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The Use and Adaptation of Learning Management System by Undergraduates (Gen Z) at a Higher Learning Institution in South Africa During a Pandemic

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The Use and Adaptation of Learning Management System by Undergraduates (Gen Z) at a Higher Learning Institution in South Africa During a Pandemic

A

Research Report

By

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(1792283)

In

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ABSTRACT

The COVID-19 pandemic significantly disrupted higher education worldwide, forcing institutions to rapidly adopt remote learning through Learning Management Systems (LMSs). This study investigates how Generation Z undergraduate students at a South African university engaged with LMS platforms during the pandemic, focusing on the factors that influenced effective usage and perceived learning success. Guided by the Faithful Appropriation Model (FAM), the research employed a cross-sectional survey of first-year students, with 81 valid responses analyzed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The findings highlight the critical roles of IT support and self-efficacy for self-regulated learning in fostering faithful LMS appropriation. Interestingly, higher computer self-efficacy was associated with lower LMS engagement, suggesting overconfidence may hinder platform use as intended. The study contributes theoretically by extending FAM with new variables relevant to remote learning, and practically by informing LMS design and institutional support strategies. Limitations include the small sample size and reliance on retrospective self-reporting, which may affect generalizability. This research supports national educational goals by offering insights for improving digital learning environments in crisis contexts.

Keywords: Learning Management Systems (LMS), Generation Z, COVID-19, Online Learning, Faithful Appropriation Model (FAM), Self-Efficacy, South Africa

DECLARATION

This study paper, which I, Zamani Mbhele, hereby declare is the product of my own independent effort. It is submitted to the University of the Witwatersrand in Johannesburg in partial fulfilment of the criteria for the Master of Commerce in Information Systems degree. I also attest that this work hasn't been turned in for credit toward any other degree or test at any other university.

DEDICATION

To my beloved mother, Nelly Muriel Ntshangase, I owe my deepest gratitude for the for the countless sacrifices you have made and still do to make sure I live a respectable life. To my late father, Sthembiso 'Zonke' Mbhele, I hope that my achievements bring pride to your eternal rest. I will always be thankful to my sister, Slindile Mbhele, whose understanding and unfailing support have been my constant anchor since the day I was born. To my daughter, Kimi Kayise Mbhele, you are the light of my life and the reason I find purpose each day. To my entire family, I promise to devote every ounce of my strength to improve our lives and work tirelessly for brighter days, so long as God continues to bless me with the opportunity to do so.

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LIST OF ABBREVIATIONS

Abbreviations	Meaning
LMS	Learning Management System
FAM	Faithful Appropriation Model
HE	Higher Education
HEIs	High Education Institutions
IT	Information Technology
COVID-19	Corona Virus
Gen Z	Generation Z
TAM	Technology Acceptance Model
IDT	Innovation Diffusion Theory
TRA	Theory of Planned Behaviour
UTAUT	Unified Theory of Acceptance and Use of Technology
TOE	Technology-Organization-Environment
RBT	Resource-Based Theory

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The global shift toward digital education has placed Learning Management Systems (LMSs) at the center of higher education delivery, particularly during disruptive events like the COVID-19 pandemic. For Generation Z (Gen Z)—a cohort raised in an era of ubiquitous digital technology—LMSs offer a familiar yet complex environment for academic engagement (Chandra, 2021). However, the pandemic's abrupt transition to remote learning exposed systemic challenges, including digital infrastructure gaps, limited support services, and varying levels of student digital literacy (Cardullo et al., 2021; Irfan et al., 2020; Onyema, 2020). These challenges raised critical questions about whether LMS platforms, as implemented, were truly effective for promoting learning among Gen Z students in crisis contexts.

In South Africa, these concerns were compounded by socio-economic disparities that influenced students' ability to access and benefit from LMSs (Maphalala et al., 2021). While higher education institutions (HEIs) made efforts to provide devices, internet access, and training, these measures often fell short in ensuring equitable and effective learning outcomes. Existing studies have largely examined LMS adoption and usage patterns but have insufficiently addressed the nuanced, post-adoption experiences of Gen Z students—specifically how they appropriated LMS tools and whether this contributed to their learning success during the pandemic.

This study responds to this gap by applying the Faithful Appropriation Model (FAM) to assess how Gen Z students at a South African university—referred to here as "University A" to preserve anonymity—used LMS platforms in line with their intended design. The concept of *faithful appropriation*, derived from the Faithful Appropriation Model (FAM), provides a valuable lens for examining the fidelity and depth of student engagement with LMS platforms. This study extends FAM to incorporate contextual and psychological variables relevant to Gen Z learners navigating remote learning conditions.

The central focus of this study is the link between LMS appropriation and *learning success*. However, learning success is treated here not merely as academic performance, but as a composite of student's perceived satisfaction, engagement, and confidence in the learning process. Exploring how different support and personal factors influence this outcome offers theoretical and practical insights for improving digital learning environments. Variables such as IT support, task-technology fit, and self-efficacy are explored in FAM to understand how they influenced both students' appropriation behaviors and their perceived learning success.

Understanding Gen Z's experiences is essential, as they represent a majority of the undergraduate population and bring distinct preferences and expectations to digital learning. Unlike previous generations, Gen Z students are accustomed to interactive, personalized, and visually driven digital environments, which may not align seamlessly with conventional LMS structures. Investigating how these students engaged with LMSs under emergency conditions provides valuable insights for improving platform design, institutional support, and pedagogical strategies.

This research aligns with South Africa's National Development Plan (NDP) 2030 and the United Nations Sustainable Development Goal 4 (SDG4), both of which emphasize the role of inclusive, quality education in advancing socio-economic development (Chigova, 2021). By examining the learning dynamics of Gen Z students during the pandemic, the study contributes to ongoing efforts to build resilient digital education systems that support both equity and excellence in higher learning.

1.2 Problem Statement

In navigating the uncertainties of our contemporary world, leaders must effectively employ all available tools for managing change (Newman & Ford, 2021). Significant challenges were caused by the COVID-19 pandemic, which compelled South African universities to quickly transition to technology-driven teaching and learning strategies in the second quarter of 2020 (Serhan, 2020; Waizenegger et al., 2020).

This swift shift necessitated a widespread adoption of Learning Management Systems (LMSs), pushing students—particularly Gen Z— to rely on online learning tools like Microsoft Teams, Zoom, WhatsApp, and Slack (C. Mpungose & Khoza, 2020). However, this abrupt shift to fully online learning via LMS presented well-known issues, such as students' limited access to computer resources, lack of digital skills, and limited internet access (Cardullo et al., 2021; Irfan et al., 2020; C. B. Mpungose, 2020; B. B. Nair & Solanki, 2023; Paea et al., 2024; Pillay & Madzimure, 2023)

Despite higher education institutions (HEIs) attempting to bridge these gaps by providing laptops, internet data plans, and computer literacy training, these measures often fell short of ensuring learning success (Francom et al., 2021; Singh & Meena, 2024). Research shows that while LMSs offer individualized learning processes and provide feedback that supports learners, they still lack some critical features necessary for promoting self-regulated learning (Ali et al., 2019; Çakiroğlu et al., 2024a; Janson et al., 2017; Todorova, 2022). In a time where Gen Z students are expected to seamlessly navigate digital platforms, the reality of technology-mediated education places increasing pressure on them to regulate their learning independently, often without adequate guidance (Çakiroğlu et al., 2024b; Janson & Leimeister, 2017; C. B. Mpungose, 2020)

The complexity of LMS platforms can overwhelm users, especially when the system is perceived as not fitting the task at hand (Liu & Yu, 2023; Mahat et al., 2024; Su & Guo, 2021). This exacerbates the problem Gen Z students face in aligning their learning needs with the technology available to them. Effective management of these systems has thus become a critical factor in determining the success of higher education under such conditions.

The process of learning encompasses diverse ways in which students acquire, process, and retain information during educational activities (Bastos et al., 2019; Marougkas et al., 2023). It involves cognitive, emotional, and physical aspects and is influenced by many factors such prior knowledge, motivation, and the learning environment (Makransky & Petersen, 2023; Shehata et al., 2024). This process includes attention

and perception, information processing, memory storage, and retrieval (Hua et al., 2023). For Gen Z, who are accustomed to rapid information access but may not have fully developed their self-regulated learning skills, this environment presents a unique challenge (Malahati, 2023; Muasyaroh, 2024).

Learning success, on the other hand, gauges the extent to which an individual achieves their learning goals or objectives and applies new knowledge, skills, or attitudes (Said & Muslimah, 2021; Yusup et al., 2023). The learning process and learning success are intricately linked, and effective learning strategies, including active learning, metacognition, self-regulation, and supportive learning environments, enhance the likelihood of achieving learning goals and success (Morgan, 2024; Prather et al., 2020; Wu, 2024).

Earlier studies have frequently examined the factors affecting the acceptance and use of LMSs during the pandemic, yet there has been relatively little emphasis on understanding the students' direct experiences—the ways in which learners navigate and adapt to LMS structures (Raza & Qazi, 2021; Tanjung & Utomo, 2021). Gen Z students, in particular, approach technology differently, bringing their unique preferences and challenges to the mix, which conventional models of technology adoption tend to overlook (Al-Maroof et al., 2020; Ramírez-Herrero et al., 2024). There is a pressing need to explore how this generation engaged with and adapted LMSs throughout the pandemic (Adeshola & Agoyi, 2023; Makumane, 2023; Turnbull et al., 2021). In order to fill these gaps, the current study asks how students—especially those from Generation Z—used learning management systems (LMSs) during this unprecedented period.

1.3 Research Questions

This study's main research question is:

> How did Gen Z students utilize LMS in their learning process during the pandemic at a higher learning institution in SA?

From this question, the following sub-questions arise.

SRQ1: How did LMS use impacted Gen Z students' learning success during the pandemic at a higher learning institution in South Africa?

SRQ2: What factors hindered Gen Z students' learning success while using LMS during the pandemic at a higher learning institution in South Africa?

1.4 Research Objectives

This study has two goals in mind:

1.4.1 Primary Objective:

- To investigate how Gen Z students utilized LMS in their learning process during the COVID-19 pandemic at a higher learning institution in SA.

1.4.2 Secondary Objectives:

- To evaluate how using an LMS impacted learning success of Gen Z students at a South African higher learning institution during the pandemic.
- To identify the factors that affected or hindered Gen Z students' use of LMS learning success using LMS during the pandemic at a South African higher learning institution.

1.6 Purpose of Study

The purpose of this study is to explore the experiences of Gen Z students using LMS at a South African university, referred to as "University A," during the COVID-19 pandemic. The study aims to evaluate how students engaged with LMS in their learning process, the challenges they faced, and the factors that contributed to their learning success or failure. By filling this gap in the literature, the study offers suggestions for enhancing LMS design and implementation in higher education as well as insights into how LMSs promote remote learning in emergency situations.

1.7 Significance of the Study

This research makes contributions to academia, policy, and practice, among other fields. The findings provide educational institutions with valuable insights about how to better build and support learning management systems to fulfil the demands of Gen Z students during emergencies. By offering suggestions to improve access to high quality education via digital platforms, this research supports South Africa's National Development Plan 2030 and is in line with the United Nations Sustainable Development Goal 4 (SDG4), which calls for ensuring inclusive and equitable quality education (Halkos & Gkampoura, 2021). Finally, by applying the Faithful Appropriation Model (FAM) to investigate LMS usage during a pandemic, the work advances the larger information systems (IS) research community

1.8 Context and Rationale for South Africa and University A

The decision to study Learning Management System (LMS) use by Generation Z students during the COVID-19 pandemic in a South African university stem from the country's unique socioeconomic and educational challenges, as well as the broader global shift toward digital learning. South Africa, characterized by significant inequalities in education and digital infrastructure, presents a compelling context for examining how digital natives like Generation Z adapted to remote learning during a global crisis. The pandemic amplified these disparities, particularly for students in under-resourced areas, creating a critical need to understand how digital solutions such as LMS platforms were used.

South Africa's economic development is closely tied to educational advancements, but the pandemic's disruption of traditional educational models accelerated the need for digital learning solutions like LMS. Generation Z, having grown up during rapid technological advancements, was a key demographic affected by this shift. Understanding their experiences is vital, as they represent the future workforce and will play a crucial role in shaping South Africa's trajectory in the years to come.

Moreover, the country's socioeconomic context highlights persistent issues like the digital divide, where internet access and the affordability of devices remain barriers to online learning, especially in rural and disadvantaged areas. Investigating how Generation Z students at University A interacted with LMS platforms during the pandemic provides valuable insights into overcoming these barriers and promoting digital equity. This research can inform policies aimed at enhancing digital learning accessibility and improving educational outcomes, ensuring that LMS platforms are designed to meet the needs of diverse student populations.

South Africa also stands out as a regional leader in digital and technological infrastructure, making it an ideal case study for LMS usage during the pandemic. In 2021, 72% of South Africa's population used the internet, significantly higher than other African nations such as Kenya (29%) and Nigeria (53%) during the same period (World Bank, 2024) (Chatterjee et al., 2022). This high level of internet penetration underscores South Africa's potential to successfully implement digital learning solutions during crises like COVID-19. Furthermore, South Africa leads in other critical areas, such as access to electricity (89% of the population), compared to countries like Nigeria (59.5%) and Ghana (86.3%) (World Bank, 2024). These infrastructural advantages positioned South African universities, such as University A, to better support remote learning compared to their regional counterparts.

Generation Z students, who thrive on visual and interactive technology, form the majority of the undergraduate population in South Africa. Their digital fluency, combined with South Africa's relatively advanced internet infrastructure, makes the country a key focus for assessing the effectiveness of LMS platforms during the pandemic. Studying their experiences in South Africa not only enhances our understanding of digital education in a local context but also provides lessons for other African nations facing similar challenges with lower levels of infrastructure development.

Higher education institutions, such as University A, play a pivotal role in South Africa's social and economic development. Universities are tasked with producing highly skilled graduates essential for national progress, as well as improving the quality of life for

students and their communities (Mohammadpour, 2021). University A, in particular, has been at the forefront of addressing both global and local challenges, including the COVID-19 pandemic (Makoni, 2020; Subramaney et al., 2020), poverty, unemployment, and social inequality (Osman, 2020).

The university holds a prominent position in global, continental, and local university rankings. Globally, it ranks within the 301-350 band in the Times Higher Education (THE) World University Rankings 2024, and at #267 in the QS World University Rankings 2024 (universityguru.com, 2024). Regionally, University A is consistently ranked as the second-best university in Africa, after the University of Cape Town, according to both QS and THE rankings. It also holds the #2 position in the US News Best Global Universities Rankings for Africa, further demonstrating its research strength and academic excellence (edurank.org, 2024; universityguru.com, 2024).

University A is not only a leader in academic performance but also a driver of social change. It has redefined its role beyond traditional higher education to actively contribute to South Africa's broader development goals. By focusing on generating the skills and expertise necessary to reduce poverty, inequality, and unemployment, University A positions itself as a key player in shaping the future of South Africa and Africa as a whole.

1.9 Delimitations of Study

1. **Contextual Scope**: The study is limited to University A, and findings may not apply broadly to other South African universities or educational institutions in different countries with varying technological capacities
2. **Sample Size**: A smaller student sample may limit the representativeness of the findings to the entire student population at University A
3. **Timeframe**: The study only examines LMS use during the pandemic, limiting its applicability to non-pandemic learning environments.

4. **Cultural and Demographic Differences**: Cultural diversity among students could influence their perspectives and experiences with LMS, creating variability in adaptation that may not be universally applicable.
5. **LMS Platform Specificity**: This study focuses on a particular LMS at University A, which may limit the applicability of findings to other institutions using different platforms.
6. **Data Collection Methodology**: The reliance on self-reported surveys introduces potential bias and may not capture the complete spectrum of student experiences with LMS.
7. **Data Availability**: The availability and accuracy of student LMS usage data could impact the depth of the analysis, limiting insights into long-term adaptation and engagement.
8. **Learning Styles**: LMS may not cater equally to all learning styles, which could limit the effectiveness for certain students and reduce the generalizability of results.
9. **Privacy Concerns**: Students' concerns about data privacy and security may reduce their willingness to participate fully, affecting the reliability of the data collected.

1.10 Summary of the Chapter

Learning management systems (LMSs) play a critical role in enabling globally accessible learning experiences, as shown in Chapter 1, which introduces the reader to the essential interaction between learning and technology in modern education. It talks on how the COVID-19 outbreak caused a paradigm shift, highlighting how important LMSs are to facilitating remote learning. The chapter articulates the significance of understanding students' utilization and adaptation of LMSs. The rationale for selecting South Africa and University A is delineated, emphasizing the institution's pivotal role in addressing societal challenges and fostering national development. Finally, the chapter delineates the study's delimitations, recognizing constraints such as sample size

limitations, cultural differences, and data collection methodologies, aiming for a comprehensive understanding of LMS dynamics amidst the pandemic.

The research report's remaining sections are organized as follows.

Chapter 2 focuses on literature that was engaged to understand the topics that underpins the study, including LMS, COVID-19, Gen Z, learning process and learning success.

Chapter 3 discusses the theoretical underpinnings of the study, including the constructs used in the study. Furthermore, a conceptual research framework developed during the study is discussed.

Chapter 4 discusses the research methodology that was applied to answer the research questions, collection and analysis of data, and ethical considerations.

Chapter 5 presents data analysis techniques employed and provides results from the statistical calculations done.

Chapter 6 discusses the research results or findings and connects them to literature.

Chapter 7 concludes the study with the study contributions, study limitations and future research recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter critically reviews existing literature relevant to LMS usage, technology adoption, and learning success in higher education, with a focus on Generation Z students during the COVID-19 pandemic. The review draws on global and South African studies to position this research within broader debates on digital learning, educational equity, and student engagement. The structure of the chapter is thematic, beginning with the impact of COVID-19 on higher education, followed by a review of LMS adoption and use, characteristics of Gen Z learners, conceptualisations of learning success, and the theoretical frameworks underpinning this study. The chapter concludes by identifying the key research gap and justifying the need for the current investigation.

2.2 The Impact of COVID-19 on Higher Education

The COVID-19 pandemic disrupted education systems globally, prompting an abrupt transition to remote learning. Universities were compelled to adopt online modalities with minimal preparation time, placing Learning Management Systems (LMSs) at the core of instructional delivery (Crawford et al., 2020). In South Africa, this shift exposed pre-existing inequalities in infrastructure, digital readiness, and academic support, particularly among historically disadvantaged institutions (Matome & Jantjies, 2021).

The Department of Higher Education and Training (DHET) initiated various interventions—such as data subsidies and device distribution—to facilitate continued learning. However, challenges persisted, including limited digital literacy, inconsistent connectivity, and underutilization of LMS features (Mhlanga & Moloi, 2020). These structural barriers complicated both access and engagement, particularly for first-year students adapting to university-level learning amid a global crisis

This context underscores the importance of examining not just LMS adoption, but how students engaged with these platforms in practice. The study positions this inquiry within the South African higher education landscape, acknowledging the compounding effects of socio-economic disparity and crisis-driven digital transformation.

2.3 The Response of Higher Education to the Pandemic

The global higher education sector exhibited varied responses to the challenges brought by COVID-19, achieving differing levels of success. In developed nations like Australia, Germany, and the United Kingdom, universities promptly adapted to online learning, shutting down campuses and leveraging well-established digital infrastructures (Crawford et al., 2020). Similarly, universities in the United States moved quickly to shift classes online (Klein et al., 2022).

In contrast, institutions in developing economies, including Brazil, Indonesia, and South Africa, faced more significant obstacles. Numerous universities faced challenges due to limited technological resources and infrastructure, hindering their transition to fully online learning (Crawford et al., 2020). Despite these challenges, some countries, including South Africa, China, and India, adapted by delaying semester start dates and implementing emergency online strategies using LMS platforms (Annamalai et al., 2021; Crawford et al., 2020; Leah, 2021).

The pandemic's effects on higher education underscore the need to understand how students adapted to online learning, particularly in under-resourced environments. This study investigates the effectiveness of LMS usage during this time, offering insights into the online teaching strategies implemented by universities in response to the crisis and evaluating how well LMS platforms met students' learning needs during this significant transition.

2.4 Learning Management Systems: Functions and Challenges

Learning Management Systems (LMSs) are integrated platforms designed to support the delivery, management, and evaluation of teaching and learning (Raza & Qazi, 2021). They offer functionalities such as content distribution, assessment, communication, and progress tracking (Almarashdeh, 2016). In the South African context, LMSs like Sakai and Moodle have become central to institutional strategies for flexible learning, particularly in the wake of the COVID-19 pandemic (Khoza, 2016; Leah, 2021).

LMSs are commonly implemented in higher education to manage educational content and practices, enabling both synchronous and asynchronous delivery (Raza & Qazi, 2021). However, the literature distinguishes LMSs from Learning Content Management Systems (LCMSs) and Content Management Systems (CMSs). While LCMSs are primarily designed for e-learning developers to create, manage, store, reuse, and deliver digital learning content (Micheletto et al., 2022), LMSs focus more on learner-centered activities such as interaction, progress tracking, and assessment (Bradley, 2020). In contrast, CMSs function primarily as repositories for storing and presenting content (He & Huang, 2023). Despite these distinctions, the boundaries between these platforms are increasingly blurred, as all three can support learning delivery and content management (Mishchenko, 2021). This study focuses on LMS artifacts used extensively to facilitate online learning in the context of a South African university.

Despite their utility, LMSs pose significant challenges for both instructors and students. Studies have reported low engagement with interactive features, inconsistent use across courses, and steep learning curves for first-year students (Czerniewicz et al., 2020; Mlitwa & Ogundaini, 2022). These issues are exacerbated by infrastructural disparities and uneven support for academic staff, contributing to inconsistencies in content quality and pedagogical effectiveness.

From the student perspective, the effectiveness of LMS use is influenced not only by the platform's design but also by students' digital literacy, access to reliable internet, and their perceptions of institutional support (Mphahlele, 2022; Snoussi, 2019). A key strength of LMSs is their ability to provide a centralized hub for learning materials,

communication, and assessment, accessible from any internet-enabled device (Bradley, 2020). However, studies have also highlighted barriers including unreliable connectivity, low bandwidth, limited access to devices, poor ICT infrastructure, and insufficient technical support (Dampson et al., 2020; Wiki et al., 2014). These limitations were especially pronounced during the pandemic-induced shift to emergency remote learning.

Globally, institutions have adopted both open-source and commercial LMSs such as Moodle, Sakai, Canvas, and Blackboard (Karadimas, 2018; Ukhov et al., 2021). Open-source platforms include Moodle, Sakai, ATutor, Claroline, MyGuru2, and MyLMS, while commercial options encompass Blackboard, SuccessFactors, Canvas, Angle Learning, Cornerstone, and Connect Edu (Kasim & Khalid, 2016). Among these, Canvas stands out for its distinct features and usability advantages (Burrack & Thompson, 2021; C. Mpungose & Khoza, 2020).

This study examined LMS use at one of South Africa's prominent universities, referred to as University A (Leah, 2021). It aimed to assess how undergraduate students engaged with LMS tools during the COVID-19 pandemic, with specific attention to the extent of appropriation fidelity—how closely students' use aligned with the pedagogical intentions of the tools. The global shift to online learning during the pandemic (Maphalala et al., 2021) makes this inquiry particularly relevant, as it provides insight into how LMSs were appropriated under pressure by a digitally native generation.

Previous studies have shown that LMS platforms significantly influence student engagement, satisfaction, and academic performance (Avcı & Ergün, 2022; Karaoğlan Yılmaz, 2022). This underscores the importance of not only adopting but also effectively implementing LMSs in ways that foster deep and meaningful learning experiences. By focusing on the practical use of LMSs by Generation Z students, this study moves beyond binary adoption models and instead interrogates the nuanced realities of platform use during an educational crisis.

2.5 Generation Z and Digital Learning Behaviors

Generation Z (Gen Z), typically defined as those born between 1995 and 2010, represents the first cohort of students raised entirely in a digitally connected world. Their exposure to smartphones, social media, and constant internet access has shaped unique cognitive and behavioral traits that distinguish them from prior generations (Seemiller & Grace, 2016). These include a preference for visual content, multitasking, instant feedback, and interactive, personalized learning environments.

In the higher education context, Gen Z's digital fluency presents both opportunities and challenges. While they may navigate platforms with ease, this does not guarantee deep engagement or alignment with pedagogical goals (Chicca & Shellenbarger, 2018). Research indicates that Gen Z learners often value autonomy and flexibility but may struggle with self-regulation and information overload (Turner, 2015). Their expectations for technology-rich learning environments can lead to frustration when LMS platforms are inconsistent, non-intuitive, or lack interactive features.

During the COVID-19 pandemic, these dynamics became more pronounced. While many Gen Z students were able to access and use LMSs, their experience was shaped by broader contextual factors—such as isolation, reduced academic support, and elevated stress levels—which influenced how they engaged with digital tools (Aristovnik et al., 2020). This raises critical questions about the assumption that digital nativity equates to effective online learning.

This study focuses on Gen Z not only because they form the majority of undergraduate enrolments, but also because their interaction with LMSs offers insights into the evolving nature of digital pedagogy. By understanding how Gen Z students appropriated LMS tools during an educational crisis, the research aims to contribute to the design of more responsive and student-centered digital learning environments.

2.6 Conceptualizing Learning Success in Digital Contexts

Learning success is a multifaceted concept that extends beyond academic grades to include student satisfaction, engagement, perceived learning gains, and self-regulated learning behaviors (Kuh et al., 2006). In digital learning environments, especially those mediated through Learning Management Systems (LMSs), success depends not only on the learner's cognitive ability but also on their interaction with the technological ecosystem(Sun et al., 2008). The concepts of the learning process and learning success are intricately linked to the adoption and effective use of LMS platforms in higher education. Platforms like Canvas, for example, provide digital environments that streamline the learning process and enhance educational outcomes (C. B. Mpungose, 2020).

The learning process is dynamic and shaped by factors such as cognitive abilities, motivation, and individual learning styles(McLoughlin & Lee, 2010). A significant factor influencing this process is the learner's experience and familiarity with the LMS platform. Research shows that students who are well-acquainted with LMS functionalities tend to have more positive learning experiences and achieve better academic outcomes ((Kaewsaiha & Chanchalor, 2021; Sobaih et al., 2021). Beyond user familiarity, platform design and functionality play a crucial role in shaping engagement and learning outcomes. Features such as intuitive navigation, interactive tools, and multimedia resources contribute to creating an effective and engaging digital learning environment (Lonn & Teasley, 2009; Rios et al., 2018).

