha Burger
B.A.(HED.)

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cell: 083 653 5255

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Independent Skills Development Facilitator

Dear Ms Mpungose

This letter is to record that I have completed a language edit of your dissertation entitled, "Student user experience of a mobile learning application at an ODeL institution in the Gauteng Province".

The edit that I carried out included the following:

- Spelling
- Grammar
- Vocabulary
- Punctuation
- Pronoun matches
- Word usage
- Sentence structure
- Correct acronyms (matching your supplied list)
- Captions and labels for figures and tables
- Spot checking of 10 references

The edit that I carried out excluded the following:

- Content
- Correctness or truth of information (unless obvious)
- Correctness/spelling of specific technical terms and words (unless obvious)
- Correctness/spelling of unfamiliar names and proper nouns (unless obvious)
- Correctness of specific formulae or symbols, or illustrations

Yours sincerely

Retha Burger

18 October 2022