Learning success is also defined by the extent to which learners acquire and apply new knowledge, skills, or attitudes (Al-Mamary et al., 2021). While academic performance indicators—such as grades and course completion rates—are commonly used measures, learning success also encompasses student satisfaction, engagement, and retention (Rios et al., 2018). Evidence suggests that LMS use positively impacts these outcomes. For example, Xu & Jaggars (2013) found that students using LMS platforms achieved higher course completion rates and better grades than those who did not. Similarly, a meta-analysis by (Bernard et al., 2014) highlighted a moderate positive effect of LMS use on student achievement in both online and blended learning contexts.

Research has further demonstrated that factors such as platform usability, institutional support, digital competence, and learner autonomy significantly influence perceptions of learning success ((Joo et al., 2013; McLoughlin & Lee, 2010). In remote or online learning contexts, success is also shaped by students' ability to adapt to self-directed learning, manage their time, and navigate digital resources (Zimmerman, 2002). These non-cognitive and contextual elements become particularly critical during emergency learning scenarios, where traditional forms of academic support are limited.

This study adopts a student-centered view of learning success, operationalized through constructs such as satisfaction with the learning process, confidence in learning tasks, and the perceived usefulness of LMS features. By integrating these dimensions into the Faithful Appropriation Model, the study seeks to understand how digital engagement—mediated by personal and institutional factors—contributes to positive learning outcomes during periods of disruption.

2.7 Theoretical Foundations: TAM, UTAUT, and the Faithful Appropriation Model (FAM)

Understanding how students engage with digital learning platforms requires a theoretical grounding in models of technology adoption and use. This section critically reviews three major frameworks— the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Faithful Appropriation Model (FAM)—to justify the conceptual framework guiding this study.

The Technology Acceptance Model (TAM), developed by Davis (1989), posits that perceived usefulness and perceived ease of use influence users' attitudes toward and intention to use technology. While TAM has been widely applied in educational contexts, its focus on pre-adoption attitudes limits its ability to explain how technology is actually used after adoption, especially under conditions of stress or compulsion.

influence and of TAM's limitations, Venkatesh et al. (2003b) introduced UTAUT, which integrates constructs such as performance expectancy, effort expectancy, social

influence, and facilitating conditions. UTAUT has shown stronger predictive power across diverse contexts, including education. However, like TAM, it emphasizes adoption intentions rather than sustained, meaningful engagement—a critical limitation in the context of emergency remote learning, where adoption was not optional.

In contrast, the Faithful Appropriation Model (FAM), developed by (Janson & Leimeister, 2017), centers on *post-adoption use*—how users engage with technology in ways that either align or deviate from the designer's intended pedagogical purpose. FAM introduces the concept of *appropriation fidelity* to measure the quality of technology use beyond mere adoption. This makes it particularly relevant for understanding LMS use during the pandemic, when students were required to use these platforms regardless of readiness or preference.

This study adopts and extends FAM by incorporating additional constructs that reflect the specific experiences of Gen Z students during remote learning. These include Computer Self-Efficacy (CSE), Self-Regulated Learning (SRL), IT Support, and Task-Technology Fit (TTF). These variables were selected based on empirical evidence from prior studies and refined to align with the South African higher education context. The integration of these constructs strengthens the model's explanatory power and enhances its applicability to crisis-driven digital learning scenarios.

By building on FAM and critically engaging with TAM and UTAUT, this study establishes a robust theoretical foundation for analyzing how Gen Z students appropriated LMS tools and how this influenced their learning success during the COVID-19 pandemic.

2.8 Synthesis and Research Gap

The preceding sections reviewed literature across five key areas: the disruption of higher education by the COVID-19 pandemic, the functionality and limitations of LMS platforms, the unique characteristics of Generation Z learners, evolving definitions of learning success, and theoretical models of technology use. While each area offers

valuable insights, a synthesis of these themes reveals a distinct and underexplored research gap.

Most studies on LMSs have emphasized access and adoption, often using frameworks like TAM and UTAUT that foreground user intentions and perceptions. However, these models are limited in explaining how students actually use LMS platforms once adoption has occurred—particularly under conditions of crisis. The Faithful Appropriation Model (FAM) addresses this limitation by focusing on post-adoption behaviors and the fidelity of technology use. Yet, few studies have operationalized FAM in the context of undergraduate learners in developing countries, and even fewer have extended it to account for the lived experiences of Gen Z students during emergency remote education.

Similarly, the literature on Gen Z learners often celebrates their digital fluency but under-theorizes how this fluency interacts with institutional constraints, platform design, and self-regulation. There is a need to critically examine whether digital nativity translates into effective LMS use—particularly when support structures are inconsistent and learning environments are unstable.

Additionally, while "learning success" is widely referenced, its measurement tends to focus on academic outcomes rather than students' holistic perceptions of engagement, satisfaction, and capability. By redefining learning success through this broader lens, this study responds to the call for more student-centered evaluations of digital learning environments.

This research addresses these gaps by extending FAM to include contextually relevant variables—such as IT support, task-technology fit, and self-regulated learning efficacy—and by applying the model to a population of Gen Z students at a historically disadvantaged South African university. The study contributes to theory by adapting FAM to a crisis-education setting, and to practice by offering evidence-based recommendations for supporting meaningful digital engagement in higher education.

2.9 Summary of the Chapter

This chapter reviews literature on LMS usage, technology adoption, and learning success in higher education, focusing on Generation Z students during the COVID-19 pandemic in South Africa. It examines the pandemic's disruption of higher education, varied institutional responses, LMS functions and challenges, Gen Z's digital learning behaviours, and evolving definitions of learning success. While models like TAM and UTAUT explain adoption intentions, they overlook post-adoption behaviours; the Faithful Appropriation Model (FAM) addresses this gap by assessing how closely LMS use aligns with pedagogical intentions. The study extends FAM with constructs such as Computer Self-Efficacy, Self-Regulated Learning, IT Support, and Task-Technology Fit, applying it to Gen Z students at a historically disadvantaged South African university. This approach addresses underexplored links between digital nativity, institutional constraints, and holistic measures of learning success, offering both theoretical insights and practical recommendations for enhancing meaningful LMS engagement in crisis-driven contexts.

CHAPTER 3: THEORETICAL BACKGROUND AND RESEARCH MODEL

3.1 Introduction

This chapter provides an overview of the theoretical foundations related to technology use and adoption. It reviews the key theories commonly applied in information systems research to understand how individuals and organizations engage with new technologies. The chapter also introduces the Faithful Appropriation Model (FAM), which forms the core framework of this study. The model is discussed in detail, with a focus on its relevance to learning management systems (LMS) usage. Finally, the chapter presents the study's hypotheses, which are formulated based on an extended version of the FAM, incorporating additional factors identified in recent literature.

3.2 Theories of Technology Use

Researchers have investigated technology adoption and usage using different approaches and methods to understand the factors that affect user acceptability (Al-Maroof et al., 2020; Che & Zhang, 2018; Rafique et al., 2020). Popular models such as the Technology Acceptance Model (TAM) (Davis, 1989), Innovation Diffusion Theory (IDT) (Rogers, 1962), Theory of Reasoned action (TRA) (Ajzen, 2012), Theory of Planned Behaviour (TPB) (TRA) (Ajzen, 2011), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003a), Resource-Based Theory (RBT) (Barney, 1991), and Technology-Organization-Environment model (TOE) (Tornatzky et al., 1990) have been utilizing for this purpose.

These models focus on different components in the technology adoption process; for example, some emphasize the external environment of an organization, while others focus on the technological features (Qashou & Saleh, 2018). IDT focuses on external environmental aspects such as the social systems and norms that influence adoption, i.e., innovations can face resistance or support from various social systems and norms,

such as cultural values, organizational routines, and regulatory frameworks (Rogers, 1962). According to Wani and Ali (2015) the IDT model looks at traits including relative advantage, compatibility, complexity, trialability, and observability to describe how new concepts and technology are embraced and disseminated within a social system. Therefore, creating successful implementation strategies requires an awareness of how these elements affect an innovation's uptake.

According to TAM, two important elements influencing user adoption of technology are perceived utility (PU) and perceived ease of use (PEU) (Davis, 1989). On the other hand, according to TRA, users' intentions to utilise technology for learning are mostly influenced by their attitudes and subjective norms (Madden et al., 1992). When determining adoption, TPB takes into account three factors: perceived behavioural control, attitude towards behaviour, and behavioural goals (Ajzen, 1991).

According to Williams et al. (2015), the UTAUT takes into account four important categories that have a direct impact on an individual's intention and behaviour: performance expectancy, ease of use, social influence, and enabling factors. The RBT and TOE frameworks evaluate an organization's technological proficiency by taking into account elements like the infrastructure of technology that is available and the organization's capacity to employ technology to enhance performance (Alvarez & Busenitz, 2007; Baker, 2012). These frameworks concentrate on the organisational, environmental, and technological factors that influence an institution's adoption of technology.

Several studies have used these frameworks to evaluate technology's success by examining user adoption and acceptability (Hsieh & Wang, 2007; Qashou, 2021; Wani & Ali, 2015). The usage of words like adoption and acceptability, however, may ignore the distinctive traits and sense-making processes of individual users, which have a big impact on how technological products are used and accepted (Min et al., 2019). The intricacy of user behaviour and preferences may require that technology acceptance models take into account a wider range of contextual, social, and psychological elements that affect how people use and accept new technologies.

In contrast to these models, the purpose of this study was to find out how students used and adjusted to learning management systems (LMS) during a pandemic. The traditional concepts of technology use, such as adoption and acceptance, need to acknowledge that users can develop new ways of utilizing technology (Al-Maroof et al., 2020). This limited understanding might lead to the assumption that users are passive consumers who will use the same technology regardless of context, task differences, or interpersonal cooperation (Al-Maroof et al., 2020).

3.3 Faithful Appropriation Model (FAM)

The faithful appropriation model (FAM) is a theoretical framework used in information systems to help researchers understand how information systems are adopted and adapted in organizations (Carraher-Wolverton & Burleson, 2021). For instance, Nguyen et al. (2021a) employed the model to examine how changes made by accounting regulators impact the use of accounting information systems (AIS), which in turn impacts the performance of the accounting process. The study discovered that while the perceived efficacy of constraints on IT use did not significantly explain faithfulness of appropriation (FOA), perceived system restrictiveness, IT professional support, and accountants' self-efficacy do (Nguyen et al., 2021a).

In order to assure learning success in higher education, Janson and Leimeister (2017) use the model to examine how students faithfully appropriate learning management systems (LMS). The study discovered that the degree to which students reliably use LMS is highly influenced by perceived IT assistance, interactivity, and task-technology fit. Furthermore, their results show that perceived learning success and pleasure with the learning process are significantly correlated with faithful appropriation (Janson & Leimeister, 2017).

The faithful appropriation model is expanded in this study by adding additional variables that, in light of current research, influence how much students faithfully appropriate LMS during the COVID-19 pandemic (Su & Guo, 2021). Indicators of students' learning

achievement, for example, include computer self-efficacy and self-efficacy for self-regulated online learning during the pandemic, according to research (Bećirović et al., 2022).

Appropriation refers to how technology users actively select and adopt technology structures, going beyond the mere design of the technology itself (Carroll et al., 2002; Rogoff, 2008; Salovaara & Tamminen, 2009). It involves exploring, evaluating, and deciding to adopt or reject a technology (Carroll et al., 2002). Appropriation moves, faithfulness of appropriation, instrumental uses, and enduring attitudes toward appropriation are some of the several facets of appropriation (DeSanctis et al., 2008; DeSanctis et al., 1994; DeSanctis et al., 1993).

Appropriation moves occur when users are given technology structures and choose to use them directly, relate them to other structures, interpret them based on their usage, or make judgments about their usefulness (DeSanctis et al., 1993). The faithfulness of appropriation refers to users' choices in using technology features faithfully or unfaithfully, with faithful appropriations aligning with the intended design goals and spirit of the technology (Chin, Gopal, & Salisbury, 1997; David et al., 2002; DeSanctis et al., 1993). The "spirit" represents the official narrative that guides users' behaviour, perception of features, and filling of procedural gaps in technology use (Bostrom et al., 2014).

According to Janson & Leimeister (2017), faithful appropriations adhere to the spirit and structural feature design, but unfaithful appropriations depart from these. When users utilize suitable elements for various objectives, such as managing communication or task activities in a learning management system (LMS), this is known as instrumental use (DeSanctis et al., 1993). Finally, persistent attitudes are the attitudes users display as they appropriate technology structures, including comfort, perception of value, and willingness to work hard and succeed (DeSanctis et al., 1993).

The idea of faithful appropriation is essential to the learning process because it helps students set expectations for the use and advantages of technology as well as suitable learning structures and methods that align with the spirit of the technology, all of which

have an impact on learning success (Bostrom et al., 2009, 2014). Furthermore, as the learning process encompasses cognitive processes, interactions, individual traits, learning support, and other elements influencing learning outcomes, students' active participation is essential (Saurabh & Robert, 2013).

3.4 FAM Hypothesis Development

Janson and Leimeister (2017) identify three proximal constructs—**IT Support**, **Interactivity**, and **Task–Technology Fit (TTF)**—that shape faithful appropriation in technology-mediated learning. Each construct speaks directly to how students encounter and work within an LMS, and together they underpin both user experience and effective course design.

IT Support concerns the availability, responsiveness, and quality of the institution's technical services and infrastructure (Bitzer & Söllner, 2013). In practice, this includes help-desk assistance and troubleshooting, user training, system maintenance and uptime, and access enablement such as data bundles/zero-rating and device loans. Strong support removes friction from core study workflows—fixing login or submission problems, ensuring stable access to materials and assessments, and equipping students to use required features—so learners can follow intended LMS pathways rather than resort to workarounds. Conceptually, IT Support is distinct from **Interactivity** (pedagogical exchanges) and **TTF** (functional alignment of tools to tasks).

Interactivity is the extent to which the LMS mediates reciprocal, pedagogically meaningful exchanges among learners, instructors, and content (Annamalai et al., 2021). It is reflected in the quality, frequency, and reciprocity of engagement enabled by LMS affordances—such as graded, instructor-moderated forums with peer feedback, structured chats, or synchronous sessions that integrate breakout tasks and reflective prompts. Interactivity differs from **TTF** (workflow/functional alignment) and from **IT Support** (institutional services/infrastructure).

Task–Technology Fit (TTF) captures how well LMS features, and performance characteristics align with the requirements of academic tasks (Jeyaraj, 2022). High TTF means students can access materials, complete assessments, submit work, receive feedback, and track progress accurately and efficiently. For instance, an assignment that requires iterative drafting and feedback is better supported when the LMS offers version control, rubric-based marking, inline commenting, deadline management, and timely notifications—more than a basic file-upload.

The COVID-19 pivot to emergency remote learning sharpened these dynamics and introduced additional constraints (Al-Maroof et al., 2020). Institutions faced support backlogs and resource inequities, raising the stakes for **IT Support** (Bhamani et al., 2020). Social and instructional presence moved online, making **Interactivity** within the LMS a potential buffer against isolation (El-Dakhs, Masrai, et al., 2022). Simultaneously, unfamiliar tools and steep learning curves threatened **TTF**, as students struggled to complete routine academic tasks within new digital workflows (Kuswoyo et al., 2022a).

Firstly, constrained **IT Support** during the pandemic hindered many students' ability to engage fully with the LMS. With limited technical assistance and uneven access enablement, learners struggled to troubleshoot issues and reliably reach essential resources. This motivates testing the effect of perceived support on appropriation fidelity.

> H1: Perceived IT support during the pandemic will positively affect students' faithful appropriation of LMS use at a higher education institution.

Moreover, the move online removed much of the spontaneous interaction and socialisation of physical classrooms. Where LMS-based **Interactivity** was weak or inconsistently orchestrated (El-Dakhs, Masrai, et al., 2022), students could experience isolation and reduced exchange of ideas. This motivates examining whether perceived interactivity relates to faithful use.

> H2: Perceived interactivity during the pandemic will positively affect students' faithful appropriation of LMS use at a higher education institution.

Furthermore, the rapid adoption of unfamiliar platforms posed **TTF** challenges. Navigating new systems and fragmented workflows made routine academic tasks harder to complete within the LMS (Kuswoyo et al., 2022a). This motivates testing whether perceived task–technology alignment supports faithful use.

> H3: Perceived task-technology fit during the pandemic will positively affect students' faithful appropriation of LMS usage in higher education institution.

3.4.1 How faithful LMS appropriation is relevant in the learning process satisfaction and learning success.

The connection between **learning process satisfaction**, **learning success**, and **faithful LMS appropriation** can be understood by considering the role of technology use in the learning process and its impact on students' experiences and learning outcomes. First, it is essential to acknowledge that LMSs are designed with specific goals and intended functionalities. The concept of **faithful appropriation** refers to the extent to which users adopt and utilize the instructional strategies and frameworks of the technology in a manner that aligns with the original design goals (Chin, Gopal, & Salisbury, 1997). In technology-mediated learning, faithful appropriation occurs when students effectively engage with the LMS, follow the prescribed instructional methods, and adhere to the platform's objectives and epistemological viewpoint (Salovaara & Tamminen, 2009).

Therefore, when students engage in faithful LMS appropriation, they align their use of the LMS with the intended design goals. This alignment allows students to fully utilize the instructional strategies and frameworks offered by the LMS, creating a cohesive learning experience. As a result, students are more likely to feel satisfied with their learning process because they perceive that their actions and efforts align with the intended purpose of the technology. This satisfaction arises from a sense of coherence, effectiveness, and a belief that they successfully utilize the available tools and resources to support their learning journey. In line with this view, this study hypothesizes:

H4: Faithful LMS appropriation will positively affect students' learning process satisfaction.

By engaging in faithful LMS appropriation, students effectively utilize the LMS features and strategies in alignment with the overall learning goals and epistemological viewpoint. This alignment enhances students' ability to acquire and internalize the content and knowledge facilitated by the LMS. When students appropriately use the instructional strategies and frameworks of the LMS, they are more likely to experience improved learning outcomes (Ikhsan et al., 2019; Serhan, 2020), such as higher levels of understanding, better knowledge retention, and enhanced critical thinking skills. Consequently, students perceive tremendous **learning success** because they have effectively utilized the LMS to support their academic progress. Thus, the study hypothesizes:

H5: Faithful LMS appropriation will positively affect students' perceived learning success.

Meta-cognitive and affective learning outcomes are two of the many components that make up learning outcomes (Gupta et al., 2010). Perceived learning success is one example of a meta-cognitive result that shows how well people understand their own learning processes and may be related to the acquisition of cognitive information (Bostrom et al., 2009, 2014; Hernandez-de-Menendez et al., 2020). The emotional components of the learning process are the focus of affective outcomes, such as **learning process satisfaction** (Gupta et al., 2010). Therefore, how people view the learning process from an affective perspective has a significant impact on how successful they believe their learning to be. Students may have greater self-efficacy and, as a result, greater learning performance when they are happier with their educational experience. Thus, the research postulates:

H6: Learning process satisfaction will positively affect perceived learning success.

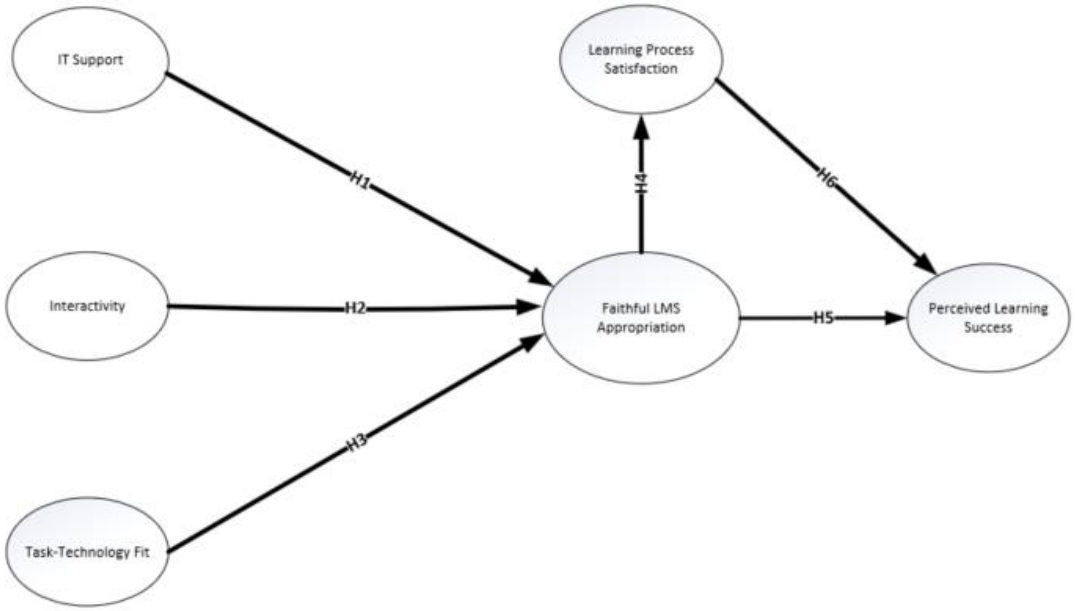


Figure 1 - Faithful Appropriation Model

3.5 Extended Faithful Appropriation Model

By adding characteristics that were determined to be pertinent in the context of LMS usage during the COVID-19 pandemic, this study expands on FAM (Al-Maroof et al., 2020; Chen et al., 2013; Katsarou, 2021). These factors include **self-efficacy for self-regulated learning (SESRL)** (Cui, 2021) and **computer self-efficacy (CSE)** (Katsarou, 2021). The self-efficacy theory, which holds that a person's attitude toward their capacity to complete a task affects their emotional reaction, including stress, anxiety, and behavior, provides the foundation for the inclusion of self-efficacy (Bandura et al., 1999).

Self-efficacy, which represents an individual's confidence or attitude toward their ability to use technologies, serves as the foundation for computer self-efficacy (Dong et al., 2020). In essence, computer self-efficacy measures how confident computer users are in their capacity to comprehend, use, and apply computer knowledge and skills (Han &

Geng, 2023; Umrani et al., 2023; Wang et al., 2024). It refers to an individual's beliefs about their ability to complete a specific task using a computer (Katsarou, 2021).

Higher **computer self-efficacy** was associated with more time spent using online learning tools and, consequently, higher levels of engagement with the learning processes(Katsarou, 2021; Wang et al., 2024). This results in students achieving positive learning outcomes (Katsarou, 2021). Therefore, this study extends the faithful appropriation model by adding CSE as directly influencing faithful LMS appropriation. Hence, the study further hypothesizes.

H7: Computer self-efficacy will positively affect individual students' faithful LMS appropriation.

Additionally, studies indicate that students' learning success is significantly predicted by their **self-efficacy for self-regulated learning** (Bećirović et al., 2022; Dinh & Nguyen, 2022). The generic skill known as SESRL helps people stay focused, evaluate their progress toward task completion, and explain success in a variety of contexts (Qashou, 2021). Due to the COVID-19 epidemic, recent research has shown that SESRL significantly affects students' academic performance when they are learning remotely (Dinh & Nguyen, 2022; Qetesh et al., 2020). Accordingly, the study believes that SESRL has a direct impact on students' faithful LMS appropriation.

H8: Self-efficacy for Self-regulated learning will positively affect individual students' faithful LMS appropriation.

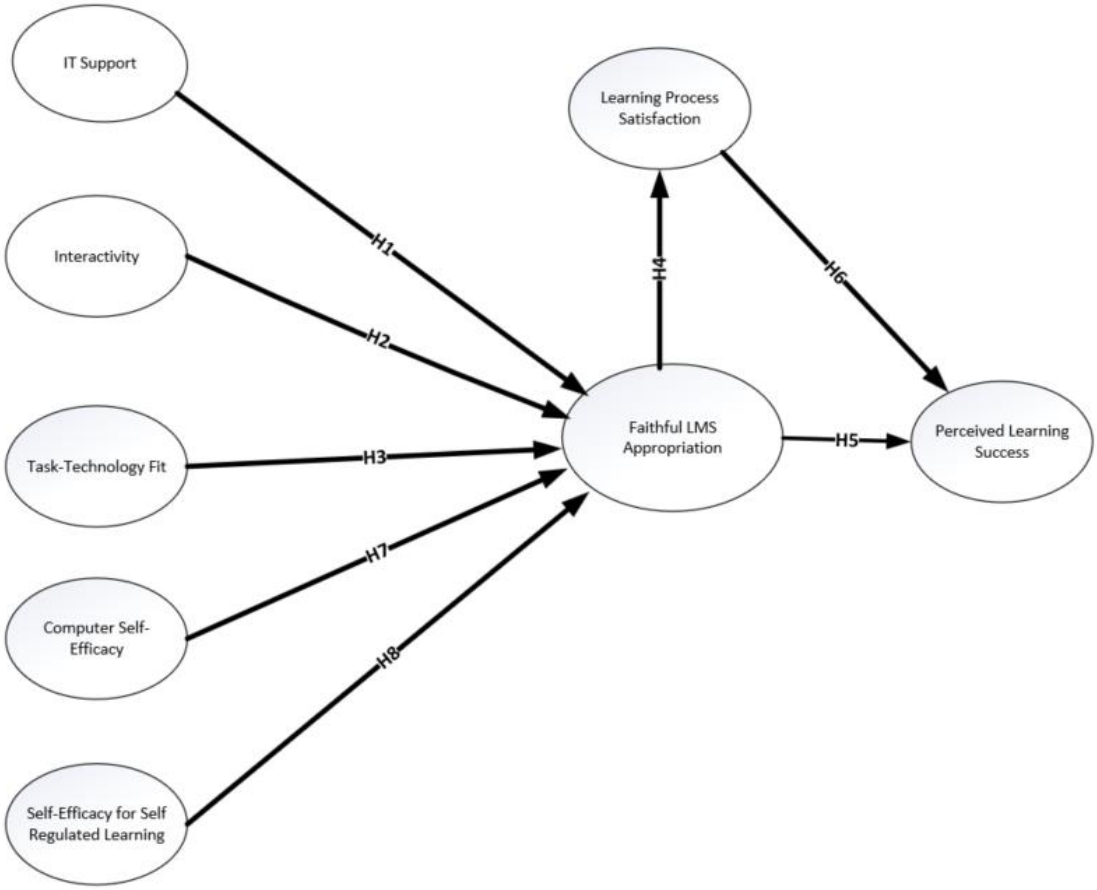


Figure 2 - Extended Faithful Appropriation Model

3.6 Summary of the Chapter

This chapter examines several models, including the Unified Theory of Acceptance and Use of Technology (UTAUT), Innovation Diffusion Theory (IDT), and Technology Acceptance Model (TAM), and how they have been applied to comprehend technology adoption and usage by concentrating on distinct adoption process elements. The Faithful Appropriation Model (FAM), on the other hand, investigates how information systems are embraced and modified inside the company. The chapter goes on to describe 6+3

how FAM was expanded in the study to look into how students used learning management systems (LMS) during the COVID-19 pandemic, taking into account elements such as computer self-efficacy, self-efficacy for self-regulated learning, interactivity, IT support, and task-technology fit.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

We explored various kinds of research models that have been used to study technology adoption and use in the previous chapter. The research approach used for this study is presented in this chapter. The chapter is organized into the following sections: the research paradigm and approach, research design and methodology, data collection methods, data analysis techniques, and, finally, the ethical considerations related to the study.

4.2 Research Paradigm and Approach (i.e., positivist, deductive)

The research paradigm adopted in this study is positivism, which emphasizes objectivity and quantitative methods to discover one objective truth about the world (Park et al., 2020). This approach is rooted in the philosophical *ontology* of realism, which posits that reality exists independently of human perception (House, 1991). Reality is considered to be out there in the world, and it can be observed, measured, and understood through scientific methods. For positivists, reality is composed of facts, and these facts exist regardless of individual beliefs or interpretations.

Positivist adopts an empirical *epistemology*, where knowledge is primarily acquired through sensory experience and observation. This approach favours quantitative methods and seeks to establish general laws through the collection of data and the testing of hypotheses. For positivists, knowledge is only valid if it can be observed, measured, and empirically verified. The goal is to produce objective, reliable, and universal knowledge that is free from bias and subjectivity.

Positivist *axiology* generally assumes a value-neutral approach to research. It posits that science, and research should be objective and free from the researcher's personal values, biases, and emotions. The belief is that by strictly adhering to the scientific method, researchers can produce objective knowledge that is not influenced by their own values. This approach reflects the idea that values should not interfere with the pursuit of knowledge.

Furthermore, the study employed a deductive approach, which involved testing established concepts and patterns derived from theory using empirical data (Hall et al., 2022). This approach, often referred to as theory-testing research, aims to validate or refine existing theories (Bhattacherjee, 2012). In this study, an extended faithful appropriation model (FAM) is utilized as the theoretical lens to examine the use of learning management system (LMS) and their impact on Gen-Z's learning process and learning success during a pandemic.

The FAM model focuses on how users adapt, and faithfully appropriate technology based on its intended purposes, which in turn influences outcomes. The model emphasizes constructs such as *appropriation faithfulness*, which refers to the degree to which users' actions align with the intended use of the technology, and *structural features*, which are the inherent capabilities of the technology. By applying the model, this study assesses whether Gen-Z university students, used LMS in ways that aligned with their design purposes and how this alignment affected their learning process and overall learning success during a pandemic.

4.3 Research Design and Methodology (i.e., quantitative, questionnaire)

As a way to measure and objectively generalize conclusions about the population under study, a researcher uses a quantitative research approach, gathering data through surveys and experiments (Park et al., 2020). This approach contrasts with the qualitative method, which is predicated on the subjective interpretation of data (Alharahsheh & Pius,

2020). This study's research design was a cross-sectional survey design (Connelly, 2016), which entailed gathering data from a sample of people surveyed at one particular moment in time. Cross-sectional are commonly employed in nursing, medical, and social science research to assess the knowledge, attitudes, and the opinions of those surveyed at one particular moment in time (Connelly, 2016).

Researchers frequently investigate the connection between similar kinds of factors. This exemplified by a study by Atchison et al. (2021), that examined the adult population in the United Kingdom (UK) during the COVID-19 pandemic. Their research focused on how sociodemographic characteristics, risk perceptions of COVID-19, preventive behaviours, and willingness to self-isolate influenced both risk perceptions and behavioural responses of the adult population.

The main tool used to collect data for this study was a questionnaire. In addition to examining the elements influencing their learning process and success, the study sought to determine how Gen Z undergraduate students perceived the use of learning management systems during the pandemic. The study collected data from a cohort of respondents towards the end of 2023 and early 2024.

4.4 Data Collection Methods

A structured questionnaire (see Appendix A) was used to gather data from the target population of undergraduate students at a South African university. An informed consent form accompanied the questionnaire. Prior permission to distribute the instrument to undergraduates who studied during the pandemic was obtained from the university registrar. Following approval, the registrar's office distributed the consent notice and the survey link (online form) to all eligible students.

Questionnaires are typically **closed-** or **open-ended** (Connor Desai & Reimers, 2019). Closed-ended questionnaires present predefined response options and are useful when the researcher seeks precise, comparable data across respondents and groups. Open-ended questionnaires invite narrative responses (e.g., "why/how/what do you think")

that yield richer qualitative detail (Rowley, 2014). Each approach carries trade-offs (Kelley et al., 2003): closed formats maximise standardisation and comparability; open formats maximise depth and nuance (Connor Desai & Reimers, 2019).

Given this study's objective—to **test a theory-driven structural model** quantitatively and compare responses across multiple constructs—a **closed-ended questionnaire** was selected. The instrument comprised five sections: **(i) demographics** (age, gender, year of study), **(ii) LMS usage profile during COVID-19** (platform, frequency), **(iii) perceptions of IT Support** (ITS), **Interactivity** (Int), and **Task–Technology** Fit (TTF), **(iv) Faithful LMS Appropriation** (FLMSA), **Learning Process Satisfaction** (LPS), and **Perceived Learning Success** (PLS), and **(v) Computer Self-Efficacy** (CSE) and **Self-Efficacy for Self-Regulated Learning** (SESRL).

Response scaling. Compared to simpler scales, the **7-point Likert scale** used in the questionnaire provided a wider range of response alternatives, improving the precision with which respondents' perceptions were captured. This scale facilitates more nuanced insights into respondents' judgments and engages their "faculty of reason" " (Joshi et al., 2015). In addition, a **bipolar scale** was utilised to assess the **learning process** construct, allowing respondents to rate satisfaction along a continuous spectrum from one end (e.g., "extremely dissatisfying") to the other (e.g., "extremely satisfying") (Höhne et al., 2021). This approach is user-friendly, easy to comprehend, and offers a clearer view of satisfaction levels than binary (yes/no; true/false) formats (Höhne et al., 2021).

4.4.1 Data Collection Instruments Advantages and Disadvantages

Advantages: Questionnaires enable rapid, cost-effective data collection at scale, support anonymity, and produce standardized responses that are efficient to analyze—well suited to **descriptive, survey, correlational, and cross-sectional** designs (L. Cohen et al., 2009; Rowley, 2014). These characteristics were advantageous for capturing patterns of LMS use and related perceptions among Gen Z students across faculties during pandemic conditions.

Limitations: Self-report instruments can introduce **recall bias**, **social desirability**, and limited opportunity to probe misunderstandings (Thoen et al., 2021). They are less suitable for exploratory/qualitative aims that require depth and iterative probing (e.g., interviews/focus groups), and repeated administrations may induce fatigue; sensitive topics may also require alternative methods. That said, administering the survey online was appropriate for this study: questionnaires are highly effective for gathering large amounts of data from **scattered and diverse populations**, and—because **Gen Z is** typically digitally savvy and comfortable with online tools—online administration ensured **easy access** and **quick response times**. This made it ideal for capturing a **broad range of perspectives** on LMS use during the pandemic, including **patterns in engagement, satisfaction, and challenges**, within a relatively short period. In this study, risks were further mitigated through **clear construct definitions/tooltips**, **pilot testing**, **assured anonymity**, and **procedural/statistical remedies** for common method variance (Section 4.4.2).

4.4.2 Procedural and Statistical Remedies to Control the Common Method Bias

The study employed procedural design and statistical remedies to address the issue of **Common Method Variance** (CMV), which can arise from the measurement techniques rather than the theoretical constructs represented by the measures. These remedies are essential for minimizing method biases and ensuring the validity of conclusions drawn from the data (Tehseen et al., 2017).

To ensure the validity and reliability of the data collected, several procedural remedies were implemented in this study. First, **anonymity** was maintained for all respondents, and specific measures were taken to minimize evaluation apprehension. Respondents were informed that there were no wrong answers, and they were encouraged to respond honestly to all questions (Podsakoff et al., 2003). This approach aimed to reduce the likelihood of emotional or socially desirable responses, which could otherwise bias the results (Tehseen et al., 2017).

Additionally, care was taken to construct the scale items in an unambiguous manner to minimize confusion and misinterpretation. This was addressed by conducting a **pilot study** with at least five randomly selected students, who provided insights on the clarity of the questionnaire. Their feedback was instrumental in refining the instrument before the main data collection phase. Item ambiguity is a common challenge in survey research (Manapat et al., 2021), making this step particularly crucial.

The pilot study revealed that some of the wording in the questionnaire was either too complex or ambiguous, which led to confusion among the students. Based on their feedback, the language was simplified, making it more direct and ensuring that respondents would interpret the questions as intended. For example, statement such "*I may not have followed the intended guidelines for using the LMS*" was revised to "*I did not use the LMS the way I was supposed to.*" This refinement not only helped avoid misinterpretation but also improved the overall clarity of the scale items. Moreover, pilot participants identified minor spelling and grammatical errors that might have gone unnoticed. These errors were promptly corrected, enhancing the professionalism of the questionnaire and minimizing distractions for participants.

Feedback from the students also highlighted issues with the flow of questions. They noted instances where the sequence was disjointed or where certain questions appeared out of context. As a result, the questionnaire was reorganized to ensure a more logical progression that aligned with the natural thought processes of respondents. This restructuring made the survey easier to navigate and more engaging for participants.

Furthermore, the **timing** of questionnaire administration can significantly influence both respondent engagement and the quality of the data collected. The pilot participants provided valuable insights regarding their preferences for when to receive the questionnaire. They suggested distributing it after course registrations but before the exam period, or alternatively, after the exam period. This timing was deemed ideal, as it would reduce the academic pressures on students, allowing them sufficient time to respond thoughtfully to the questions. Such strategic timing is expected to enhance participation rates and improve the overall quality of the collected data.

4.4.3 Measures

The measurement indicators in this study were created from an extensive review of the literature and were specifically designed to align with each latent construct being measured. The indicators for **IT support (ITS)**, **Interactivity (Int)**, and **Task-technology Fit (TTF)** were sourced from the study conducted by (Janson & Leimeister, 2017). They were linked these to appropriation in technology-mediated learning.

The indicators for **Faithful LMS Appropriation (FLMSA)** were adapted from prior research in technology-mediated learning (TML) (Chin, Gopal, & Salisbury, 1997; Saurabh & Robert, 2013). **Learning Process Satisfaction (LPS)** and **Perceived Learning Success (PLS):** affective/metacognitive outcomes adapted from Alavi & Leidner (2001), Gupta & Bostrom (2013), and recent applications (Al-Sofi, 2021).

Additionally, **Computer Self-Efficacy (CSE)** was included in the measurement framework, reflecting an individual's belief in their ability to successfully use computers and related technologies (Katsarou, 2021). This construct is crucial as it influences how effectively students engage with technology in their learning environments. Self-Efficacy for **Self-Regulated Learning (SESRL)** was also incorporated, representing an individual's beliefs about their capacity to manage and regulate their own learning processes effectively. This includes the ability to set goals, monitor progress, and maintain focus (Qashou, 2021). Together, these constructs form a comprehensive measurement framework that captures the essential factors influencing student learning process and learning success in technology-mediated contexts.

Table 1 - Operationalization of the Latent Constructs

Construct	Type	Abbreviation	Measures
IT Support	Latent	ITS	▪ Availability of IT support ▪ Responsiveness of IT support

			▪ Quality of IT support
Interactivity	Latent	Int	▪ Frequency of interactive activities ▪ Quality of interaction ▪ User satisfaction with interactivity
Task-Technology Fit	Latent	TTF	▪ Task-technology alignment ▪ Ease of use ▪ Task completion efficiency
Computer Self-Efficacy	Latent	CSE	▪ Confidence in using a computer ▪ Skill level ▪ Perceived competence
Self-Efficacy for Self-Regulated Learning	Latent	SESRL	▪ Goal setting ability ▪ Self-monitoring frequency ▪ Time management skills
Faithful LMS Appropriation	Latent	FLMSA	▪ Proper use of LMS features ▪ Adherence to LMS guidelines ▪ Appropriation behaviour
Learning Process Satisfaction	Latent	LPS	▪ Satisfaction with learning process ▪ Perceived learning quality ▪ Engagement in learning process
Perceived Learning Success	Latent	PLS	▪ Academic performance ▪ Learning goal achievement ▪ Overall satisfaction with learning outcomes

Contextual adaption: To maintain alignment with validated instruments, item stems **used the generic term "LMS"** and avoided provider-specific naming. The **survey**

instructions established the study frame (institutional LMS use during COVID-19) and guided interpretation:

"Please provide the required personal details, then indicate as honestly as possible your agreement or disagreement with statements regarding the use and adaptation of learning management systems (LMS) by your higher learning institution (HEI) during the COVID-19 pandemic."

Sections were also **time-framed** to the lockdown/remote-learning period. For constructs such as **IT Support**, contextual examples (e.g., remote helpdesk and troubleshooting, user training, data bundles/zero-rating, device provision/loans, and systems maintenance) were referenced **in the instructions or section headers**, not embedded in the items. The instrument used a **7-point Likert scale** for agreement-based constructs and a **7-point bipolar satisfaction scale** for the learning-process construct.

Table 2 – Sample Items by Construct

Construct	Example Item(s)
IT Support (ITS)	"The technical support team was easily accessible when I encountered issue with LMS"
Interactivity (Int)	"The LMS provided opportunities for collaboration and engagement with peers and instructors."
Task-Technology Fit (TTF)	"The features and tools available in the LMS aligned with my learning tasks' requirements."
Computer Self-Efficacy (CSE)	"I was confident using the LMS."

Self-Efficacy for SRL (SESRL)	“I was able to complete my assignment by the deadlines.”
Faithful LMS Appropriation (FLMSA)	“I used the LMS improperly. *”
Learning Process Satisfaction (LPS)	“How would you describe your learning process on a bipolar scale: efficient-inefficient?”
Perceived Learning Success (PLS)	“I have learned to identify central issues of the course.”

4.4.4 Sampling and Participants

The population targeted in this study comprised first-year undergraduate students enrolled at a South African university (referred to as University A) during the COVID-19 lockdown period. This group was selected due to their transitional status into higher education and their heavy reliance on institutional Learning Management System (LMS) platforms to support remote learning. The focus on first-year students aligns with the study's objective of examining LMS appropriation fidelity among digitally native, but institutionally novice, users during a period of crisis-driven educational disruption.

To recruit participants, the study employed a combination of **systematic sampling** and **purposive sampling** techniques. Systematic sampling was chosen for its ability to generate a representative subset from a large population (Rahi, 2017). Using this method, students who interacted with the LMS during the lockdown period were systematically selected from the broader student population. In addition, **purposive sampling**, a non-probability technique, was used to specifically target **Generation Z** respondents who were introduced to LMS use during the pandemic at University A. This

technique was particularly effective in ensuring inclusion of participants with relevant and context-specific experiences (Bhattacherjee, 2012).

An **online survey** was used to collect data, distributed through institutional email and LMS announcements. The final dataset comprised **81 complete responses**, a modest sample size that nonetheless meets acceptable thresholds for exploratory modeling using Partial Least Squares Structural Equation Modeling (PLS-SEM). This approach was selected due to its robustness in small-sample contexts and its capacity to estimate complex models (Gentle et al., 2010; Hair et al., 2011a; Henseler et al., 2012). However, the relatively small sample size poses a limitation to generalizability and model complexity, which is acknowledged in the interpretation of the results.

To determine the original sample size goal, the **Raosoft sample size calculator** was employed (Srinivasan et al., 2017), based on a 5% margin of error, 95% confidence level, and an expected response distribution of 50%. This process yielded a recommended sample size of 357 students, drawn from a broader pool of approximately 5,000 first-year students registered between 2020 and 2022. Although the sample achieved falls short of this benchmark, the methodological approach and analysis tools selected (i.e., PLS-SEM) help mitigate the impact of the small sample.

Additionally, the study relied on **retrospective self-reporting**, wherein participants were asked to recall their experiences and perceptions of LMS use during the 2020–2021 lockdown. While necessary due to the delayed timing of data collection, this approach introduces potential **recall bias**, as memory and perception may shift over time. This methodological constraint is noted as a limitation in interpreting the subjectivity and accuracy of participant responses.

4.5 Data Analysis Method

To describe the characteristics of the respondent sample, the gathered data was examined using descriptive statistics, such as the mean, standard deviation, and frequency of distribution, using the SPSS tool (Marvasti, 2018). To establish causation or

a link between variables in the expanded FAM model, inferential statistics analysis was performed (H. et al., 2021; Wolverton et al., 2020).

To comprehend the connections between observable and latent variables, a partial least squares structural equation modelling (PLS-SEM) technique was used (Hair, 2021; Sharma et al., 2021). PLS-SEM is a variance-based structural equation modelling (SEM) technique that allows estimation complex cause-effect relationship models involving multiple constructs. Unlike covariance-based SEM (CB-SEM), which focuses on producing the covariance matrix, PLS-SEM seeks to maximise the amount of variance described in the basic components of the model and make it easier to understand the relationships between the variables (Hair, 2021; Sharma et al., 2021).

A popular quantitative multivariate data analysis method, the Structural Equation Model (SEM) was used to investigate the connections between observable and latent variables in a variety of predictive analysis models as well as exploratory and confirmatory hypothesis testing. This method works especially well in the social sciences, where important ideas are frequently essentially latent and not readily apparent; these are known as latent variables (Kong et al., 2022). SEM is a prominent technique for analyzing path models that contain latent variables to draw conclusions about theoretical combinations. It originated from path analysis, developed by geneticist Sewall Wright in 1921 (Bechger et al., 1999). According to (Westland, 2015), SEM has evolved through three main streams: equation regression methods, iterative maximum likelihood algorithms for path analysis, and iterative least-squares fit algorithms for path analysis.

To ensure construct validity, the analysis employed standard thresholds such as Cronbach's alpha ($\alpha > 0.7$), Composite Reliability ($CR > 0.7$), and Average Variance Extracted ($AVE > 0.5$). These tests assessed whether the measurement model reliably captured the underlying constructs. For instance, AVE values above 0.5 confirmed that items for constructs like Self-Regulated Learning and IT Support converged adequately. To evaluate discriminant validity, the Heterotrait-Monotrait (HTMT) ratio was used, with all values below the conservative threshold of 0.85. Structural path coefficients were then interpreted in light of the bootstrapped t-values and p-values, allowing robust

hypothesis testing despite the small sample size. This approach directly supports the research questions by validating each hypothesized relationship empirically.

4.6 PLS-SEM Analysis Procedure

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS software. This technique was selected due to its suitability for complex models with multiple latent constructs, particularly when working with relatively small samples and non-normal data distributions (Hair, 2021; Sarstedt et al., 2021). PLS-SEM was especially appropriate in this study, given the sample size of 81 respondents. It provides robust estimates even with limited data and offers a powerful alternative where other methods—such as Covariance-Based SEM (CB-SEM) or Multiple Regression Analysis (MRA)—may lack the statistical power to detect effects (Gentle et al., 2010; Hair et al., 2011a; Henseler et al., 2012).

The analysis followed a structured, multi-stage process, covering model specification, measurement model (outer model) evaluation, and structural model (inner model) evaluation (Hair et al., 2014). This two-step process ensured a comprehensive validation of both the constructs and their interrelationships.

For the measurement model, internal consistency reliability was assessed using Cronbach's alpha and composite reliability (CR). Convergent validity was evaluated through average variance extracted (AVE), and discriminant validity was examined using the heterotrait-monotrait ratio (HTMT). These assessments ensured that each construct consistently and distinctly captured the theoretical concept it was intended to measure.

In the structural model, hypothesized relationships among constructs were evaluated. Path coefficients were estimated and tested for statistical significance using bootstrapping (5,000 resamples), and results were reported with corresponding t-values and p-values. Additionally, effect sizes (f^2) and predictive relevance (Q^2) were calculated to evaluate the model's explanatory power. Variance inflation factors (VIFs) were also examined to detect potential multicollinearity among predictor variables.

This analytical approach directly supported the study's objectives: it enabled testing the influence of IT support, computer self-efficacy (CSE), self-regulated learning (SRL), and task-technology fit (TTF) on LMS appropriation, and the effect of appropriation fidelity on perceived learning success. It also revealed which pathways within the extended Faithful Appropriation Model (FAM) were most significant in the context of pandemic-driven digital learning.

To ensure theoretical coherence and analytical focus, each step of the Partial Least Squares Structural Equation Modelling (PLS-SEM) process was aligned with a specific research question and its corresponding hypothesis pathway. This alignment not only facilitated the empirical testing of the proposed model but also ensured that the findings were directly responsive to the broader aims of the study.

- **Main Research Question -** How did Gen Z students utilize LMS in their learning process during the pandemic at a higher learning institution in South Africa?

To address this question, the analysis focused on the construct of **Faithful LMS Appropriation (FLMSA)**, which served as a central variable in the model. This construct operationalized the idea of LMS "use" not just in terms of access or frequency, but in terms of whether students used the platform in a manner aligned with its intended pedagogical function. By modelling FLMSA as both a dependent and mediating variable, the analysis provided a structured lens for understanding the nature of LMS utilization during emergency remote learning.

- **Sub-Research Question 1 (SRQ1) -** How did LMS use impact Gen Z students' learning success during the pandemic at a higher learning institution in South Africa?

This sub-question was investigated by examining the relationships between LMS appropriation and two outcome constructs: **Learning Process Satisfaction (LPS)** and **Perceived Learning Success (PLS)**. These constructs represent students' effective and metacognitive learning experiences. PLS-SEM allowed the model to assess both direct and indirect pathways between LMS usage and learning success, offering insights into how LMS engagement may influence learning outcomes beyond mere platform access.

- **Sub-Research Question 2 (SRQ2) -** What factors hindered Gen Z students' learning success while using LMS during the pandemic at a higher learning institution in South Africa?

This question was addressed by analyzing the structural paths from five independent constructs—**IT Support**, **Interactivity**, **Task-Technology Fit**, **Computer Self-Efficacy**, and **Self-Efficacy for Self-Regulated Learning**—toward Faithful LMS Appropriation. These constructs represent a combination of institutional and learner-related factors theorized to either enable or inhibit effective LMS usage. The use of PLS-SEM made it possible to evaluate the strength and direction of influence for each factor within the full structural model.

In sum, the analytical strategy was not applied in isolation from the research design. Each construct and path in the model was mapped to a specific research question, ensuring that the statistical procedures served as tools for empirical inquiry rather than ends in themselves. This alignment strengthened the coherence between the theoretical model, research objectives, and methodological execution.

4.6.1 Model specification

The model specification phase in PLS-SEM involves setting up the inner (structural) and outer (measurement) models. The inner model illustrates the relationships between constructs, while the outer model defines relationships between indicator variables and their constructs. Model specification begins with a theoretical path model connecting variables and constructs. Constructs are categorized as exogenous (independent) or endogenous (dependent), with exogenous constructs lacking incoming arrows (e.g., FLMSA in Figure 3) and endogenous constructs explained by other constructs (e.g., PLS and LPS in Figure 3). Constructs can serve as both independent and dependent variables when positioned between two other constructs. Importantly, PLS-SEM does not permit circular or looping relationships in the model, as these create invalid loops.

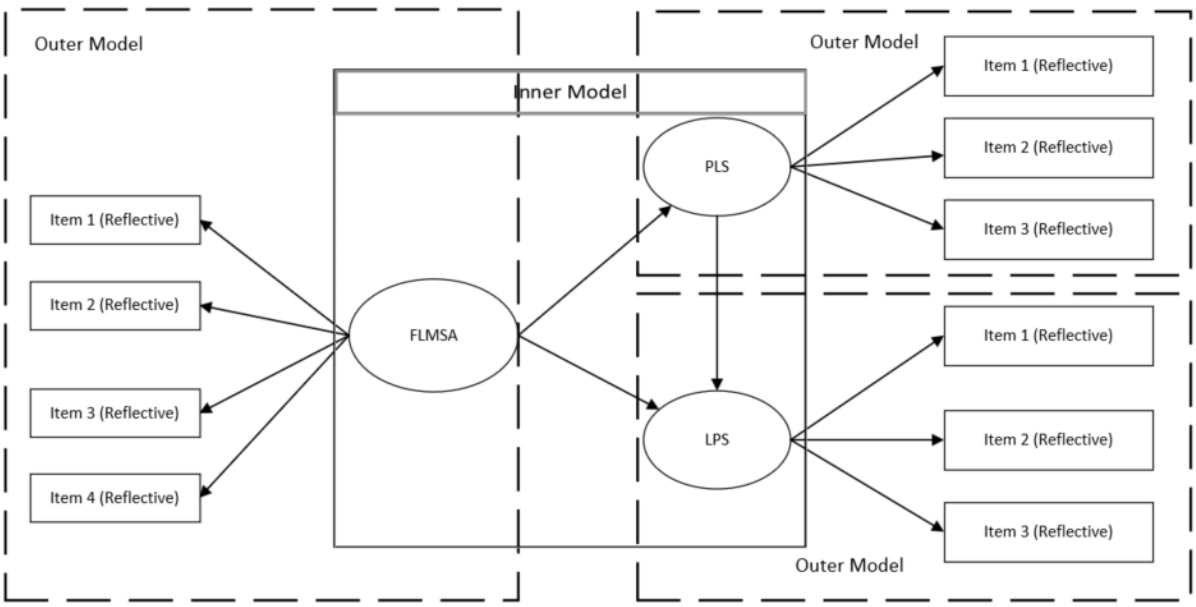


Figure 3 - Outer and Inner Models Example

In specifying the outer models, the study opted for reflective measurements, suitable when indicators are interchangeable, highly correlated, and representative of a construct's conceptual domain (Hafiz Hanafiah, 2020). Reflective indicators assume that changes in the construct cause changes in indicators, unlike formative models where indicators collectively define the construct. In this example, FLMSA has four measurement items, while both PLS and LPS have three.

4.6.2 Measurement (Outer) Model Evaluation

After specifying the inner and outer models, the next step is to run the PLS-SEM algorithm and evaluate the reliability and validity of the construct measures in the outer models (Henseler et al., 2012). This assessment ensures accurate measurement of constructs, forming a strong foundation for analyzing relationships within the inner model. Reflective models were used exclusively, necessitating the following evaluation steps:

1. **Composite Reliability**: Internal consistency reliability is assessed using composite reliability rather than Cronbach's alpha, as it does not assume equal indicator loadings and is less influenced by the number of items in the scale. Composite reliability accommodates varying indicator reliabilities and avoids underestimation often seen with Cronbach's alpha (B. Nair et al., 2021). For a construct to demonstrate acceptable internal consistency, composite reliability should be **≥ 0.70**. Values between **0.70 and 0.90** are considered ideal, while values **above 0.90** may indicate redundancy among items.
2. **Convergent Validity**: Convergent validity is confirmed if outer loadings are ≥ **0.70** and the construct's Average Variance Extracted (AVE) is ≥ **0.50**, indicating that the construct explains over half the variance of its indicators (Amora, 2021).
3. **Discriminant Validity**: To confirm discriminant validity, the Fornell-Larcker criterion is applied, requiring each construct's AVE to exceed its highest squared correlation with any other construct (Fornell & Larcker, 1981). Alternatively, cross-loadings are checked to ensure each indicator loads more strongly on its own construct than on any other constructs, with a threshold of **≥ 0.70** for primary loadings and lower loadings on other constructs.

4.6.2.1 Deletion of Reflective Indicators

Indicators with loadings below 0.70 were excluded to enhance the model's reliability and validity. Following guidelines from Hair et al. (2011, 2014), this practice ensures that only reliable measures are retained, improving model quality and robustness by focusing

analysis on the most consistent indicators.

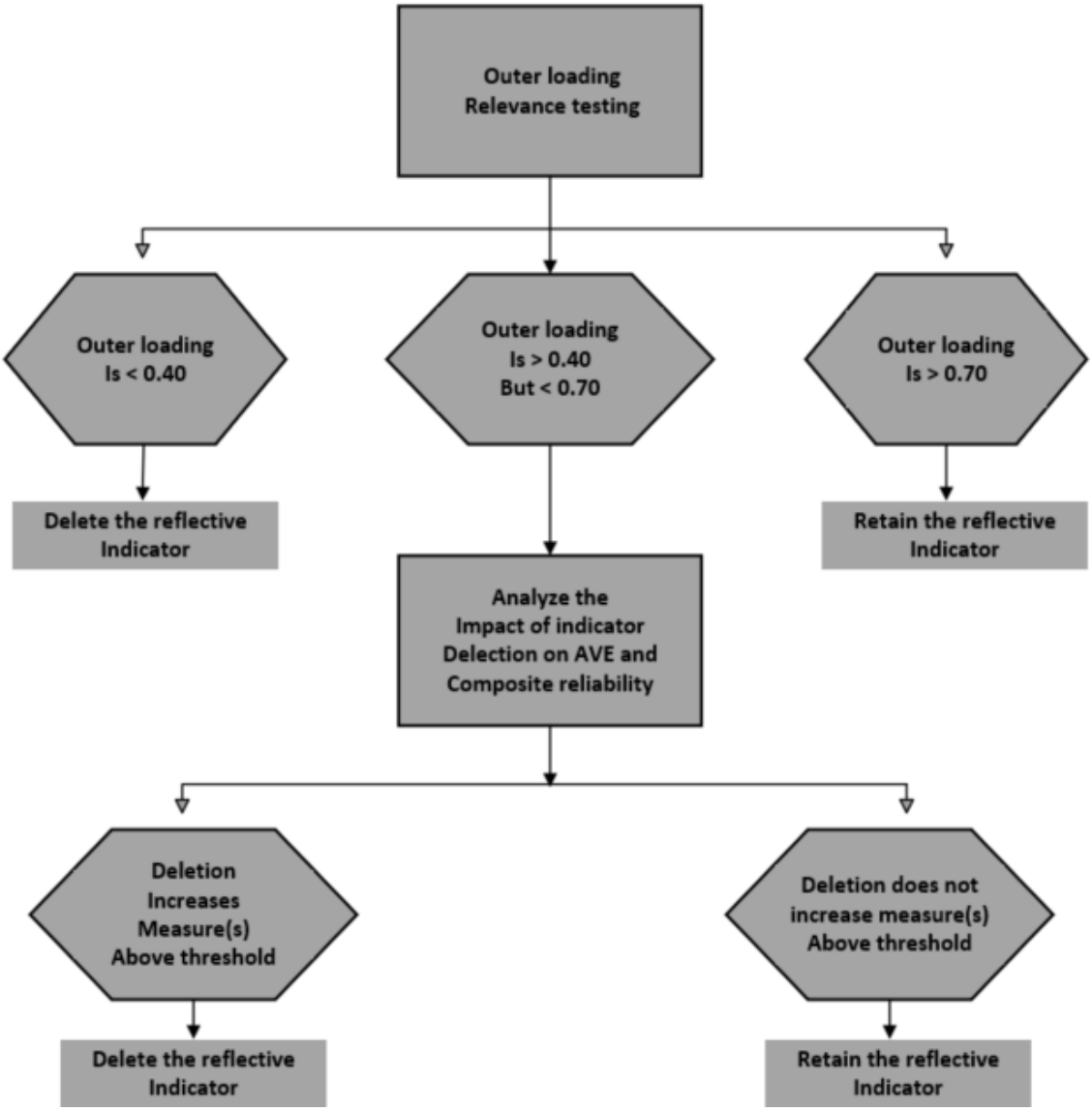


Figure 4 - Reflective Indicator Deletion Rule

4.6.3 Structural (Inner) Model Evaluation

With the outer models' reliability and validity established, the structural (inner) model is evaluated to test the hypothesized relationships between constructs. Unlike CB-SEM, which aims to fit observed and estimated covariance matrices, PLS-SEM focuses on maximizing the predictive accuracy of endogenous constructs. This evaluation utilizes several key metrics, including the coefficient of determination (R^2), cross-validated

redundancy (Q^2), path coefficients, effect size (f^2), and the significance of relationships (Sanmukhiya, 2020).

1. **Collinearity Assessment**: Before further analysis, collinearity is assessed to prevent biased results due to high correlations among predictor constructs. Variance Inflation Factor (VIF) values should ideally be below **3.3**, although values up to **5** are generally acceptable in PLS-SEM, indicating manageable multicollinearity.
2. **Coefficient of Determination (R^2)**: R^2 assesses the predictive accuracy for endogenous constructs. Generally, R^2 values of **0.75**, **0.50**, and **0.25** are considered substantial, moderate, and weak, respectively(Al Issa & Abdelsalam, 2021). For improved accuracy in models with more constructs, adjusted R^2 is recommended to avoid overfitting.
3. **Cross-Validated Redundancy (Q^2)**: Q^2 is used to evaluate the predictive relevance of the inner model. A Q^2 value above zero indicates that the model has predictive relevance for an endogenous construct, as assessed through sample re-use techniques like the blindfolding procedure (Cho et al., 2023).
4. **Path Coefficients**: Path coefficients indicate the hypothesized relationships among constructs, with values ranging between **-1** and **+1**. To determine the statistical significance of these relationships, a bootstrapping procedure is conducted, which generates standard errors and confidence intervals (Gentle et al., 2010). Coefficients closer to **±1** indicate stronger relationships, and significant path coefficients suggest that the hypothesized relationship holds within the sample data (Sarstedt et al., 2021). Following statistical significance, it is crucial to evaluate the practical relevance of significant relationships, as relationships that are significant may still have limited practical importance if the effect sizes are small.
5. **Significance of Relationships**: The significance of relationships is established through bootstrapping, where multiple resamples of the data are used to estimate the standard errors and calculate t-values for each path coefficient. A t-value greater than **1.96** typically indicates significance at the 5% level ($p < \mathbf{0.05}$), while a t-value over **2.58** indicates significance at the 1% level ($p < \mathbf{0.01}$). Significance

testing helps validate the hypothesized relationships between constructs, confirming whether effects observed in the sample are likely to represent real effects in the population.

6. **Effect Size (f^2)**: Effect size (f^2) measures the impact of each construct on the model. Calculating f^2 involves comparing the R^2 of the full model (R^2_included) with that of a reduced model (R^2_excluded) in which the specific construct is omitted:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

Equation 1 - Effect Size Formula

According to Cohen, (1989), as cited in Fritz et al. (2012) and Gignac & Szodorai (2016), f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively. Higher f^2 values indicate that the omitted construct has a significant influence on the endogenous variable's explained variance, underscoring its importance in the model.

4.7 Ethical Considerations

Ethical clearance was obtained from the university's research ethics committee (Reference No: CBUSE2139). The study adhered strictly to ethical standards governing research with human participants. Participation was entirely voluntary, and respondents were informed of their rights and protections before engaging with the study. The study therefore complied fully with institutional and international ethical principles such as those articulated in the Belmont Report and the Declaration of Helsinki, which emphasize respect for persons, beneficence, and justice in research design and implementation (Dutton, 2013; Nagai et al., 2022)

Participation in the study was entirely voluntary. In line with the principle of respect for autonomy, participants were informed that they had the right to decline participation or withdraw at any point without penalty (Salim & Habsi, 2024; Yusof et al., 2022). To operationalize this, an informed consent form was embedded at the beginning of the online questionnaire. The form outlined the study's purpose, procedures, and intended use of data, as well as assurances regarding confidentiality, anonymity, and the right to withdraw (de Alves & Teixeira, 2020)

Importantly, no personally identifying information was collected during the data-gathering process, thereby ensuring participant anonymity (Strandberg, 2019). Confidentiality was maintained by storing all responses in **password-protected** files accessible only to the researcher, consistent with institutional and professional guidelines on safeguarding participant information (Weinbaum et al., 2019). These procedures align with best practice recommendations for research data management and confidentiality in human subject's research (de Alves & Teixeira, 2020).

Overall, the ethical measures adopted in this study reflect the university's institutional commitment to responsible research practice and are consistent with internationally recognized standards for protecting the rights, dignity, and welfare of human research participants (Dutton, 2013)

4.8 Summary of the chapter

The study's research technique is described in this chapter. It details how a cross-sectional survey approach was used to collect data from Gen Z undergraduate students regarding their usage of learning management systems (LMS) during the COVID-19 epidemic, using a positivist, quantitative, and deductive research paradigm. A systematic questionnaire encompassing a number of domains, including IT support, interactivity, technology-task fit, computer self-efficacy, self-efficacy for self-regulation, and others, was delivered with consent as part of the data gathering process. In order to control prevalent bias, the benefits and drawbacks of employing questionnaires were examined, along with statistical and procedural solutions. Descriptive and inferential

statistics are covered together with the data analysis methodology used in the study, with an emphasis on partial least squares structural equation modelling (PLS-SEM) to comprehend the correlations between variables. In accordance with ethical research norms, respondents' confidentiality and anonymity were guaranteed.

CHAPTER 5: DATA ANALYSIS AND RESULTS

5.1 Introduction

This chapter delves into comprehensive data screening, demographic analysis, and subsequent statistical evaluations essential for understanding the effective use of Learning Management Systems (LMS) during the pandemic. Initially, the data cleaning process is outlined, addressing issues like outliers and inconsistent data to ensure the accuracy and reliability of the analysis. The demographic characteristics of the sample, primarily composed of Gen Z students, are examined to provide context for the findings. The chapter then progresses to reliability and validity assessments of constructs, followed by an in-depth analysis using structural equation modelling (SEM) to explore the relationships between key factors influencing LMS appropriation, learning satisfaction, and perceived success. Through hypothesis testing, the chapter aims to identify critical determinants of successful LMS use and areas for improvement, offering valuable insights for enhancing educational strategies in digital learning environments.

5.2 Data Screening

A total of 103 responses were collected between November 2023 and May 2024. Data cleaning techniques were conducted as the first step in analyzing data, including handling missing data, outliers, duplicate and inconsistent data. There were no missing data identified, however, outliers, and inconsistent data were identified. For instance, three respondents were removed because they did not meet the criteria of the targeted participants. All three respondents were removed because they specified that they did not use the learning management system during the pandemic.

Secondly, the questionnaire included a free text field for respondents to specify the type of learning management system they used. The respondents used multiple descriptions to describe the LMS they used during pandemic. The descriptions were then transformed to a single description for example, “Ulwazi” a Canvas LMS used in the university was

converted to Canvas and “Black board” was converted to Blackboard. Two other respondents specify Sakai and Canvas as two LMSs they used during the pandemic. The study acknowledges this to be possible since the university transitioned from Sakai to Canvas in the second quarter of 2021 (Leah, 2021).

Lastly, 19 responses were removed from the final data set used for analysis because they had specified to either in their first or second year of study when they completed the questionnaire. The year of study indicates that respondents were likely registered between 2020 (for those currently in their fifth year) and 2024 (for those currently in their first year), corresponding to the pandemic period. Furthermore, it is crucial to recognize that students who fail subjects within their academic year are unable to progress to the next year of study. However, to ensure the validity and reliability of the responses, data from respondents in their first and second years of study were excluded from the analysis. Overall, a sample of 81 responses were used for statistical calculations and hypothesis testing.

5.3 LMS use Analysis

5.3.1 LMS Platform used by Students

Figure 5 illustrates the distribution of LMS platforms used by students. The distribution of LMS used by students revealed that the majority of students, 75 out of 81, used Canvas as their primary learning management system. A smaller group of 4 students reported using both Sakai and Canvas, reflecting the institutions transitional phase between the two platforms.

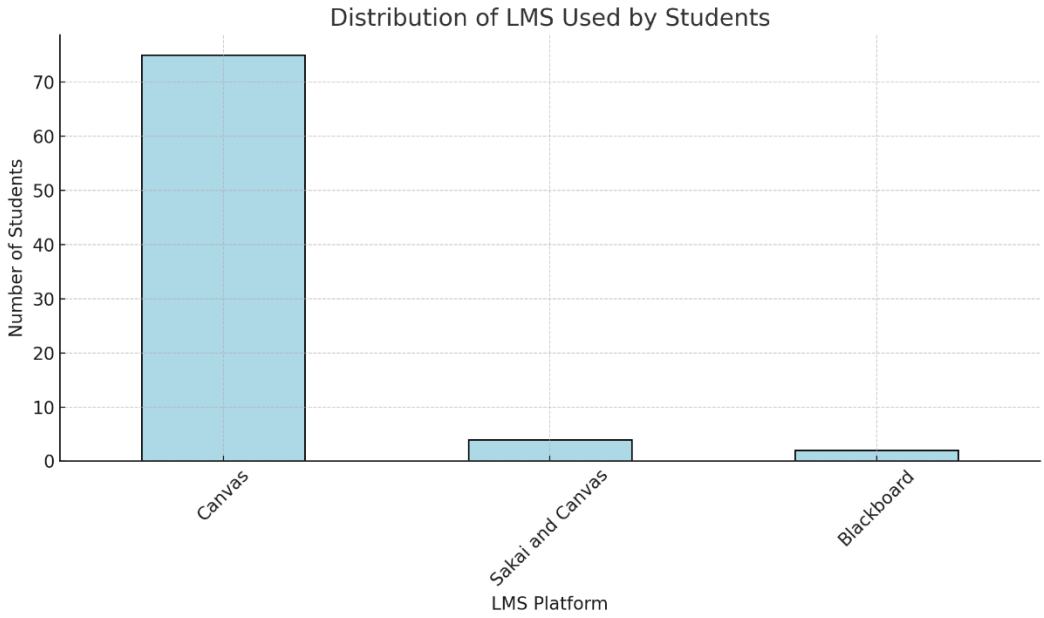


Figure 5 - LMS Used by Students

Interestingly, 2 students indicated that they used Blackboard, which raises questions, as the university under study does not officially use Blackboard as its learning management tool. This discrepancy could be due to confusion on the part of the respondents or perhaps external use of Blackboard for other courses or resources not officially supported by the institution.

5.3.2 Use Frequency

Figure 6 illustrates the frequency of LMS usage by the respondents. The analysis of LMS use frequency revealed that the majority of students, 73 out of 81, reported using the LMS on a daily basis. A smaller group of 7 students indicated that they used the LMS weekly, while only 1 student reported using it rarely. Interestingly, no students indicated monthly usage of the LMS. This high frequency of daily LMS usage reflects the central role that the platform played in students' learning processes, particularly during the pandemic, where online learning became the primary mode of instruction. The limited number of students who used the LMS less frequently may reflect varying engagement levels or different course requirements.

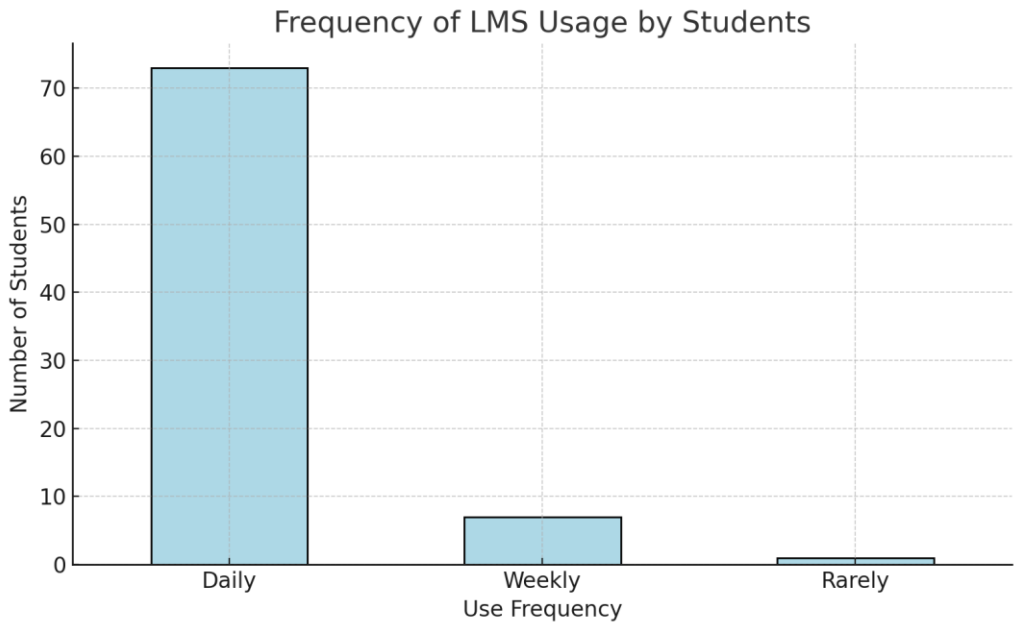


Figure 6 - LMS Use Frequency

5.3.3 LMS Use Among Students

Figure 7 illustrates LMS use distribution among students. The analysis of **LMS use distribution among students** showed that all **81 students** in the dataset reported using a Learning Management System (LMS), indicating full adoption of the platform across the student body. This universal use highlights the critical role of the LMS in supporting the institution's educational activities, particularly during a period when remote learning was essential.

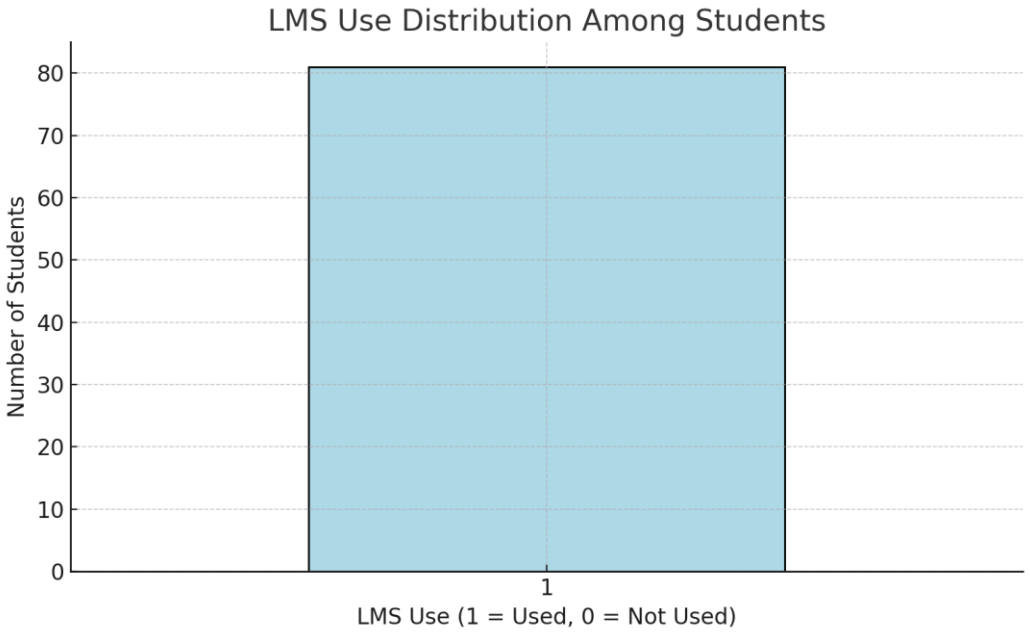


Figure 7 - LMS use

The data suggests that no students indicated non-usage of the LMS, emphasizing the platform's importance in the academic environment and the widespread reliance on it for accessing course materials, submitting assignments, and participating in online discussions.

5.4 Sample Demographics

5.4.1 Age

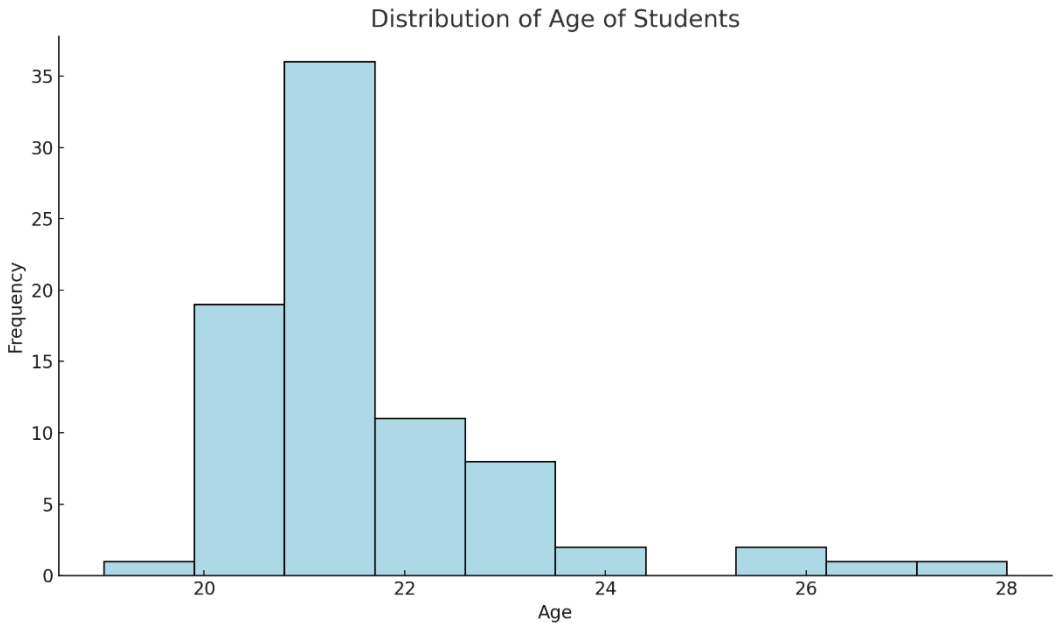


Figure 8 - Age

The histogram's age range, approximately 18 to 30 years, falls entirely within the Gen Z cohort, defined as individuals born between the mid-to-late 1990s and early 2010s. This suggests that the received sample response is of Gen Z individuals. The mean age of 21.32 aligns well with the typical age range of Gen Z in 2024, indicating that the sample is representative of the younger half of this generation. The mode, or the most frequently occurring age, around 20 years, further supports that the sample is centred around the younger segment of Gen Z. This aligns with many Gen Z individuals who are either in college, starting their careers, or in late adolescence.

Gen Z is renowned for being the first generation to be exposed to digital technology and the internet at an early age. They are highly proficient with technology and social media, characteristics that define their interaction with the world. Many individuals in the age range shown in the histogram are likely pursuing higher education or entering the workforce, influenced by their tech-savviness and the digital economy. Additionally, Gen

Z is characterized by a strong emphasis on diversity, inclusion, and social justice, often being more progressive and open- minded compared to previous generations.

The relatively low standard deviation of 1.241 indicates that the ages in the sample are clustered closely around the mean, suggesting a homogeneous age distribution within this segment of Gen Z. This age distribution provides insight into the early adulthood phase of Gen Z, where individuals are navigating significant life transitions such as higher education, starting careers, and establishing independence. Understanding this distribution helps tailor policies, marketing strategies, and services to meet the unique needs and characteristics of Gen Z, emphasizing the importance of recognizing their tech-savvy nature and progressive values.

5.4.2 Gender

Figure 6 (histogram) represents the frequency distribution of gender within a sample of 89 individuals. Descriptive statistics include a mean of 1.75 and a standard deviation of 0.459, indicating a relatively low variability in the gender distribution. The x-axis labels suggest three distinct categories, likely coded numerically (e.g., 1 for Male, 2 for, and potentially 3 for another gender category or non-binary). However, the exact coding is not provided, so the analysis is based on typical numerical coding for gender.

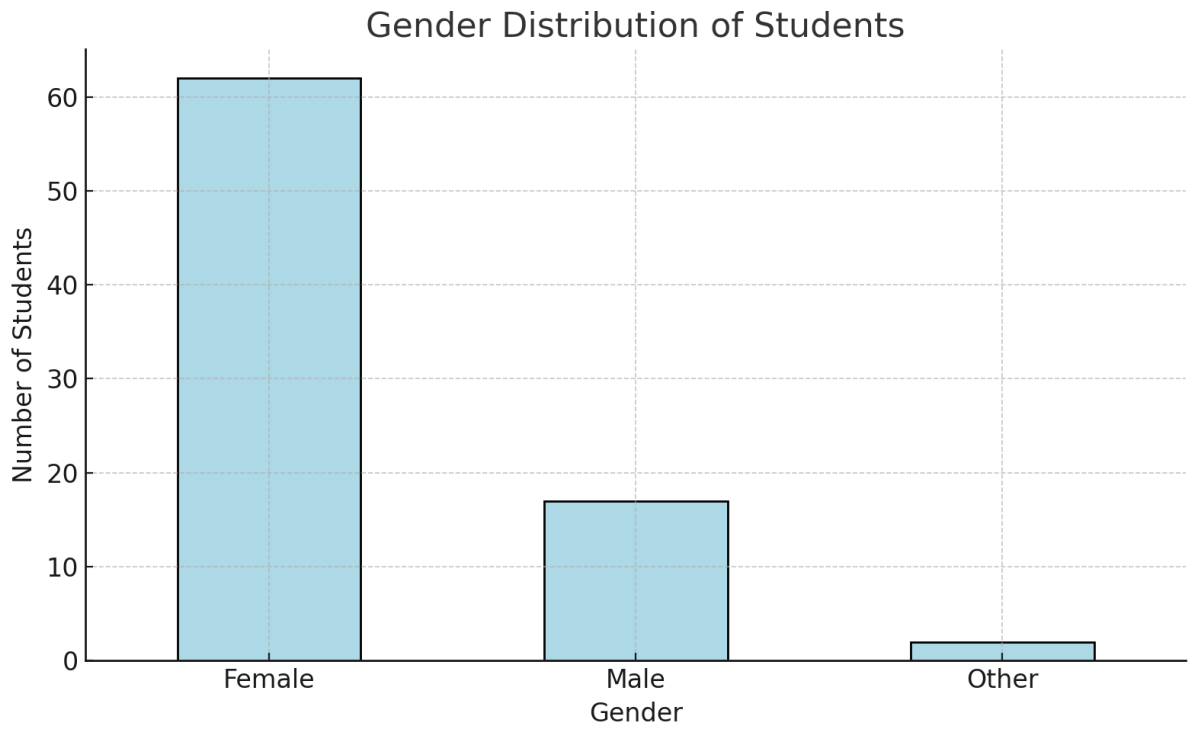


Figure 9 - Gender

The highest frequency is observed in the second category (Female), with more than 60 individuals. The first category (Male) has around 25 individuals, while the third category, which could represent non-binary or another gender, has a very low frequency of 2 individuals. The mean of 1.75 and the concentration around the first two categories confirm the predominance of individuals in the second category.

This distribution indicates a gender imbalance in the sample, with a significantly higher number of individuals in the second category (Female). Understanding this gender distribution is crucial for tailoring strategies, policies, and services to address the needs of different gender groups. It highlights the importance of considering gender diversity and representation in various contexts, such as research, marketing, and organizational

planning. Further analysis can be provided if additional details on the exact gender coding are available.

5.4.3 Year of Study

Figure 10 graph depicts the frequency distribution of the year of study for a sample of 81 individuals. The mean of the Year of Study was approximately 3.46, and the standard deviation was 0.61. This indicated that most students were in their third or fourth year of study, with relatively low variability in the years of study across the dataset

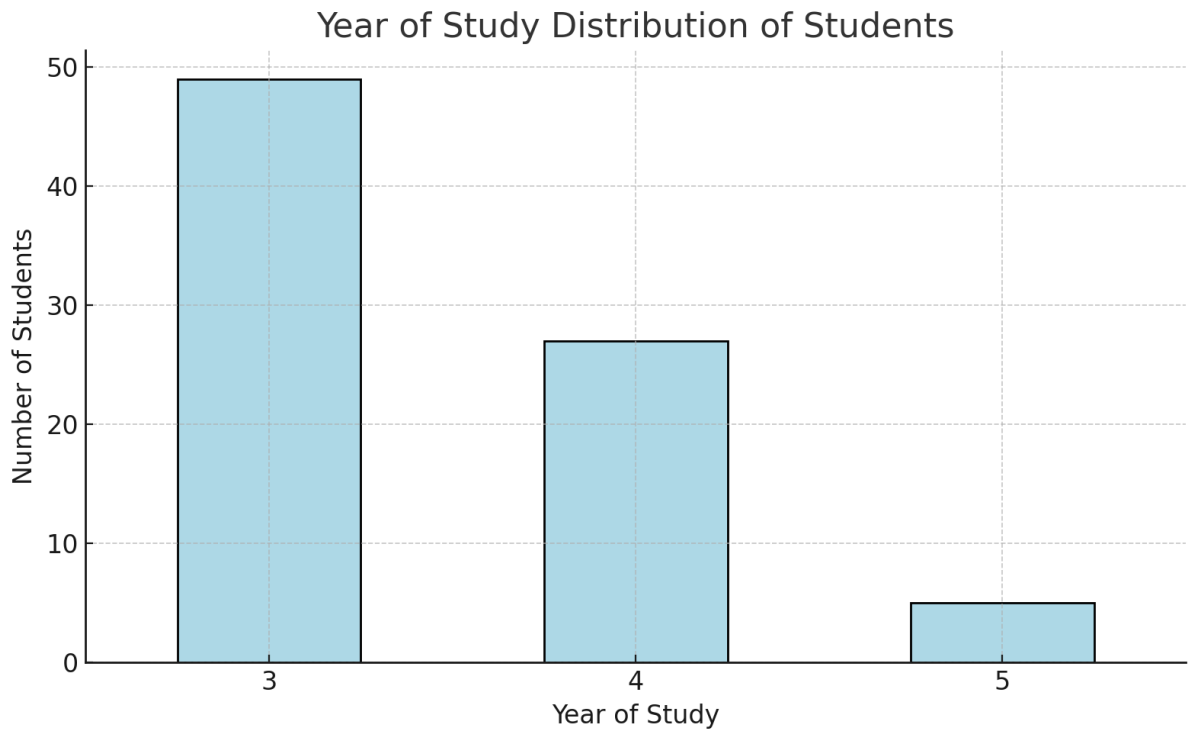


Figure 10 - Year of Study

The Year of Study distribution graph indicated that the majority of students in the dataset were in their third year of study, with 49 students falling into this category. The next largest group consisted of fourth-year students, who accounted for 27 students. A smaller portion of the dataset included fifth-year students, with only 5 students

represented. This distribution suggested that the dataset predominantly reflected students in the earlier stages of their academic programs, with fewer students at more advanced levels.

5.5 Descriptive Analysis of the Extended FAM Model Factors

5.5.1 IT Support

Table 2 illustrates the descriptive analysis of the IT support construct. The analysis indicated that overall, respondents have a positive perception of IT support, with most measures receiving above-average ratings. The mean values suggested that IT Support was generally viewed as available, responsive, and of good quality. However, there was variability in responses, with some measures showing greater inconsistency, indicating differing experiences among users.

Table 3 - IT Support Construct Descriptive Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
IT Support	81	2	7	5,74	1,243	-1,092	,267	,574	,529
IT Support	81	1	7	5,41	1,531	-1,191	,267	,953	,529
IT Support	81	1	7	6,01	1,135	-1,920	,267	4,833	,529
IT Support	81	1	7	5,41	1,634	-1,374	,267	1,093	,529
IT Support	81	2	7	5,46	1,351	-,888	,267	,087	,529
IT Support	81	1	7	4,90	1,722	-,717	,267	-,297	,529
IT Support	81	1	7	4,53	1,810	-,524	,267	-,659	,529
IT Support	81	1	7	4,75	1,854	-,653	,267	-,611	,529
Valid N (listwise)	81								

Negative skewness suggested that a majority of respondents rated IT Support favourably, while certain aspects with lower mean scores (e.g., 4.53 and 4.75) and higher variability highlight areas that could be improved to ensure a more consistent user experience. This insight can guide efforts to enhance IT Support services to better meet user expectations.

5.5.2 Interactivity

The descriptive statistics for the "Interactivity" construct, which revealed how respondents saw various facets of interaction, are shown in Table 3. The "Interactivity" construct showed generally positive perceptions among respondents, with mean values ranging from 4.58 to 6.43 on a 7-point scale. The highest mean (6.43) indicated a particularly strong agreement or satisfaction with that aspect of interactivity, while the lowest mean (4.58) suggested room for improvement.

Table 4 - Interactivity Construct Descriptive Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Interactivity	81	1	7	5,37	1,436	-1,383	,267	1,819	,529
Interactivity	81	1	7	5,81	1,276	-1,383	,267	1,888	,529
Interactivity	81	1	7	5,25	1,577	-1,106	,267	,378	,529
Interactivity	81	2	7	6,43	,907	-2,314	,267	7,089	,529
Interactivity	81	1	7	5,44	1,533	-1,152	,267	1,075	,529
Interactivity	81	1	7	5,16	1,714	-1,020	,267	,112	,529
Interactivity	81	1	7	4,58	2,036	-,501	,267	-1,055	,529
Valid N (listwise)	81								

The standard deviation numbers, which show variation in answers, range from 0.907 to 2.036. Lower values suggested that respondents had a more consistent view of certain aspects, while higher values reflect a wider range of opinions. The negative skewness values (ranging from -0.501 to -2.314) indicated that most responses were towards the higher end of the scale, demonstrating a generally favourable perception of interactivity. The high skewness (-2.314) suggests a strong consensus towards positive ratings for one particular measure.

Kurtosis values vary from -1.055 to 7.089, with some aspects showing a highly peaked distribution (kurtosis > 3), indicating that many respondents gave similar ratings, while others have more varied responses (kurtosis < 3). Overall, the data indicated that while interactivity is viewed positively, there are areas with more variation in experiences that could benefit from further exploration to enhance overall user satisfaction.

5.5.3 Technology-Task fit

Table 4 With mean scores ranging from 5.73 to 6.36 on a 7-point scale, the descriptive analysis of the "Task-Technology Fit" construct revealed generally positive attitudes, suggesting that respondents believe the LMS they use is a good fit for their jobs.

Table 5 - Technology-Task Fit Construct Descriptive Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Technology-Task Fit	81	3	7	6,22	,922	-1,737	,267	3,860	,529
Technology-Task Fit	81	3	7	6,26	,833	-1,453	,267	2,871	,529
Technology-Task Fit	81	3	7	6,12	,900	-1,199	,267	1,524	,529
Technology-Task Fit	81	3	7	6,36	,795	-1,657	,267	3,950	,529
Technology-Task Fit	81	2	7	6,30	,928	-2,363	,267	7,745	,529
Technology-Task Fit	81	2	7	5,73	1,173	-1,214	,267	1,564	,529
Technology-Task Fit	81	1	7	5,81	1,343	-1,527	,267	2,305	,529
Technology-Task Fit	81	1	7	5,94	1,228	-1,623	,267	3,208	,529
Valid N (listwise)	81								

The comparatively high mean scores indicate that users thought the technology and task requirements were well matched. The highest mean value (6.36) indicates particularly strong alignment in one aspect, while the lowest mean (5.73) still suggested an above-average fit. The standard deviation values range from 0.795 to 1.343, indicated moderate variability. Lower values suggest a consensus among respondents on certain aspects, while higher values indicate more diverse opinions.

The skewness values range from -1.199 to -2.363, indicated that most responses are skewed towards the higher end of the scale, reflecting generally positive perceptions of task-technology fit. Kurtosis values vary from 1.524 to 7.745, with some measures showing a highly peaked distribution, indicating strong agreement among respondents, while others are more moderate. The highest kurtosis value (7.745) suggests a very concentrated set of responses around the mean for that measure.

Overall, the data suggested that respondents feel the technology is well-aligned with their tasks, but there is some variability in perceptions. The highly positive skewness and kurtosis values for certain aspects indicate strong consensus and satisfaction, making

this an area of strength in the study. However, the measures with higher variability may warrant further exploration to understand differences in user experiences.

5.5.4 Faithful LMS Appropriation

Table 5, the descriptive analysis for the "Faithful LMS Appropriation" construct indicated that respondents generally have a lower perception of this aspect, as shown by the mean values ranging from 2.16 to 2.74 on a 7-point scale. This suggested that users may have not fully adhered to or properly used the LMS features as expected.

Table 6 - FLMSA Construct Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Faithful LMS Appropriation	81	1	7	2,74	1,948	1,000	,267	-,361	,529
Faithful LMS Appropriation	81	1	7	2,16	1,684	1,850	,267	2,597	,529
Faithful LMS Appropriation	81	1	7	2,27	1,710	1,577	,267	1,430	,529
Faithful LMS Appropriation	81	1	7	2,20	1,749	1,729	,267	1,965	,529
Valid N (listwise)	81								

The relatively low mean values suggested that respondents did not feel they were using the LMS faithfully or effectively. The highest mean of 2.74, indicated that even the most positively rated measure falls below the midpoint of the scale. The standard deviation values ranged from 1.684 to 1.948, indicated considerable variability in responses. This suggested that there were a wide range of opinions about LMS appropriation, with some users adhered closely to the intended use while others did not.

The skewness values were all positive, ranging from 1.000 to 1.850, indicating that the distribution of responses is skewed towards the lower end of the scale. This suggested that more respondents provided lower ratings, reinforcing the idea that LMS appropriation is not as strong. Kurtosis values range from -0.361 to 2.597, suggesting a mix of distributions. The values closer to zero indicated a more normally distributed set of responses, while the higher values indicate a concentration around certain ratings.

The analysis suggested that respondents did not feel they faithfully appropriated the LMS, as indicated by the consistently low mean scores. The high variability and positive skewness further indicated that while some users engaged properly with the LMS, many did not. This highlights an area of concern and suggests a need for targeted interventions or training to encourage more effective use of the LMS features.

5.5.5 Learning Process Satisfaction

Table 6 With mean scores ranging from 5.19 to 5.37 on a 7-point scale, the descriptive analysis of the "Learning Process Satisfaction" construct revealed that respondents tended to express positive satisfaction. This indicated that, overall, participants were satisfied with their learning process experiences.

Table 7 - Learning Process Satisfaction Construct Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Learning Process Satisfaction	81	2	7	5,32	1,138	-,978	,267	1,503	,529
Learning Process Satisfaction	81	2	7	5,30	,914	-,931	,267	1,895	,529
Learning Process Satisfaction	81	2	7	5,37	1,006	-,958	,267	2,162	,529
Learning Process Satisfaction	81	1	7	5,19	1,205	-,937	,267	1,544	,529
Valid N (listwise)	81								

With the highest mean score of 5.37, which indicates that this component was assessed most favourably, the mean scores, all above 5.0, indicated that the majority of respondents were reasonably satisfied with the learning experience. A moderate degree of response variability was indicated by the standard deviation values, which varied from 0.914 to 1.205. This suggested that although a large number of respondents thought the learning process was good, their satisfaction levels varied somewhat.

The skewness values were negative (ranging from -0.931 to -0.978), showing that the responses were slightly skewed toward the higher end of the scale, meaning that more respondents provided higher ratings, reinforcing a generally positive sentiment. The kurtosis values, ranging from 1.503 to 2.162, suggested that responses were moderately

peaked, indicating that a significant number of respondents tended to cluster around the mean values.

Respondents generally reported satisfaction with the learning process, as indicated by the consistently high mean scores. Although there was some variability in responses, the overall trend suggested that the majority had a favourable experience with the learning process, which was reflected in the negative skewness and moderately peaked distribution.

5.5.6 Perceived Learning Success

Table 7, the descriptive analysis of the "Perceived Learning Success" construct indicated that respondents generally perceived their learning success positively, with mean values ranging from 5.43 to 5.85 on a 7-point scale. This showed that participants felt they had achieved a relatively high level of success in their learning experience.

Table 8 - Perceived Learning Success Descriptive Analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Perceived Learning Success	81	1	7	5,43	1,396	-1,073	,267	,940	,529
Perceived Learning Success	81	1	7	5,75	1,090	-1,508	,267	3,854	,529
Perceived Learning Success	81	1	7	5,79	1,115	-1,514	,267	3,575	,529
Perceived Learning Success	81	1	7	5,75	1,146	-1,388	,267	2,840	,529
Perceived Learning Success	81	1	7	5,81	1,119	-1,598	,267	3,896	,529
Perceived Learning Success	81	1	7	5,59	1,253	-1,174	,267	1,448	,529
Perceived Learning Success	81	1	7	5,68	1,149	-1,415	,267	2,915	,529
Perceived Learning Success	81	2	7	5,85	1,216	-1,421	,267	1,834	,529
Valid N (listwise)	81								

The mean scores, all above 5.0, suggested that respondents felt successful in their learning experiences, with the highest mean being 5.85. This indicated a strong sense of perceived learning success among respondents. The standard deviation values ranged from 1.090 to 1.396, indicating moderate variability in responses. This meant that while

many respondents rated their learning success positively, there was some variation in individual perceptions.

The skewness values were consistently negative (ranging from -1.073 to -1.598), which indicated that the distribution of responses was skewed towards the higher end of the scale. This suggested that more respondents rated their learning success positively, reinforcing the overall favourable perception. The kurtosis values, ranging from 0.940 to 3.896, indicated a mix of moderately and more sharply peaked distributions. This suggested that while many respondents' ratings clustered around the mean, there were also some items where responses were more concentrated.

Respondents generally felt they had experienced learning success, as evidenced by the consistently high mean scores and negative skewness values. While there was some variability, the data suggested that most participants had a positive perception of their learning outcomes, indicating a successful learning experience.

5.5.7 Computer Self-Efficacy

Table 8, the descriptive analysis of the "Computer Self-Efficacy" construct revealed that respondents generally perceived themselves as confident and competent in using computers, with mean values ranging from 5.59 to 6.31 on a 7-point scale. This indicated that participants felt comfortable with their computer skills.

Table 9 - Computer Self-Efficacy

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Computer Self-Efficacy	81	1	7	6,07	1,138	-1,767	,267	4,256	,529
Computer Self-Efficacy	81	2	7	5,89	1,183	-1,405	,267	1,916	,529
Computer Self-Efficacy	81	3	7	6,31	,875	-1,570	,267	2,730	,529
Computer Self-Efficacy	81	4	7	6,16	,901	-,957	,267	,239	,529
Computer Self-Efficacy	81	1	7	5,59	1,330	-1,266	,267	1,759	,529
Computer Self-Efficacy	81	1	7	5,83	1,282	-1,272	,267	1,614	,529
Computer Self-Efficacy	81	3	7	6,19	1,038	-1,482	,267	1,884	,529
Computer Self-Efficacy	81	2	7	6,14	1,170	-1,807	,267	3,309	,529
Valid N (listwise)	81								

The mean scores, ranging from 5.59 to 6.31, showed that respondents had a high level of self-efficacy when it came to using computers, with the highest mean (6.31) indicating a strong sense of confidence in one aspect of computer use. The standard deviation values ranged from 0.875 to 1.330, indicating relatively moderate variability in responses. This suggested that while most respondents felt confident in their computer skills, there were some differences in their levels of self-efficacy.

The skewness values were negative, ranging from -0.957 to -1.807, which meant that the distribution of responses was skewed towards the higher end of the scale. This implied that a majority of respondents rated their computer self-efficacy positively. The kurtosis values varied from 0.239 to 4.256, with some measures showing a highly peaked distribution (greater than 3), indicating that responses were strongly concentrated around the mean for certain aspects of computer self-efficacy.

Respondents generally felt confident in their computer skills, as evidenced by the high mean values and negative skewness. Although there was some variability in responses, the majority of participants perceived themselves as competent and capable when using computers, indicating a high level of computer self-efficacy overall.

5.5.8 Self-Efficacy for Self-Regulated Learning

Table 9, the descriptive analysis of the "Self-Efficacy for Self-Regulated Learning" construct revealed that respondents had a moderate to high level of confidence in their ability to manage and regulate their own learning process, with mean values ranging from 4.86 to 6.10 on a 7-point scale.

Table 10 - Self-Efficacy for Self-Regulated Learning

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Self-Efficacy for Self Regulated Learning	81	2	7	6,10	1,020	-1,507	,267	2,967	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,47	1,574	-1,155	,267	,515	,529
Self-Efficacy for Self Regulated Learning	81	1	7	4,86	1,686	-,455	,267	-,811	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,27	1,441	-,981	,267	,709	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,33	1,508	-,904	,267	,340	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,17	1,649	-,729	,267	-,541	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,20	1,608	-,811	,267	-,098	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,40	1,481	-1,141	,267	,850	,529
Self-Efficacy for Self Regulated Learning	81	1	7	5,60	1,329	-1,296	,267	2,030	,529
Valid N (listwise)	81								

The mean scores, ranging from 4.86 to 6.10, indicated that respondents generally felt capable of self-regulated learning. The highest mean (6.10) suggested that one aspect of self-regulated learning was particularly well-regarded, while the lowest mean (4.86) indicated a more moderate level of confidence. The standard deviation values ranged from 1.020 to 1.686, indicating a fair amount of variability in responses. This suggested that while many respondents felt confident in their self-regulated learning abilities, there were variations in the degree of self-efficacy reported.

The skewness values varied from -0.455 to -1.507, showing that most responses were skewed towards the higher end of the scale. This implied that the majority of respondents rated their self-efficacy for self-regulated learning positively, though one item was less skewed, indicating a more even distribution of responses. The kurtosis values ranged from -0.811 to 2.967, indicating that some responses were more spread out (values less than 3), while others were more peaked, suggesting more consistency around the mean for those particular items.

The analysis showed that respondents generally felt confident in their ability to regulate their learning, with most participants rating themselves positively on this construct. The variability in responses indicated that while many felt capable of self-regulated learning,

some respondents had lower levels of confidence in certain areas, suggesting potential opportunities for support or skill development in self-regulated learning strategies.

5.6 Measurement Model (Outer Model) Evaluation

5.6.1 Standard PLS-SEM Algorithm (exploratory phase)

SmartPLS 4 tool was used to execute PLS-SEM algorithm calculation for the **81** cases ready for analysis. A graphical result of the Standard PLS-SEM Algorithm computation applied to the study model is shown in Figure 11. Evaluating the measurement methodology and the calibre of the indicators used to gauge different latent constructs was the main goal. This method was selected because it works well for managing intricate models with several constructions, particularly when the sample size is small. The goal of the investigation was to find indicators that did not match the suggested loading levels in order to improve the measurement model. This step was necessary before transitioning to hypothesis testing in a more confirmatory analysis phase.

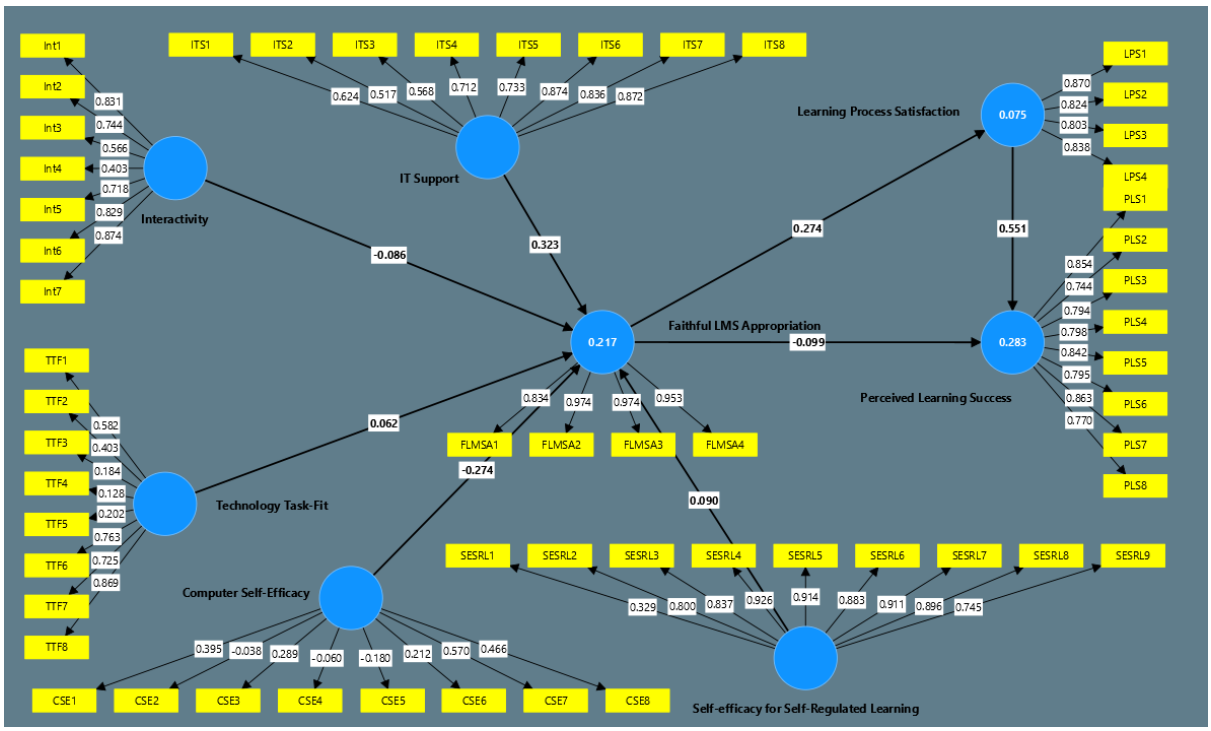


Figure 11 - Standard PLS-SEM Algorithm Graphical Output

The Standard PLS-SEM Algorithm was selected for several reasons. The first stage of the model's development was exploratory, with the main goal being to assess and enhance the calibre of the indicators linked to each latent construct. This goal is best served by the Standard PLS-SEM technique, which aims to maximise the explained variance in latent variables. Furthermore, this approach made it possible to identify indications that were candidates for deletion due to their low outer loadings. By guaranteeing that only valid and dependable indicators were kept, the Standard PLS-SEM algorithm allowed the measurement model to be refined. After this exploratory phase, the analysis was intended to transition to the Consistent PLS-SEM Algorithm, which would provide more accurate and unbiased estimates for hypothesis testing during the confirmatory phase.

5.6.2 Outer Loadings for Reflective Constructs

In this phase of the analysis, the outer loadings for each reflective construct were evaluated to determine the reliability of the indicators. The outer loadings represented how well each indicator reflected its corresponding latent variable, with a threshold of 0.7 being considered acceptable for retention. Indicators with loadings between 0.5 and 0.7 were considered for retention based on theoretical importance, while those with loadings below 0.5 were marked for deletion (Hair et al., 2014).

Table 11 - Outer Loadings for Reflective Constructs

Construct	Indicator	Loading	Action
Interactivity	Int1	0.831	Retained
	Int2	0.744	Retained
	Int3	0.566	Retained (Reconsider)
	Int4	0.403	Deleted
	Int5	0.718	Retained
	Int6	0.829	Retained
	Int7	0.874	Retained

IT Support	ITS1	0.624	Retained (Reconsider)
	ITS2	0.517	Retained (Reconsider)
	ITS3	0.568	Retained (Reconsider)
	ITS4	0.712	Retained
	ITS5	0.733	Retained
	ITS6	0.874	Retained
	ITS7	0.836	Retained
	ITS8	0.872	Retained
Task-Technology Fit	TTF1	0.582	Retained (Reconsider)
	TTF2	0.403	Deleted
	TTF3	0.184	Deleted
	TTF4	0.128	Deleted
	TTF5	0.202	Deleted
	TTF6	0.763	Retained
	TTF7	0.725	Retained
	TTF8	0.869	Retained
Computer Self-Efficacy	CSE1	0.395	Deleted
	CSE2	-0.038	Deleted
	CSE3	0.289	Deleted
	CSE4	-0.06	Deleted
	CSE5	-0.18	Deleted
	CSE6	0.212	Deleted
	CSE7	0.57	Retained (Reconsider)
	CSE8	0.466	Retained (Reconsider)
Faithful LMS Appropriation	FLMSA1	0.834	Retained
	FLMSA2	0.974	Retained
	FLMSA3	0.974	Retained
	FLMSA4	0.953	Retained

Self-Efficacy for Self-Regulated Learning	SESRL1	0.329	Deleted
	SESRL2	0.8	Retained
	SESRL3	0.837	Retained
	SESRL4	0.926	Retained
	SESRL5	0.914	Retained
	SESRL6	0.883	Retained
	SESRL7	0.911	Retained
	SESRL8	0.896	Retained
	SESRL9	0.745	Retained
Learning Process Satisfaction	LPS1	0.87	Retained
	LPS2	0.824	Retained
	LPS3	0.803	Retained
	LPS4	0.838	Retained
Perceived Learning Success	PLS1	0.854	Retained
	PLS2	0.744	Retained
	PLS3	0.794	Retained
	PLS4	0.798	Retained
	PLS5	0.842	Retained
	PLS6	0.795	Retained
	PLS7	0.863	Retained
	PLS8	0.77	Retained

This phase of the analysis allowed for a thorough evaluation of the reflective indicators, with low-performing indicators being identified for deletion and strong indicators being retained, setting the stage for further analysis in the confirmatory phase.

5.6.3 Model Refinement

Based on the results of the outer loadings, several indicators (CSE1, CSE2, CSE3, CSE4, CSE5, CSE6, CSE8, SESRL1, TTF2, TTF3, TTF4, and TTF5) were deleted due to poor outer

loadings. The remaining indicators were retained, and the model was adjusted accordingly. After refining the measurement model using the Standard PLS-SEM algorithm, the next step was to run the Consistent PLS-SEM Algorithm (PLSc). This algorithm corrected the estimates for reflective constructs, providing unbiased path coefficients and loadings, making it suitable for hypotheses testing in the confirmatory phase (Hair, 2021). Using PLSc ensured that the path estimates are comparable to those derived from covariance-based SEM (like AMOS) and are reliable for making theoretical inferences (Hair, 2021; Hair et al., 2014).

5.6.4 Consistent PLS-SEM Algorithm (confirmatory phase)

The path coefficients, outer loadings, and R^2 values for the reflective constructions are among the graphical output findings of the Consistent PLS-SEM method computations that are shown in Figure 12. Several significant connections between the model's constructs were shown by the Consistent PLS-SEM Algorithm's results. **Faithful LMS Appropriation** explained **24%** of the variation, according to the explained variance ($\mathbf{R^2}$) values, indicating that components like **IT Support**, **Interactivity**, and **Technology Task-Fit**, and **Computer Self-Efficacy** had a moderate influence.

Learning Process Satisfaction had a lower $\mathbf{R^2}$ value of **9%**, which implied that while Faithful LMS Appropriation influenced satisfaction, other factors likely contributed to learning satisfaction. In contrast, **Perceived Learning Success** had an $\mathbf{R^2}$ of **35.7%**, indicating that a considerable portion of its variance was explained by both **Faithful LMS Appropriation** and **Learning Process Satisfaction**.

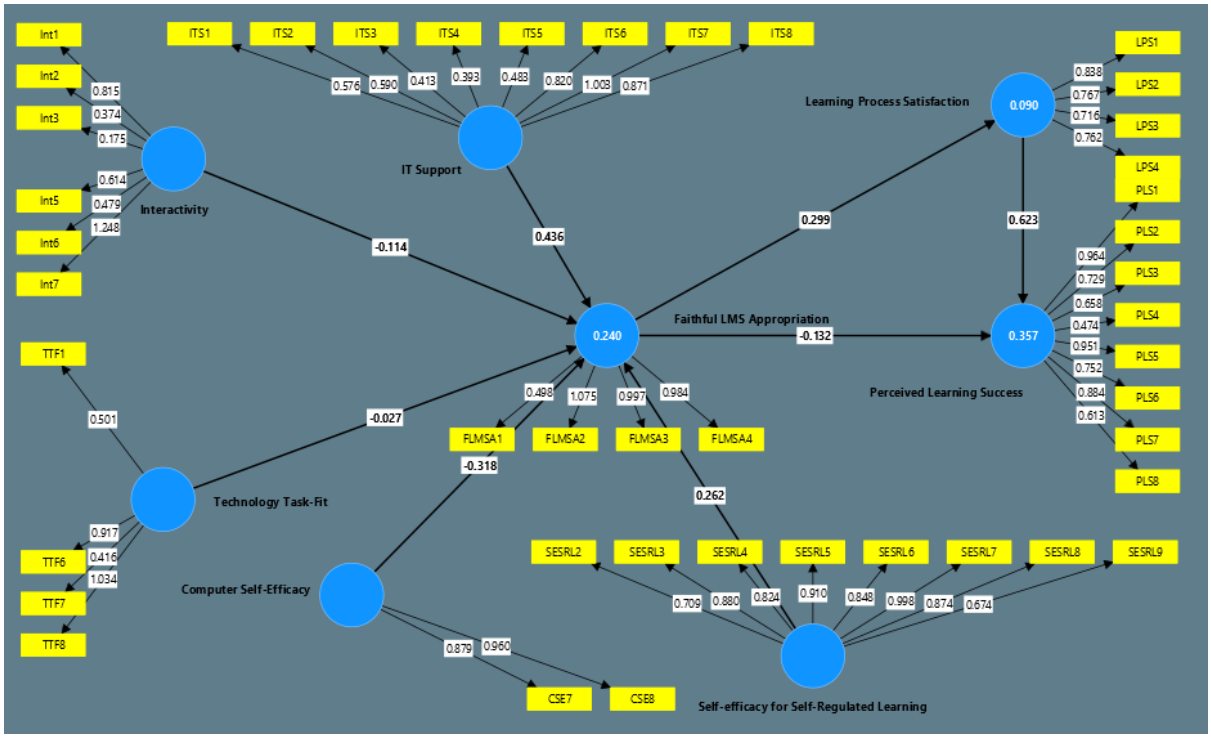


Figure 12 - Consistent PLS-SEM algorithm Graphical Output

The path coefficients demonstrated the strength and direction of the relationships between the constructs. **IT Support** (0.436) showed a strong positive effect on **Faithful LMS Appropriation**, making it a critical driver of LMS usage. However, **Interactivity** (-0.114) and **Technology Task-Fit** (-0.027) exhibited weak or negative relationships with **Faithful LMS Appropriation**, suggesting that these factors were not significant in influencing LMS usage in this context. **Computer Self-Efficacy** (0.262) had a moderate positive influence on LMS usage. In terms of the outcome variables, **Perceived Learning Success** (0.132) was less affected by Faithful LMS Appropriation than **Learning Process Satisfaction** (0.299), which was positively but moderately affected. Students' contentment with the learning process was a major predictor of their reported learning success, as seen by the strongest correlation found between learning process satisfaction and perceived learning success (0.623).

The outer loadings assessed the reliability of the individual indicators representing their respective constructs. Most indicators for IT Support, Faithful LMS Appropriation, Learning Process Satisfaction, and Perceived Learning Success demonstrated strong loadings, indicating that they were reliable measures of their constructs. However, certain indicators, particularly in **Interactivity** (e.g., Int2: 0.374, Int3: 0.175), **Technology**

Task-Fit (e.g., TTF7: 0.416), and **IT Support** (e.g., ITS4: 0.393, ITS3 0.413, ITS5 0.483) had lower loadings and they were removed in the next iteration to enhance the model's overall reliability.

5.6.5 Construct Reliability and Validity

The results of the Consistent PLS-SEM algorithm's analysis of construct reliability and validity are shown in Table 11. Cronbach's alpha and **Composite Reliability** (rho_a and rho_c) were analyzed to evaluate the internal consistency reliability. Additionally, the constructs' convergent validity was assessed using the Average Variance Extracted (AVE).

Table 12 - Construct Reliability and Validity Results

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Computer Self-Efficacy	0.915	0.921	0.917	0.847
Faithful LMS Appropriation	0.953	0.991	0.954	0.844
IT Support	0.826	0.867	0.836	0.516
Interactivity	0.841	0.958	0.830	0.582
Learning Process Satisfaction	0.854	0.857	0.855	0.596
Perceived Learning Success	0.925	0.939	0.918	0.593
Self-efficacy for Self-Regulated Learning	0.952	0.958	0.952	0.715
Technology Task-Fit	0.779	0.849	0.785	0.567

All constructs had Cronbach's alpha scores between **0.779** and **0.953**, which indicates good to outstanding internal consistency. Constructs such as **Computer Self-Efficacy (0.915)**, **Faithful LMS Appropriation (0.953)**, and **Self-Efficacy for Self-Regulated Learning (0.952)** exhibited very high internal consistency, demonstrating that the items within these constructs were highly reliable. Even **IT Support (0.826)**, which had the lowest alpha value among the constructs, was still above the acceptable threshold of 0.7, showing that this construct was also sufficiently reliable.

All of the constructs' composite reliability (rho_a and rho_c) values were far higher than the suggested cutoff point of 0.7, which further supported their internal consistency. For instance, **Faithful LMS Appropriation** showed remarkable reliability with composite

reliability ratings of **0.991 (rho_a)** and **0.954 (rho_c)**. Similarly, composite reliability values above 0.9 indicate good reliability for **Computer Self-Efficacy**, **Self-Efficacy for Self-Regulated Learning**, and **Perceived Learning Success**. **Technology Task-Fit** (rho_a: 0.849, rho_c: 0.785) and **IT Support** (rho_a: 0.867, rho_c: 0.836), two constructs with lower composite reliability scores, nevertheless surpassed the threshold, showing acceptable levels of dependability.

Convergent validity was evaluated using the **Average Variance Extracted (AVE)** values; a threshold of **0.5** indicates sufficient convergent validity. This threshold was met or surpassed by every construct, indicating that each one accounted for over 50% of the variation in its corresponding indicators. Strong convergent validity was indicated by the notably high AVE values of **Computer Self-Efficacy (0.847)**, Faithful **LMS Appropriation (0.844)**, and **Self-Efficacy for Self-Regulated Learning (0.715)**. Despite having lower AVE values than other constructs, constructs like **Technology Task-Fit (0.567)** and **IT Support (0.516)** also showed sufficient convergent validity.

In conclusion, the results indicated that all of the constructs had sufficient convergent validity and excellent internal consistency reliability. The measuring model's validity and reliability were validated by the high Cronbach's alpha, composite reliability, and AVE values, which also supported the constructs' applicability for additional hypothesis testing.

5.6.6 Discriminant Validity of Constructs

The discriminant validity was assessed using the Fornell-Larcker criterion. This method evaluates discriminant validity by comparing the correlations between the constructs with the square root of each construct's Average Variance Extracted (AVE). Discriminant validity has been established if the square root of the AVE for a given construct is greater than its highest correlation with any other construct. In Table 12, the diagonal elements display the square roots of the AVE (bold), while the off-diagonal elements display the correlations between the constructs. The square root of each construct's AVE must be

greater than the correlations in the corresponding rows and columns in order to confirm discriminant validity.

Table 13 - Discriminant validity - Fornell-Larcker Criterion

	CSE	FLMSA	ITS	Int	LPS	PLS	SESRSL	TTF
CSE	0.920							
FLMSA	-0.108	0.919						
ITS	0.333	0.411	0.719					
Int	0.399	0.264	0.751	0.763				
LPS	0.464	0.299	0.471	0.456	0.772			
PLS	0.462	0.055	0.505	0.622	0.584	0.770		
SESRSL	0.456	0.286	0.522	0.600	0.600	0.611	0.845	
TTF	0.500	0.194	0.584	0.609	0.530	0.564	0.601	0.753

The square root of the AVE for **Computer Self-Efficacy (CSE)** was **0.920**, higher than its strongest connection with Technology Task-Fit (0.500) and higher than its highest correlation with any other construct. This demonstrates the discriminant validity of CSE. Additionally, the discriminant validity of **Faithful LMS Appropriation (FLMSA)** was confirmed by its square root of the **AVE** of **0.919**, which was higher than its greatest connection with IT Support (0.411).

The discriminant validity of **IT Support (ITS)** was supported by the square root of the **AVE**, which was **0.719**, and its best association with Self-Efficacy for Self-Regulated Learning (0.522). **Interactivity (Int)** also exhibited discriminant validity, as evidenced by its maximum correlation (0.751) with IT Support, which was lower than 0.763, and its square root of the **AVE** of **0.763**.

The discriminant validity of the construct **Learning Process Satisfaction (LPS)** was confirmed by its square root of the **AVE** of **0.772**, which was greater than its greatest connection with Perceived Learning Success (0.622). The discriminant validity of **Perceived Learning Success (PLS)** was also proven because its square root of the **AVE**

was **0.770**, which was higher than its maximum correlation with Learning Process Satisfaction (0.622).

In conclusion, the discriminant validity for all constructs in the model was confirmed. For each construct, the square root of the AVE exceeded its correlations with other constructs, ensuring that each construct measured a unique aspect of the data and was distinct from the others in the model. This supports the overall validity of the measurement model.

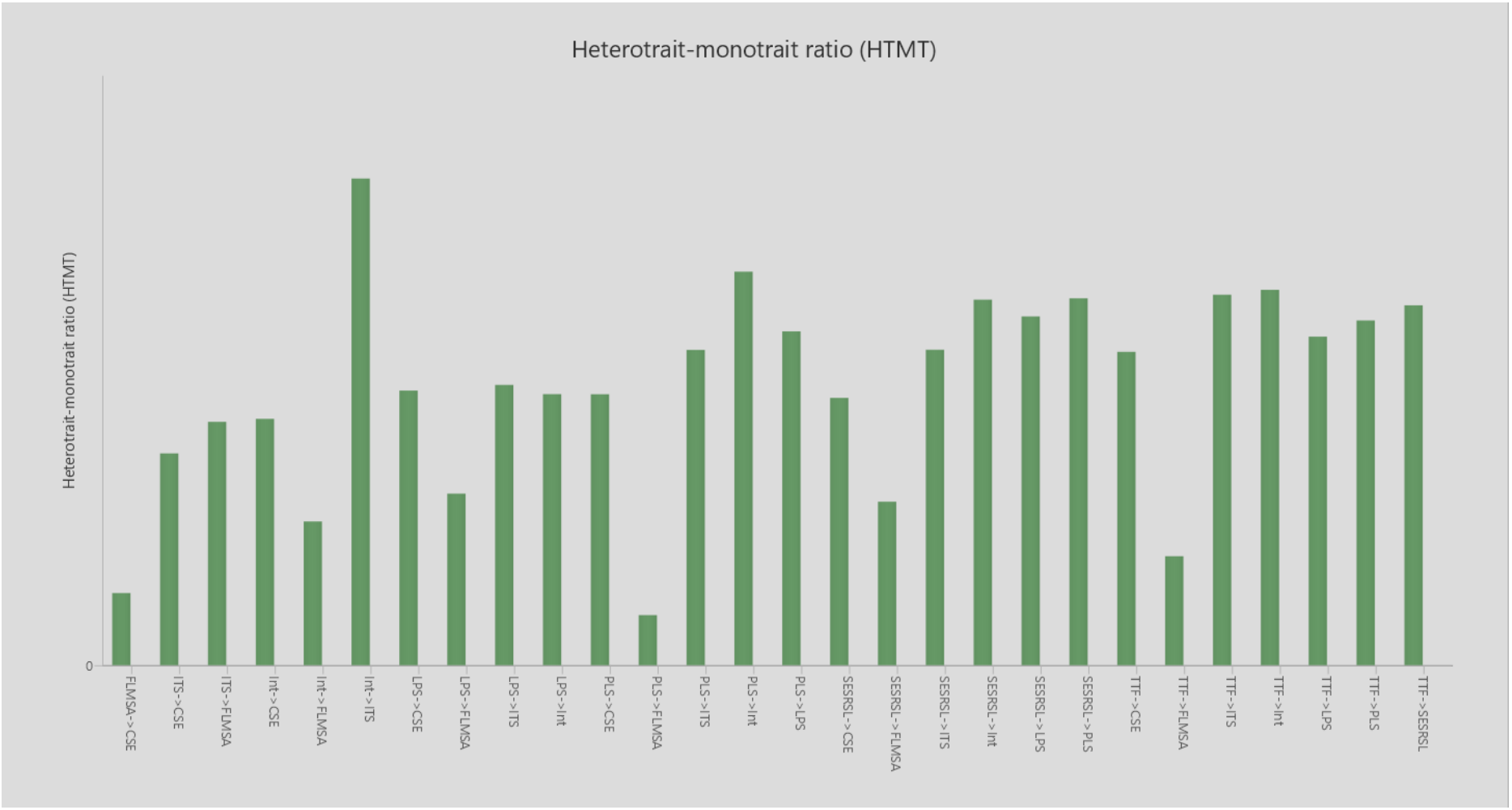


Figure 13 - Heterotrait-monotrait ratio (HTMT)

For a number of construct pairs, Figure 13 displays the **Heterotrait-Monotrait Ratio (HTMT)** bar, an essential measure in structural equation modeling to assess discriminant validity. The Heterotrait-Monotrait Ratio (HTMT) was used to evaluate the discriminant validity of the model; a generally accepted threshold of **0.85** indicates that the constructs are sufficiently dissimilar from one another. The HTMT values for every pair of constructs in this study were below the 0.85 limit, demonstrating discriminant validity across the board.

The relationship between **Faithful LMS Appropriation (FLMSA)** and **Computer Self-Efficacy (CSE)** had an HTMT value of **0.122**, and the relationship between **IT Support (ITS)** and **CSE** was **0.359**, both of which indicate strong discriminant validity. Similarly, **ITS** and **FLMSA** had an HTMT value of **0.413**, and **Interactivity (Int)** and **CSE** had an HTMT of **0.418**, confirming that these constructs are distinct.

Other relationships, such as **Learning Process Satisfaction (LPS)** and **CSE** (0.466), and **LPS** and **ITS** (**0.476**), also demonstrated adequate discriminant validity. While the relationship between **PLS** and **Int** showed a relatively high HTMT value of **0.668**, it still remained below the 0.85 threshold, ensuring sufficient distinctiveness between these constructs. The relationships involving **Self-Efficacy for Self-Regulated Learning (SESRL)** also indicated good discriminant validity, with values such as **SESRL** ↔ **CSE** (**0.454**), **SESRL** ↔ **FLMSA** (**0.277**), and **SESRL** ↔ **LPS** (**0.623**).

Finally, the HTMT values for **Technology Task-Fit (TTF)** and other constructs confirmed strong discriminant validity, with values such as **TTF** ↔ **CSE** (**0.532**), **TTF** ↔ **FLMSA** (**0.185**), and **TTF** ↔ **ITS** (**0.629**). All of these relationships demonstrated HTMT values well below the threshold of 0.85, affirming that these constructs are adequately distinct from one another.

In conclusion, the HTMT analysis confirmed that all constructs in the model exhibited discriminant validity, as all construct pairs had HTMT values below the threshold of 0.85. Despite some constructs showing relatively higher HTMT values, such as **PLS** ↔ **Int** (**0.668**)

and **SESRL** ↔ **Int** (**0.620**), they remained within acceptable limits, ensuring the model's validity.

5.6.7 Collinearity Statistics

The **Variance Inflation Factor (VIF),** a collinearity metric, is shown for each predictor in an inner model matrix in Table 13. Multicollinearity between the constructs in the inner model was evaluated using the VIF. When the **VIF** number is less than **5**, multicollinearity is not an issue; when it is greater than 5, multicollinearity issues may be present. All of the constructs in this analysis had VIF values that were far below the cutoff, indicating that multicollinearity is not an issue for the model.

Table 14 - Collinearity Statistics

Collinearity statistics (VIF) - Inner model - Matrix

	CSE	FLMSA	ITS	Int	LPS	PLS	SESRSL	TTF
CSE		1.412						
FLMSA					1.000	1.098		
ITS		2.447						
Int		2.769						
LPS						1.098		
PLS								
SESRSL		1.887						
TTF		2.089						

Computer Self-Efficacy (CSE) exhibited a VIF value of 1.412 when related to Faithful LMS Appropriation (FLMSA), indicating that CSE is a distinct predictor without overlapping

significantly with other variables. Similarly, Faithful LMS Appropriation had VIF values of 1.000 and 1.098 with Learning Process Satisfaction (LPS) and Perceived Learning Success (PLS), respectively. These low values indicate that FLMSA does not experience multicollinearity in its relationships with LPS and PLS.

Both IT Support (ITS) and Interactivity (Int) showed VIF values of 2.447 and 2.769 with Faithful LMS Appropriation, confirming that they are distinct and independent predictors with no significant multicollinearity. Similarly, Self-Efficacy for Self-Regulated Learning (SESRL) and Technology Task-Fit (TTF) had VIF values of 1.887 and 2.089, respectively, further indicating that these constructs do not suffer from multicollinearity.

In conclusion, the VIF analysis confirmed that all constructs in the model demonstrated low levels of multicollinearity, with VIF values well below the critical threshold of 5. This suggests that each construct is independent and contributes meaningfully to the model, ensuring that the regression results are reliable and valid.

5.7 Structural (Inner) Model Evaluation

The study followed the steps suggested by the authors of PLS-SEM analysis method (Hair et al., 2014). First, the structural model is evaluated for collinearity issues; next, the significance and relevance of the structural model relationships are evaluated; third, the level of R2 is evaluated; fourth, the effect sizes are evaluated; fifth, the predictive relevance Q2 and Q1 effect sizes are evaluated.

To examine the association between the latent variables of the extended FAM Model, a PLS-SEM bootstrapping computation was performed in SmartPLS 4. Using a subsample of 5000, a percentile bootstrap, and a significance level of 0.05, the bootstrapping process employs standard parameters. The model's graphical output from the standard PLM-SEM bootstrapping computation is shown in Figure 14. T-values and R2 values for the constructs

are shown in the outer model, while the path coefficients are shown in the inner model with p-values in brackets. For endogenous constructs, the R2 values indicate the predictive accuracy; according to conventional norms, values of 0.75, 0.50, and 0.25 are regarded as substantial, moderate, and weak, respectively.

Accordingly, R2 values above these cutoffs indicate higher predictive accuracy for the endogenous constructs, whereas values below them indicate lower predictive accuracy. Therefore, if the R^2 value is greater than 0.75, it would be classified as substantial. If it is equal to or below 0.25, it would be classified as weak.

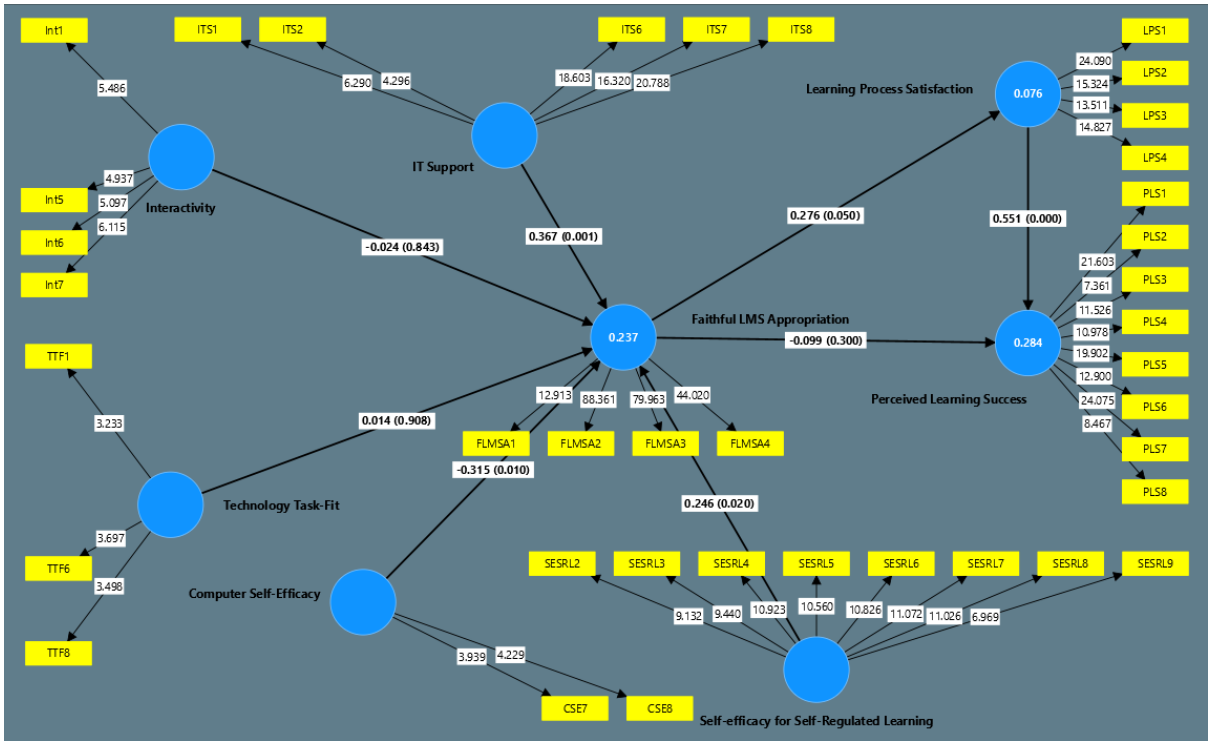


Figure 14 - PLS-SEM Bootstrapping Graphical Output

5.7.1 Path coefficients

The associations between variables in the expanded model are shown in Table 14 together with the path coefficients, means, standard deviations, T-values, and P-values. The P-values

play a major role in determining the significance of these relationships; statistical significance is usually indicated by a threshold of **0.05**.

Table 15 - Path coefficients Results

Path coefficients - Mean, STDEV, T values, p values					
	Original sample (O)	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**
CSE -> FLMSA	-0.315	-0.322	0.121	2.603	0.009
FLMSA -> LPS	0.276	0.278	0.143	1.931	0.054
FLMSA -> PLS	-0.099	-0.101	0.096	1.037	0.300
ITS -> FLMSA	0.367	0.350	0.113	3.243	0.001
Int -> FLMSA	-0.024	0.000	0.126	0.194	0.846
LPS -> PLS	0.551	0.565	0.088	6.233	0.000
SESRSL -> FLMSA	0.246	0.238	0.106	2.317	0.021
TTF -> FLMSA	0.014	0.034	0.117	0.116	0.908

The PLS-SEM algorithm's route coefficient analysis results showed a number of noteworthy connections between the constructs. **Faithful LMS Appropriation (FLMSA)** was found to be significantly impacted negatively by **Computer Self-Efficacy (CSE)** ($\beta = -0.315$, $p = 0.009$), indicating that lower levels of LMS appropriation were linked to higher levels of computer self-efficacy. **IT Support (ITS)** also had a significant positive effect on **FLMSA** ($\beta = 0.367$, $p = 0.001$), indicating that increased IT support led to greater LMS appropriation. Additionally, FLMSA was favourably impacted by Self-Efficacy for Self-Regulated Learning (SESRL) ($\beta = 0.246$, $p = 0.021$), indicating that students who had higher levels of self-regulation efficacy were better at appropriating the LMS.

A weakly favourable effect of LMS appropriation on learning satisfaction was indicated by the marginally significant connection between **FLMSA** and **Learning Process Satisfaction (LPS)** ($\beta = 0.276$, $p = 0.054$). Nevertheless, there was no statistically significant correlation between FLMSA and PLS ($\beta = -0.099$, $p = 0.300$), indicating that LMS appropriation had no discernible effect on students' perceptions of their own learning progress.

Other relationships, such as **Interactivity (Int)** and **Technology Task-Fit (TTF)** on **FLMSA**, were not significant, indicating that these constructs did not substantially influence LMS

appropriation. On the other hand, **Learning Process Satisfaction (LPS)** had a strong positive effect on **Perceived Learning Success (PLS)** (β = 0.551, p = 0.000), suggesting that higher satisfaction with the learning process was strongly associated with increased perceptions of learning success.

Overall, the findings highlighted the significant roles of IT Support, Computer Self-Efficacy, and Self-Efficacy for Self-Regulated Learning in influencing LMS appropriation, as well as the critical impact of learning satisfaction on perceived learning success.

Table 16 - Confidence Intervals

Path coefficients - Confidence intervals				
	Original sample (O)	**Sample mean (M)**	**2.5%**	**97.5%**
CSE -> FLMSA	-0.315	-0.322	-0.534	-0.049
FLMSA -> LPS	0.276	0.278	-0.028	0.526
FLMSA -> PLS	-0.099	-0.101	-0.297	0.074
ITS -> FLMSA	0.367	0.350	0.114	0.558
Int -> FLMSA	-0.024	0.000	-0.249	0.247
LPS -> PLS	0.551	0.565	0.379	0.725
SESRSL -> FLMSA	0.246	0.238	0.015	0.428
TTF -> FLMSA	0.014	0.034	-0.217	0.248

As shown in table 15, the route coefficient analysis and the confidence intervals offered further information about the connections between the model's constructs. Confidence intervals provide us with a range that, with a given degree of confidence, represents the parameter's real value. The link may not be statistically significant if the confidence interval is zero.

Since the confidence interval did not include zero (95% CI: -0.534 to -0.049), the link between **Computer Self-Efficacy (CSE)** and **Faithful LMS Appropriation (FLMSA)** was found to be significant, supporting the conclusion that higher CSE significantly lowered LMS

appropriation. The confidence interval for the relationship between **Learning Process Satisfaction (LPS)** and **Faithful LMS Appropriation (FLMSA)** was rather large (95% CI: -0.028 to 0.526), and it encompassed zero. This supported the marginal significance found in the earlier analysis (p = 0.054) and showed that the effect was not statistically significant at the 95% confidence level. This implies that although **FLMSA** and **LPS** had a positive association, there was no reason to be confident in this finding.

The path between FLMSA and PLS also showed a confidence interval that included zero (95% CI: -0.297 to 0.074), confirming that this relationship was not statistically significant. This suggests that LMS appropriation did not have a meaningful impact on students' perceptions of learning success.

The relationship between ITS and FLMSA was strongly supported, as the confidence interval (95% CI: 0.114 to 0.558) did not include zero, confirming the significant positive effect of IT support on LMS appropriation. Similarly, the path between LPS and Perceived Learning Success (PLS) was highly significant, with a confidence interval (95% CI: 0.379 to 0.725), showing that greater satisfaction with the learning process had a strong and reliable impact on perceived learning success.

The path from **Self-Efficacy for Self-Regulated Learning (SESRL)** to **FLMSA** was also statistically significant, as the confidence interval (95% CI: 0.015 to 0.428) did not cross zero, indicating that students with higher self-regulation efficacy were more likely to effectively appropriate the LMS. Lastly, the relationship between Technology Task-Fit (TTF) and FLMSA had a confidence interval that included zero (95% CI: -0.217 to 0.248), confirming that this relationship was not significant, and TTF did not have a meaningful impact on LMS appropriation.

In conclusion, the confidence interval analysis reinforced the significant effects of IT Support, Computer Self-Efficacy, and Self-Efficacy for Self-Regulated Learning on LMS appropriation, as well as the strong influence of Learning Process Satisfaction on Perceived

Learning Success. However, other relationships, such as FLMSA to PLS, and TTF to FLMSA, were found to be non-significant, as their confidence intervals included zero.

Table 17 - Confidence Intervals Bias Corrected

Path coefficients - Confidence intervals bias corrected					
	Original sample (O)	**Sample mean (M)**	**Bias**	**2.5%**	**97.5%**
CSE -> FLMSA	-0.315	-0.322	-0.007	-0.504	0.046
FLMSA -> LPS	0.276	0.278	0.002	-0.072	0.501
FLMSA -> PLS	-0.099	-0.101	-0.002	-0.303	0.072
ITS -> FLMSA	0.367	0.350	-0.017	0.140	0.580
Int -> FLMSA	-0.024	0.000	0.025	-0.301	0.195
LPS -> PLS	0.551	0.565	0.014	0.333	0.692
SESRSL -> FLMSA	0.246	0.238	-0.008	0.031	0.440
TTF -> FLMSA	0.014	0.034	0.020	-0.305	0.201

Table 16 presents path coefficients along with bias-corrected confidence intervals, providing an adjusted perspective on the relationships between variables. Bias correction accounts for systematic errors in estimates, yielding more accurate confidence intervals. The interpretation remains similar: intervals that include zero suggest non-significant relationships, while those that do not indicate statistical significance.

The bias-corrected confidence interval analysis provided additional confirmation of the significance of the relationships in the structural model. The relationship between Computer Self-Efficacy (CSE) and Faithful LMS Appropriation (FLMSA) remained marginally significant, with a confidence interval that slightly approached zero (-0.504 to 0.046), suggesting some uncertainty regarding the strength of this negative effect. The path between FLMSA and Learning Process Satisfaction (LPS) had a confidence interval that included zero (-0.072 to 0.501), indicating that this relationship was not statistically significant.

Similarly, the relationship between FLMSA and Perceived Learning Success (PLS) was confirmed as non-significant, with a confidence interval (-0.303 to 0.072) that included zero, reinforcing that LMS appropriation did not have a meaningful impact on perceived learning success. In contrast, IT Support (ITS) had a significant positive effect on FLMSA, as the confidence interval (0.140 to 0.580) did not include zero, confirming that IT support strongly influenced LMS appropriation.

The relationship between Interactivity (Int) and FLMSA was non-significant, as the confidence interval (-0.301 to 0.195) included zero, indicating that interactivity did not have a substantial effect on LMS appropriation. On the other hand, the path from Learning Process Satisfaction (LPS) to Perceived Learning Success (PLS) was highly significant, with a confidence interval (0.333 to 0.692) that excluded zero, suggesting that learning satisfaction had a strong positive impact on perceived learning success.

The relationship between Self-Efficacy for Self-Regulated Learning (SESRL) and FLMSA was also significant, with a confidence interval (0.031 to 0.440) that did not include zero, confirming that higher self-regulation efficacy positively impacted LMS appropriation. However, the relationship between Technology Task-Fit (TTF) and FLMSA was non-significant, as its confidence interval (-0.305 to 0.201) included zero, indicating that TTF did not meaningfully influence LMS appropriation.

In summary, the bias-corrected confidence intervals confirmed the significance of key paths such as ITS → FLMSA, LPS → PLS, and SESRL → FLMSA, while relationships like FLMSA → PLS, Int → FLMSA, and TTF → FLMSA were found to be non-significant. These findings provided further clarity on the strength and direction of the relationships within the model.

5.7.2 Model Fit Assessment (R-square, f-square, Standardized Root Mean Square Residual, Unweighted Least Squares, Geodesic)

The R-squared and adjusted R-squared values for the FLMSA, LPS, and PLS models are shown in Table 15. The percentage of the dependent variable's variability that can be accounted for by the independent variables in the model is shown by the R-squared value. A more precise indicator of the model's explanatory ability is the adjusted R-square value, which takes into consideration the number of predictors in the model.

Table 18 - R-square

R-square - Mean, STDEV, T values, p values					
	Original sample (O)	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**
FLMSA	0.237	0.279	0.061	3.903	0.000
LPS	0.076	0.097	0.076	0.998	0.318
PLS	0.284	0.316	0.094	3.016	0.003

The **R-squared (R^2)** values were analyzed to see how much of each endogenous latent variable's variation was explained by the model. With an R^2 value of **0.237** for **Faithful LMS Appropriation (FLMSA)**, the model was able to account for 23.7% of the variance in FLMSA. This result, which had a **t-value** of 3.903 and a **p-value** of 0.000, was statistically significant, indicating that the predictors—like IT Support and Self-Efficacy for Self-Regulated Learning—had a substantial role in explaining FLMSA. This outcome showed that this construct has a considerable amount of predictive value.

In the case of **Learning Process Satisfaction (LPS)**, the R^2 value was **0.076**, meaning the model explained only 7.6% of the variance in LPS. This value was not statistically significant, as evidenced by a t-value of 0.998 and a p-value of 0.318, which exceeded the **0.05** threshold. This indicated that the predictors included in the model did not significantly explain the variance in Learning Process Satisfaction, implying that other factors outside the model might be influencing this construct.

For **Perceived Learning Success (PLS)**, the **R^2** value was **0.284**, showing that the model explained 28.4% of the variance in PLS. This was statistically significant, with a t-value of 3.016 and a p-value of 0.003, falling below the 0.05 significance level. This finding suggested that the predictors, such as Learning Process Satisfaction, significantly contributed to explaining Perceived Learning Success, indicating a moderate level of predictive power for this construct.

In summary, the model demonstrated a moderate ability to explain the variance in Faithful LMS Appropriation and Perceived Learning Success, both of which were statistically significant. However, the model's ability to explain variance in Learning Process Satisfaction was limited and not statistically significant, suggesting that additional factors not included in the model may affect this construct. These results highlighted the model's strength in predicting LMS appropriation and perceived learning success but its weaker predictive power for learning satisfaction.

Table 19 - f-square

f-square - Mean, STDEV, T values, p values

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
CSE -> FLMSA	0.097	0.118	0.072	1.360	0.174
FLMSA -> LPS	0.082	0.117	0.105	0.783	0.434
FLMSA -> PLS	0.013	0.027	0.037	0.343	0.731
ITS -> FLMSA	0.089	0.095	0.062	1.437	0.151
Int -> FLMSA	0.000	0.010	0.019	0.018	0.986
LPS -> PLS	0.392	0.464	0.222	1.769	0.077
SESRSL -> FLMSA	0.045	0.052	0.040	1.112	0.266
TTF -> FLMSA	0.000	0.012	0.021	0.007	0.995

The effect sizes of the predictors on the endogenous latent variables were revealed by the f-square analysis, which is shown in Table 18. With a p-value of 0.174 and a t-value of 1.360, the association between **Computer Self-Efficacy (CSE)** and **Faithful LMS Appropriation (FLMSA)** was not statistically significant, although having a small effect size (f2 = 0.097). With a p-value of 0.434 and a t-value of 0.783, the association between **Faithful LMS**

Appropriation (FLMSA) and Learning Process Satisfaction (LPS) was also not statistically significant, and the effect size was likewise tiny ($f^2 = 0.082$).

The impact of **FLMSA** on **Perceived Learning Success (PLS)** had a very small effect size ($f^2 = 0.013$), which was also not statistically significant, as indicated by a p-value of 0.731 and a t-value of 0.343. Similarly, **IT Support (ITS)** had a small effect size ($f^2 = 0.089$) on FLMSA, but this effect was not statistically significant, with a p-value of 0.151 and a t-value of 1.437. The relationship between Interactivity (Int) and FLMSA had no meaningful effect size ($f^2 = 0.000$), and this relationship was not significant, with a p-value of 0.986.

In contrast, the effect of **Learning Process Satisfaction (LPS)** on **Perceived Learning Success (PLS)** demonstrated a large effect size ($f^2 = 0.392$), but it approached statistical significance without reaching it, with a p-value of 0.077 and a t-value of 1.769. This suggested that LPS had a substantial effect on PLS, but the sample might not have provided enough statistical power to confirm the significance of the relationship.

With a p-value of 0.266 and a t-value of 1.112, the association between **FLMSA** and **Self-Efficacy for Self-Regulated Learning (SESRL)** was not statistically significant, while having a small effect size ($f^2 = 0.045$). Finally, FLMSA was unaffected by Technology Task-Fit (TTF) ($f^2 = 0.000$), and the p-value of 0.995 suggested that this association was not significant.

In summary, the f-square analysis revealed that while **Learning Process Satisfaction (LPS)** had a notable impact on **Perceived Learning Success (PLS)**, this relationship was marginally insignificant. Most other relationships, including those involving CSE, ITS, and SESRL on FLMSA, showed small effect sizes and were not statistically significant. This analysis highlighted that while some relationships had observable effects, none were strong enough to be deemed statistically significant in the current model.

Table 20 - Standardized Root Square Residual

SRMR				
	Original sample (O)	Sample mean (M)	95%	99%
Saturated model	0.082	0.071	0.105	0.151
Estimated model	0.215	0.089	0.122	0.145

The Standardized Root Mean Square Residual (SRMR) is a model fit indicator used in PLS-SEM to assess how well the model fits the data. Table 19, the analysis of the SRMR provided insights into the model fit. For the saturated model, the SRMR value was 0.082, which was at the commonly accepted threshold of 0.08 for good model fit. This suggested that the saturated model's fit to the observed data was marginally acceptable. However, the confidence intervals for this model ranged from 0.105 (95%) to 0.151 (99%), indicating some variability and uncertainty in this measure, suggesting that the fit might fluctuate slightly depending on the sample.

In contrast, the estimated model had an SRMR value of 0.215, which was significantly higher than the 0.08 threshold. This indicated a poor fit between the estimated model and the data, with notable discrepancies between the predicted and observed correlations. The confidence intervals for the estimated model ranged from 0.122 (95%) to 0.145 (99%), further reinforcing that the model fit was poor.

In summary, while the saturated model showed an acceptable, though borderline, fit to the data, the estimated model exhibited poor fit with SRMR values far exceeding the threshold. This suggested that the relationships between the constructs in the model may require further refinement to improve alignment with the observed data.

Table 21 - Unweighted Least Squares Discrepancy

d_ULS				
	Original sample (O)	**Sample mean (M)**	**95%**	**99%**
Saturated model	5.020	4.006	8.171	16.982
Estimated model	34.164	6.123	11.075	15.490

The d_ULS (Unweighted Least Squares Discrepancy) is another fit measure used in PLS-SEM to assess how well the model fits the data. Table 20, the analysis of the d_ULS (Unweighted Least Squares Discrepancy) provided further insights into the model fit. The saturated model exhibited a d_ULS value of 5.020, indicating an acceptable fit to the data. The sample mean of 4.006 supported the notion that the saturated model fit the data reasonably well. The confidence intervals, which ranged from 8.171 (95%) to 16.982 (99%), suggested that while the model demonstrated acceptable fit, there was some variability in fit across different samples.

In contrast, the estimated model showed a much higher d_ULS value of 34.164, reflecting poor model fit. This indicated significant discrepancies between the predicted and observed data. The sample mean for the estimated model was 6.123, further indicating poor fit, and the confidence intervals, ranging from 11.075 (95%) to 15.490 (99%), confirmed that the estimated model's fit was inadequate.

In summary, the saturated model demonstrated an acceptable level of fit, while the estimated model exhibited a poor fit, as evidenced by its high d_ULS value. This suggested that the estimated model's relationships required further refinement to better align with the observed data.

Table 22 - Geodesic Discrepancy

d_G				
	Original sample (O)	**Sample mean (M)**	**95%**	**99%**
Saturated model	4.203	5.067	7.797	9.752
Estimated model	4.489	5.102	7.861	9.754

The analysis of the d_G (Geodesic Discrepancy), Table 21, provided further insights into the model fit. The saturated model exhibited a d_G value of 4.203, indicating an acceptable level of fit with the observed data. The sample mean of 5.067 supported this conclusion, showing that the model aligned reasonably well with the data. The confidence intervals for the saturated model ranged from 7.797 (95%) to 9.752 (99%), reflecting some variability in the fit across different samples.

The estimated model had a d_G value of 4.489, which was slightly higher than the saturated model but still indicated a reasonable fit. The sample mean for the estimated model was 5.102, similar to that of the saturated model, suggesting minimal deviation between the two models. The confidence intervals for the estimated model ranged from 7.861 (95%) to 9.754 (99%), showing similar variability as the saturated model.

In summary, both the saturated and estimated models demonstrated acceptable fit based on their d_G values, with the saturated model having a slightly lower discrepancy. The small difference between the two models indicated that they performed similarly in terms of fit, and both showed reasonable alignment with the observed data.

5.7.3 Hypothesis Results

Table 23 - Hypothesis Results

Hypothesis	Path Coefficient (β)	T-value	P-value	Bias-Corrected Intervals (95%)	Result
H1 ITS -> FLMSA	β = 0.367	3.243	0.001	0.140 to 0.580	**Supported**
H2 Int -> FLMSA	β = -0.024	0.194	0.846	-0.249 to 0.247	**Not Supported**
H3 TTF -> FLMSA	β = 0.014	0.116	0.908	-0.217 to 0.248	**Not Supported**
H4 FLMSA -> LPS	β = 0.276	1.931	0.054	-0.072 to 0.501	**Not Supported**
H5 FLMSA -> PLS	β = -0.099	1.037	0.300	-0.303 to 0.072	**Not Supported**
H6 LPS -> PLS	β = 0.551	6.233	0.000	0.333 to 0.692	**Strongly Supported**
H7 CSE **->** FLMSA	β = **-0.315**	2.603	0.009	-0.504 to -0.046	**Not Supported** (Negative effect)

H8 SESRL -> FLMSA	β = 0.246	2.317	0.021	0.031 to 0.440	**Supported**

The analysis of the hypotheses, as presented in Table 22, revealed several key findings:

- **H1**: IT Support (ITS) → Faithful LMS Appropriation (FLMSA) Result: Supported (β = 0.367, p = 0.001) This confirms that institutional IT support positively influenced students' faithful use of LMS platforms. It aligns with the literature emphasizing the critical role of infrastructure, responsiveness, and troubleshooting services in promoting platform engagement during crisis learning (Al-Fraihat et al., 2020).
- **H2**: Interactivity (Int) → FLMSA Result: Not Supported (β = -0.024, p = 0.846) Contrary to expectations, perceived interactivity did not significantly predict LMS appropriation. This could suggest that students were more focused on accessing core content and assessments than engaging in interactive or collaborative features, especially under remote learning stress.
- **H3**: Task-Technology Fit (TTF) → FLMSA Result: Not Supported (β = 0.014, p = 0.908) Despite being emphasized in the literature, TTF was not a significant driver in this context. This may reflect students' pragmatic use of LMSs as required tools rather than their perception of platform-task alignment, or a lack of awareness of how tools were meant to be used.
- **H4**: FLMSA → Learning Process Success (LPS) Result: Not Supported (marginal) (β = 0.276, p = 0.054) Although approaching significance, this relationship was not statistically supported at the 0.05 threshold. This suggests that faithful LMS use alone may not directly influence how students experience the learning process—perhaps due to external stressors or weak pedagogical design.
- **H5**: FLMSA → Perceived Learning Success (PLS) Result: Not Supported (β = -0.099, p = 0.300) Surprisingly, appropriation fidelity did not positively predict perceived learning outcomes. The small negative coefficient may indicate that strict adherence

to LMS features without pedagogical adaptation may not meet student expectations or learning needs.

- **H6**: LPS → PLS Result: Strongly Supported (β = 0.551, p = 0.000) This was the strongest supported pathway, affirming that students' sense of progress and engagement in the learning process significantly predicted their overall perception of learning success. It emphasizes that learner experience and motivation are critical to digital education outcomes.
- **H7**: Computer Self-Efficacy (CSE) → FLMSA Result: Not Supported – Negative Effect (β = -0.315, p = 0.009) This unexpected negative relationship suggests that students with higher confidence in their technical abilities may have engaged with LMSs in ways that diverged from instructional intent—possibly using shortcuts, external tools, or resisting platform constraints. This finding challenges assumptions from TAM that higher self-efficacy always predicts positive usage.
- **H8**: Self-Efficacy for Self-Regulated Learning (SESRL) → FLMSA Result: Supported (β = 0.246, p = 0.021) This confirms that students with strong SRL skills were more likely to use LMSs as intended. It aligns with Zimmerman (2002), who emphasizes that self-monitoring and goal setting are essential in digital and independent learning contexts.

5.8 Synthesis of Key Findings

At a glance, the results show a clear pattern across antecedents and outcomes. Regarding **antecedents of faithful LMS appropriation (FLMSA)**, three variables were most informative: **IT Support** was positively associated with FLMSA; **Self-Efficacy for Self-Regulated Learning (SESRL)** was also positively associated; and **Computer Self-Efficacy (CSE)** showed a **negative** association with FLMSA. In contrast, **Interactivity** and **Task–Technology Fit (TTF)** did **not** exhibit significant associations with FLMSA in this context. For **downstream outcomes**, **Learning Process Satisfaction (LPS)** was a strong, positive

predictor of **Perceived Learning Success (PLS)**, whereas FLMSA did not show a significant direct association with PLS and was only marginally related to LPS.

Model diagnostics indicated acceptable reliability and validity of the constructs and low collinearity; explained variance was moderate for PLS and FLMSA and lower for LPS, suggesting additional influences outside the current model. Descriptive usage statistics confirmed widespread and frequent LMS access during the pandemic period; however, the **interpretive meaning of usage frequency** (engagement vs. necessity) is not inferred here and will be considered in the next chapter. Overall, the findings identify **institutional scaffolding (IT support)** and **learner self-regulation** as salient correlates of appropriation, and **process quality (LPS)** as the proximal correlate of perceived success. The **critical interpretation** of why certain paths were significant (or not) and what this implies for Gen Z learning and LMS design is developed **in Chapter 6**.

5.9 Summary of the Chapter

This chapter presented the analytical workflow and results in a structured sequence. After screening and preparing the data, the respondent profile was outlined and descriptive statistics for the study constructs were reported. The **measurement model** demonstrated satisfactory indicator performance, internal consistency, convergent validity, and discriminant validity, with no problematic collinearity. The **structural model** results from PLS-SEM then addressed the study hypotheses: IT Support and SESRL were positively associated with FLMSA, CSE was negatively associated with FLMSA, and neither Interactivity nor TTF showed significant associations with FLMSA. On the outcome side, LPS was strongly and positively associated with PLS, while FLMSA did not directly predict PLS and was only marginally related to LPS. Model performance indices were mixed, with moderate explained variance for key outcomes and scope for refinement.
In keeping with the chapter's reporting focus, interpretation was kept deliberately limited. The **next chapter (Chapter 6: Discussion and Interpretation)** interrogates these patterns

in depth—examining plausible mechanisms, contextual factors specific to pandemic-era learning, and implications for theory (extended FAM) and practice (LMS design, institutional support).

CHAPTER 6: DISCUSSION AND INTERPRETATION

6.1 Introduction

This chapter moves from reporting results to explaining them. Building directly on the PLS-SEM findings presented in Chapter 5, it interprets how **IT Support (ITS), Interactivity (Int), Task–Technology Fit (TTF), Computer Self-Efficacy (CSE)** and **Self-Efficacy for Self-Regulated Learning (SESRL)** relate to **Faithful LMS Appropriation (FLMSA)**, and how **Learning Process Satisfaction (LPS)** relates to **Perceived Learning Success (PLS)**. The goal is to make sense of the observed associations under emergency remote teaching and to show what they mean for Gen Z learners' everyday study practices on the LMS.

Two signposts guide the analysis. First, all interpretations are **associational** and consistent with a **cross-sectional PLS-SEM** design; they do not claim causality. Second, "use" is treated as **faithful appropriation**—enacting the LMS as intended—rather than mere access frequency. The chapter proceeds by (i) clarifying what high LMS access does and does not imply, (ii) explaining the mechanisms behind the significant and non-significant paths in the extended FAM, and (iii) drawing implications for design, support, and pedagogy. A succinct conclusion closes the argument, followed by a summary of the chapter.

6.2 Interpreting LMS Usage Frequency

While the data shows that over 90% of students reported daily LMS use, this finding requires careful interpretation. High-frequency use alone should not be conflated with meaningful engagement or effective learning. In the context of pandemic-era remote learning, LMS platforms served as the sole gateway to lectures, assignments, announcements, and assessments. Therefore, frequent access may have been driven more by institutional necessity than by student motivation or deep pedagogical interaction.

This distinction is critical: students may have logged in frequently to meet minimum course requirements without fully engaging with the platform's learning affordances. For example, discussion forums, quizzes, and multimedia features may have been underutilized even if login metrics were high. Without triangulating usage data with qualitative insights—such as student reflections, instructor observations, or analytics on feature-level interactions—claims about the success of LMS use risk being overstated.

Moreover, this pattern underscores a broader concern identified in the study: **faithful appropriation** is not guaranteed by access or frequency alone. True engagement requires alignment between platform features, pedagogical intent, and student learning behaviours. The results highlight the need for **future research that adopts a mixed-methods approach**, incorporating log data, student interviews, and instructor perspectives to better assess the quality—not just the quantity—of LMS interaction.

In sum, while the data confirms the LMS was central to students' academic routines, its educational impact must be evaluated through a more nuanced and multidimensional lens.

6.3 Demographics Insights and Contextual Interpretation

The sample's demographic profile provides a critical backdrop for interpreting the main results, especially in relation to Generation Z's digital habits and educational engagement.

Age: The sample's mean age of 21.32 (SD = 1.241) falls squarely within the Gen Z cohort, confirming the study's focus on this generation. The low standard deviation suggests that respondents were relatively homogeneous in age, reflecting a specific life stage: early adulthood. At this stage, learners are navigating new levels of autonomy, academic expectations, and digital environments—making their self-regulated learning (SRL) capacity particularly relevant. This reinforces the finding that SRL significantly influenced LMS appropriation (H8), aligning with literature that highlights SRL as a key trait of Gen Z learners (Zimmerman, 2002).

Gender: The distribution was notably skewed, with over 60 of the 89 respondents identifying as female. While not the primary focus of this study, this imbalance may have subtly shaped the results. Some research suggests female students report higher levels of SRL and help-seeking behavior in online environments (Broadbent & Poon, 2015), which could partially explain the strong influence of SRL and IT support observed here (H1 and H8). However, the current sample is not large enough for rigorous gender-based subgroup analysis.

Year of Study: Most respondents were in their **third** (n = 49) or **fourth** year (n = 27), with a small number in their fifth year (n = 5). This is a critical insight, as it suggests that many students had **multiple years of LMS exposure**, potentially contributing to more stable usage patterns and stronger expectations about platform performance. These students may have developed independent learning strategies, again reinforcing the importance of SRL. However, the lack of significant effects from **CSE** and **TTF** (H3, H7) may reflect a plateau in digital engagement or a lack of innovation in LMS delivery over time.

6.4 Factors of the Extended FAM Model

6.4.1 IT Support

The study's findings revealed that **IT Support (ITS)** played a crucial role in promoting Faithful LMS Appropriation (FLMSA), significantly enhancing students' effective use of Learning Management Systems (LMS) **(β = 0.367, T-value = 3.243, p = 0.001)**. In PLS-SEM, **path coefficients (β)** generally need to be **≥ 0.2** to reflect a meaningful relationship, while a **p-value** below **0.05** is usually regarded as statistically significant. A **t-value** above **1.96** also indicates significance at the 5**% level (p < 0.05)**, further validating the importance of ITS in supporting students' LMS use.

This finding was especially pertinent during the COVID-19 pandemic, which prompted a swift transition to remote learning. It was in line with the larger body of research emphasising how important IT support is to making digital learning platforms easier to use (Janson and

Leimeister, 2017). IT support in this context involved not only providing technical assistance but also ensuring that communication and collaboration within the LMS were seamless, as students navigated new digital learning environments under unprecedented conditions.

The digital competence of **Generation Z (Gen Z)**, who made up a substantial portion of current undergraduates, further contextualized this finding. As digital natives, Gen Z students were accustomed to integrating technology into every facet of their daily lives (Cilliers, 2017). While they were generally adept at navigating digital tools, the sudden reliance on online education during the pandemic revealed gaps in their ability to effectively use more specialized learning platforms like LMS. According to Rothman (2016), Gen Z preferred engaging, interactive approaches over traditional auditory learning methods such as lectures. Therefore, technical support that helped students fully leverage the interactive and collaborative features of LMS, such as video conferencing, discussion forums, and peer collaboration, was essential for sustaining student engagement and enhancing learning outcomes.

The significance of IT support was further supported by research by Al-Maroof et al., (2020) and Bhamani et al. (2020), who observed that students' LMS engagement was significantly hampered by the pandemic's restricted supply of technical resources. With the abrupt shift to remote learning, students were required to navigate unfamiliar digital platforms while managing technical difficulties, leading to frustration and lower levels of LMS appropriation. This was particularly evident in institutions that lacked robust IT infrastructure, where students struggled to access essential resources and tools needed for effective participation in online learning environments. The study's conclusions emphasised how important it is for educational institutions to invest in comprehensive IT support systems that could mitigate these challenges, especially in times of crisis.

Gen Z's reliance on digital tools, as explored by Hernandez-de-Menendez et al. (2020), further highlighted the need for a strong IT support framework in education. While Gen Z students were highly skilled in using social media and other technologies, their technological proficiency did not necessarily translate into effective use of LMS platforms,

especially in an academic context where the stakes and expectations differed. The availability of technical support that catered specifically to the educational applications of digital tools could bridge this gap, ensuring that students not only accessed but also appropriately engaged with LMS features designed to enhance learning.

Moreover, the findings emphasized the role of IT support in reducing the cognitive load on students by resolving technical issues promptly. The ability to troubleshoot and resolve problems related to LMS usage—such as login difficulties, submission errors, or issues with accessing learning materials—freed students to focus on learning tasks rather than being bogged down by technical barriers. As Bitzer and Söllner (2013) noted, IT support fostered smoother interactions with technology, which in turn facilitated faithful appropriation of the system by reducing distractions and minimizing disruptions to the learning process.

The findings of this study were consistent with other studies indicating that IT support was a critical facilitator of successful digital learning. Plessis (2014) highlighted that technology-enhanced learning required a dynamic and supportive environment that responded to individual students' needs. For Gen Z, who valued interactive and visually stimulating learning experiences, the presence of reliable IT support was crucial in ensuring that they could fully utilize LMS platforms in ways that matched their learning preferences. Institutions that proactively addressed these needs by providing comprehensive IT support were likely to see higher levels of LMS appropriation and enhanced learning performance for their students.

In conclusion, the substantial influence that IT support had on LMS appropriation during the pandemic underscored the importance of technical assistance in facilitating effective student engagement with online learning platforms. For Gen Z students, who were digitally savvy but faced challenges in adapting to specialized educational technologies, IT support was essential in ensuring that LMS tools were used as intended. Educational institutions needed to prioritize IT infrastructure and support services to foster smoother, more meaningful interactions with LMS platforms, particularly in remote learning environments. This approach not only enhanced faithful LMS appropriation but also improved overall

learning satisfaction and success, especially as the reliance on digital education continued to grow.

6.4.2 Interactivity

According to the study's analysis of the Interactivity (Int) factor, there was no significant impact Int had on Faithful LMS Appropriation (FLMSA) ($\beta = -0.024$, T-value = 0.194, $p = 0.846$). The path coefficient (β) was much lower than ≥ 0.2 threshold typically required to indicate a meaningful relationship, while the T-value of 0.194 fell well under the 1.96 benchmark, and the p-value of 0.846 exceeded the 0.05 level for statistical significance. When taken as a whole, these metrics show that in this case, interactivity had no discernible or statistically significant effect on FLMSA.

This was somewhat surprising given the theoretical foundation of the Faithful Appropriation Model (FAM), where interactivity was identified as a critical factor influencing students' engagement with Learning Management Systems (LMS) (Janson & Leimeister, 2017). In this study, interactivity was defined as the interaction of students, teachers, and the learning management system (LMS) through features like peer reviews, discussion boards, and other interactive technologies (Annamalai et al., 2021). Despite the well-established importance of interactivity in educational environments, the results of this study showed that it had no bearing on how students used LMS platforms during the pandemic.

There are a number of reasons why this study did not find a significant link. One possible explanation lies in the unique characteristics of Generation Z (Gen Z) students, who comprised a significant portion of the study's participants. Cilliers (2017) and Rothman (2016) noted that Gen Z students, born after 1995, are digital natives accustomed to fast decision-making, high connectivity, and complex visual imagery. These students typically favour technology-driven, interactive, and visual learning environments over more conventional aural approaches like lectures and discussions. However, the abrupt switch

to online learning during the COVID-19 pandemic probably changed their priorities, even if they still preferred interactive learning options. Instead of focusing on interaction, students may have been more concerned with accessing course materials and completing tasks due to the challenges imposed by remote learning.

Additionally, Rothman (2016) suggested that Gen Z students are adept at managing digital platforms but may experience a sense of disconnection in purely online environments, especially when deprived in-person interactions. The reduced options for socialization and spontaneous discussions in physical classrooms may have lessened the perceived importance of interactive LMS features, such as group discussions and peer evaluations, during the pandemic. El-Dakhs et al. (2022b) reinforced this view by claiming that the move from in-person to online interactions could lead to feelings of isolation, reducing the effectiveness of interactive features within LMS platforms.

Moreover, although the LMS may offer various interactive features, such as forums or peer evaluations, the effectiveness of these features can depend heavily on how the learning process incorporates them. Carroll et al. (2002) and (Rogoff (2008) suggest that the appropriation of technology is not just about the features provided but also about how users interpret, explore, and ultimately adopt or reject these features. In this study, it is possible that students did not fully engage with or appreciate the interactive elements of the LMS, perhaps due to limited training or a lack of perceived value in comparison to face-to-face interactions. Instead, students may have prioritized completing tasks, meeting deadlines, and navigating the technical aspects of the platform during remote learning, rather than focusing on communication and collaboration.

The literature also highlighted that during the pandemic, students faced technical challenges, and their focus shifted to basic functionality rather than interactive engagement. Bhamani et al. (2020) observed that student's capacity to properly utilise online learning tools was hampered by the pandemic's restricted access to IT resources. Similarly, Kuswoyo et al. (2022b), suggested that unfamiliarity with new digital tools might have presented additional barriers, further reducing the emphasis on interactive features.

Thus, while interactivity remains theoretically important, it may have been overshadowed by more immediate technical challenges in this particular context.

The literature also emphasizes the role of persistent attitudes toward appropriation, which involve users' comfort, perceived value, and willingness to engage with the technology DeSanctis et al. (1993). If students were not comfortable or did not perceive interactive features as valuable to their learning, this could explain why the interactive elements of the LMS did not significantly affect their appropriation of the system. Additionally, Nguyen et al. (2021b) found that factors such as IT support and self-efficacy had a more substantial impact on faithful system appropriation than interactivity. This study echoed those findings, indicating that students' comfort and ability to navigate LMS functionalities likely took precedence over the need for interactive engagement during a time of significant educational disruption.

Furthermore, the complexity of interactivity as a construct may have contributed to the non-significant result. Interactivity in LMS encompasses both social interaction (e.g., between students and instructors) and interaction with the technology itself. In this study, students may have used interactive features more for task completion (instrumental uses) rather than for meaningful engagement, as suggested by DeSanctis et al. (1993), which could have diluted the perceived impact of interactivity on LMS appropriation.

In conclusion, the study’s findings demonstrated that, despite the literature's indication that interactivity is crucial to the faithful appropriation of LMS, it had no discernible impact on students' effective utilisation of the system during the epidemic. The unique circumstances of remote learning, coupled with the characteristics of Generation Z learners, likely shifted students' priorities toward accessing basic LMS functionalities and completing tasks, rather than engaging with interactive features. The better integration of interactive elements into online learning environments and the ways in which educational institutions can promote more use of these features in both regular and crisis-driven learning situations should be the focus of future research.

6.4.3 Technology-Task Fit

The analysis revealed that Technology-Task Fit (TTF) did not significantly influence Faithful LMS Appropriation (FLMSA) ($\beta = 0.014$, T-value = 0.116, $p = 0.908$). The path coefficient (β) was well below the 0.2 threshold typically necessary to indicate a meaningful relationship, with a T-value of 0.116 falling far short of the 1.96 benchmark, and a p-value of 0.908 well above the 0.05 significance level. These results suggest that the alignment between the LMS features, and the tasks required by students did not play a substantial role in determining how effectively they appropriated the system.

This result is somewhat surprising given that prior research, particularly Janson and Leimeister (2017), identified technology-task fit as a critical factor in promoting faithful appropriation of learning management systems (LMS) in higher education contexts. TTF refers to how well the LMS aligns with the specific tasks and skills required for a course or program, including its functionality, ease of use, and the ability for students to complete course-related activities (Jeyaraj, 2022).

The absence of a strong connection between TTF and FLMSA in this study could be attributed to various contextual factors, especially the effects of the COVID-19 pandemic on remote learning. The epidemic forced a rapid transition to online learning, necessitating quick LMS platform adaptation on the part of both teachers and students. Limited resources and a lack of familiarity with digital tools likely posed challenges for students in effectively utilizing LMS features (Bhamani et al. 2020). In such circumstances, students may have prioritized simply accessing course materials and meeting basic requirements rather than critically evaluating how well the LMS aligned with specific course tasks. This shift in focus could explain why TTF did not emerge as a significant factor in this study.

Moreover, Generation Z (Gen Z) students, who make up a substantial percentage of the undergraduate population, may have unique expectations and preferences regarding technology use in learning environments. Research by Cilliers (2017)and Rothman (2016)suggested that Gen Z students are digital natives with a preference for interactive, visually engaging learning methods. They are less reliant on traditional auditory approaches and more inclined towards collaborative projects, advanced organizers, and challenges. While these preferences align with task-technology fit, the sudden transition to remote learning may have disrupted Gen Z students' ability to fully engage with LMS features designed to support these preferences.

The study's findings also suggest that the pandemic's remote learning environment may have diminished the perceived importance of TTF. Students were likely more concerned with overcoming immediate challenges, such as navigating unfamiliar platforms and dealing with technical issues, than assessing the degree to which LMS features aligned with specific academic tasks. This was consistent with the findings of Kuswoyo et al. (2022b), who reported that students struggled with new digital tools, which may have overshadowed their focus on the alignment between the LMS and course requirements.

Furthermore, the absence of a meaningful relationship between technology-task fit and LMS appropriation in this study may also suggest that the features provided by the LMS, such as assignment submission, quizzes, and video conferencing, were viewed as baseline functionalities rather than distinctive features that enhance the task completion process. DeSanctis et al. (1993) and Carroll et al. (2002) discussed how users actively select and appropriate technology structures based on their perceived usefulness, comfort, and alignment with goals. If the LMS features were seen as minimally meeting course requirements, students may not have considered them critical in determining their overall engagement and appropriation of the system.

In addition, research by Nguyen et al. (2021b) highlighted that factors like IT support and self-efficacy had a more significant influence on LMS appropriation during remote learning than technology-task fit. This finding is consistent with the current study, where TTF did not

emerge as a significant predictor of FLMSA. Instead, IT support and self-efficacy had a greater impact, suggesting that during the pandemic, students were more concerned with receiving technical help and building confidence in navigating the LMS, rather than assessing how well the system's features aligned with academic tasks.

The pandemic may have prompted a shift in priorities, with students focusing more on the logistical and technical challenges of remote learning. Chen et al. (2022) similarly found that self-efficacy and IT support became more crucial as students dealt with the demands of remote learning. These findings suggest that students were more focused on accessing materials, resolving technical problems, and maintaining basic engagement, rather than critically evaluating the LMS's alignment with academic tasks. This shift could explain why technology-task fit, typically considered important for LMS use, played a less significant role during the pandemic.

Moreover, Bostrom et al. (2014) emphasize the importance of the "spirit" of appropriation, which refers to users' alignment with the intended goals and design of a system. The lack of significant results for technology-task fit may indicate that students' attitudes toward the LMS were more instrumental and pragmatic, focusing on immediate needs rather than the ideal alignment between the system and their tasks. This points to the possibility that students did not faithfully appropriate the LMS according to its intended design during the pandemic but rather used it as a means of getting through their courses under challenging circumstances.

In conclusion, while technology-task fit is traditionally considered an important factor in determining how users engage with information systems, the context of the pandemic likely shifted students' focus toward more immediate technical and accessibility concerns, thus diminishing the perceived importance of task alignment. This finding suggests that during times of crisis or rapid technological adoption, other factors such as IT support and basic functionality may take precedence over more nuanced considerations of how well the technology fits the tasks at hand. Future research should further explore how contextual factors, such as a global pandemic, impact the relative importance of different elements of

system appropriation, particularly when students are navigating unfamiliar learning environments.

6.4.4 Faithful LMS Appropriation

The analysis revealed that Faithful LMS Appropriation (FLMSA) did not significantly influence Learning Process Satisfaction (LPS) (β = 0.276, T-value = 1.931, p = 0.054) or Perceived Learning Success (PLS) (β = -0.099, T-value = 1.037, p = 0.300). The path coefficient for FLMSA's impact on LPS was below the 0.2 threshold, and while its T-value of 1.931 was close, it did not meet the 1.96 benchmark for statistical significance, with a p-value slightly above 0.05. For the relationship with PLS, the path coefficient (β = -0.099) and T-value (1.037) were notably below acceptable thresholds, and the p-value of 0.300 further indicated insignificance. These findings suggest that students' alignment with the intended use of LMS features did not substantially impact their satisfaction with the learning process or their perceived learning success.

This result stands in contrast to earlier research by Janson and Leimeister (2017), who found that faithful appropriation of an LMS was a significant predictor of both learning process satisfaction and learning success. Faithful appropriation, as defined by DeSanctis et al. (1993; DeSanctis and Poole (1994), refers to how well users adopt and adapt technology according to its original design and intended purposes. When users faithfully appropriate technology, they align their behaviour and interaction with the system's "spirit," meaning that they use its features and functionalities in a way that is consistent with the designers' intentions (Bostrom et al., 2014; Chin, Gopal, Salisbury, et al., 1997). According to Carraher-Wolverton and Burleson (2021), this alignment is crucial for optimizing the benefits of an information system, as users who appropriate technology faithfully are more likely to experience the system's full potential.

One possible explanation for the non-significant findings in this study is the unique circumstances of the COVID-19 pandemic, which may have disrupted students' ability to fully engage with LMS features as intended. Su and Guo (2021) highlighted that the pandemic imposed significant barriers on students' capacity to use digital tools effectively, potentially leading to unfaithful appropriation or minimal engagement with certain LMS functionalities. The sudden transition to online learning forced students to focus on immediate task completion and accessibility rather than faithfully adhering to the LMS's intended instructional strategies. This deviation from the original design goals of the LMS could have weakened the impact of faithful appropriation on both learning satisfaction and success.

Additionally, the findings may reflect the unique characteristics of Generation Z (Gen Z) students, who comprised the majority of the undergraduate cohort in this study. Gen Z students are digital natives who are accustomed to navigating complex digital environments but often exhibit a preference for interactive, visually engaging, and collaborative learning approaches over traditional, structured learning environments (Cilliers, 2017; Rothman, 2016). Rothman (2016) explained that Gen Z's brain development has been influenced by a technology-rich environment, making them more attuned to visual stimuli and less engaged with auditory or lecture-based learning methods. Consequently, these students may have appropriated LMS features in ways that did not align with the platform's original instructional design, opting for external resources or other methods that matched their preferences for interactive learning. This divergence from faithful appropriation may have contributed to the non-significant findings regarding learning satisfaction and success.

Furthermore, Cilliers (2017) and Hernandez-de-Menendez et al. (2020) noted that Gen Z students tend to make quick decisions, which could explain why they may have bypassed certain LMS features that were not perceived as immediately useful or engaging. This finding is consistent with research by Salovaara and Tamminen (2009), who highlighted that users actively select and adopt technology structures based on perceived value. In this case, Gen Z students may have been selective in their use of LMS features, choosing only those that

directly contributed to task completion rather than faithfully appropriating the full range of instructional tools offered by the system.

Moreover, Janson and Leimeister (2017) emphasized the importance of IT support, interactivity, and task-technology fit for faithful LMS appropriation. However, this study found interactivity and task-technology fit to be non-significant, suggesting students lacked the conditions needed for full LMS engagement. Without proper support and alignment between tasks and technology, students may not have seen the LMS as a tool for enhancing learning, which may explain the minimal impact of Faithful LMS Appropriation (FLMSA) on satisfaction and success.

Nguyen et al. 2021b) highlighted that factor such as perceived system restrictiveness and self-efficacy influence LMS appropriation. In this study, higher Computer Self-Efficacy (CSE) negatively impacted FLMSA, indicating that overconfident students may have bypassed key LMS features, limiting engagement and alignment with learning goals. This aligns with Bostrom et al. (2014), who noted that when students deviate from the LMS's instructional framework, learning experiences can become fragmented, reducing satisfaction and success.

Faithful appropriation is critical for effective technology-mediated learning, as it ensures alignment between student behaviour and instructional strategies, leading to better learning outcomes. However, the pandemic may have disrupted this process, as reflected in the study's non-significant findings.

The overreliance on digital skills, particularly among Gen Z students, may have also contributed to unfaithful LMS use. Rothman (2016)noted that tech-savvy students might bypass LMS features, a behaviour observed in this study, where high self-efficacy led to underutilization of LMS functionalities.

In conclusion, the study challenges previous assumptions about FLMSA's role in learning outcomes, especially during the pandemic. The unique learning preferences of Gen Z, combined with the pandemic's disruptions, may have shifted student focus away from

faithful LMS engagement. Future research should explore how LMS platforms can be adapted to meet these learners' needs while encouraging faithful appropriation for improved learning outcomes.

6.4.5 Learning Process Satisfaction

The findings from the analysis indicated that Learning Process Satisfaction (LPS) significantly and positively influenced Perceived Learning Success (PLS) ($\beta = 0.551$, T-value = 6.233, $p = 0.000$). The path coefficient ($\beta = 0.551$) exceeded the 0.2 threshold, suggesting a strong and meaningful relationship, while the T-value of 6.233 far surpassed the 1.96 benchmark, confirming significance at the 5% level. The p-value of 0.000 further confirmed this strong, statistically significant positive effect, highlighting that higher satisfaction in the learning process positively impacted students' perceived learning success.

These findings highlight how important student evaluations of their learning outcomes are influenced by their level of satisfaction with the educational experience. Students are more likely to view their educational experience as successful when they believe that the process is clear, efficient, and in line with their expectations. This is consistent with the findings of Bostrom et al. (2014) and Janson et al. (2017) who discovered that, in the context of learning management systems (LMS), perceived learning success is significantly influenced by learning process satisfaction.

LPS reflects students' emotional responses to the educational experience, including their engagement with instructional strategies, available resources, and overall participation in the learning process. According to Cilliers (2017), interactive and visually stimulating learning environments are highly valued by Generation Z (Gen Z) students, who comprised the majority of the undergraduate cohort in this study. According to Rothman (2016), Gen Z students Gen Z students prefer interactive games, group projects, and other dynamic learning styles over traditional auditory learning techniques like lectures. In this context, the

positive influence of LPS on PLS could be understood in terms of the alignment between the students' learning preferences and the features of the LMS that facilitated interactive and engaging learning experiences.

The results emphasised how crucial it is to create learning management system environments that accommodate Gen Z's inclination for technology-driven education. Rothman (2016) and (Cilliers, (2017) emphasized that Gen Z students are digital natives who thrive in environments that offer visual stimulation and interactive learning methods. This generation has developed the cognitive ability to handle complex visual stimuli, which may explain why students who experienced a satisfying and visually stimulating learning process through the LMS were more likely to report higher perceived learning success.

Moreover, Plessis (2014) suggested that incorporating interactive technology and social media into teaching and learning could enhance education methods by focusing on individual students' needs. This perspective was reinforced by the study's findings, which showed that LMS systems with features that catered to Gen Z's inclination for interactive and collaborative learning fostered greater satisfaction and, subsequently, more positive perceptions of learning success.

As discussed in the Faithful Appropriation Model (FAM), faithful appropriation of technology, including LMSs, involves users adopting the instructional methods and features of the system in a way that is consistent with its intended goals and spirit (Bostrom et al., 2014; Chin, Gopal, Salisbury, et al., 1997). Students are more likely to have positive learning experiences and be more satisfied when they use the LMS effectively and in accordance with its intended purpose.

According to Carraher-Wolverton and Burleson (2021), the faithful appropriation of an information system, such as an LMS, creates a structured and organized learning process that fosters student satisfaction. This satisfaction arises from the perceived effectiveness of the system in supporting students' learning objectives, helping them feel more in control and engaged in their academic journey. In this study, students who were more satisfied with

their learning process reported higher levels of perceived learning success, indicating that satisfaction is an essential factor in achieving favourable learning outcomes.

The findings also relate to Gupta et al. (2010), who distinguished between different dimensions of learning outcomes, including metacognitive and affective outcomes. Learning process satisfaction, as an affective outcome, relates to students' emotional engagement with the learning process, which in turn influences their perceived learning success. Students who are emotionally satisfied with how they engage with the LMS, and the educational content are more likely to experience positive metacognitive outcomes, such as a greater understanding of the material and improved knowledge retention.

The significance of technology alignment in the learning process is further demonstrated by the positive correlation between perceived learning achievement and learning process satisfaction. According to Bostrom et al. (2009) students are more satisfied with the learning process when they are in line with the instructional strategies and design goals of the learning management system. This alignment ensures that students may take full advantage of the LMS's tools and resources, resulting in a smooth learning process that promotes a feeling of achievement.

However, the results also showed that Faithful LMS Appropriation (FLMSA) did not significantly influence Learning Process Satisfaction (LPS) ($\beta = 0.276$, $p = 0.054$). This was in contrast to earlier study by Janson and Leimeister (2017), where learning satisfaction was found to be significantly predicted by faithful LMS appropriation. This disparity may be explained by the COVID-19 remote learning environment, where students' primary focus shifted toward task completion and accessibility, rather than faithfully appropriating the LMS as intended. Su and Guo (2021) noted that the abrupt switch to online instruction during the pandemic might have interfered with students' capacity to use the LMS to its fullest potential, deviating from true appropriation.

The study also underscored the relevance of designing LMS platforms that are easy to navigate and support individual learning styles, particularly for Gen Z students. As

McLoughlin and Lee (2010) and Mpungose and Khoza (2020) highlighted, user experience and platform design are critical factors in the learning process. Gen Z students, with their quick decision-making and comfort with technology, are more likely to experience learning satisfaction when the LMS supports a seamless, visually engaging, and collaborative learning environment. These design factors were especially important during the pandemic, where students had to rely heavily on technology to facilitate their learning.

Additionally, studies by Jamari et al. (2017) and Khan et al. (2021) demonstrated the value of social support in the learning process by demonstrating how social networking sites and collaborative tools in LMS environments may foster a feeling of community among students. For Gen Z students, who value connection and teamwork, this sense of community is especially important. According to the study, students who were happier with their educational experience were probably more socially engaged, which influenced how successful they thought their studies were.

In conclusion, the findings reinforced the importance of creating a satisfying learning process through well-designed LMS platforms that suit Gen Z students' inclinations for interactive and visually stimulating learning. The significant positive relationship between Learning Process Satisfaction (LPS) and Perceived Learning Success (PLS) emphasized that when students are emotionally and cognitively involved in the learning process, they are more likely to perceive themselves as successful learners. However, the non-significant effect of Faithful LMS Appropriation (FLMSA) on learning satisfaction suggested that the pandemic's remote learning environment may have shifted students' focus away from faithfully using LMS features as intended. Moving forward, educational institutions should prioritize the design and functionality of LMS platforms to foster student engagement, satisfaction, and learning success, particularly in an increasingly digital learning landscape.

6.4.6 Perceived Learning Success

The findings from the analysis indicated that Perceived Learning Success (PLS) was significantly influenced by Learning Process Satisfaction (LPS) (β = 0.551, T-value = 6.233, p = 0.000), emphasizing the strong relationship between students' satisfaction with the learning process and their perception of academic success. The path coefficient (β = 0.551) was well above the 0.2 threshold, indicating a meaningful and substantial relationship. The T-value of 6.233 exceeded the 1.96 benchmark for significance, and the p-value of 0.000 confirmed the result as statistically significant, highlighting the positive impact of learning process satisfaction on perceived learning success.

This finding aligned with previous studies, such as those by Janson and Leimeister (2017), which also demonstrated that satisfied students were more likely to perceive themselves as successful learners. The connection between satisfaction and success was particularly relevant in the context of Learning Management Systems (LMS) during the COVID-19 pandemic when digital learning tools played a central role in the educational experience.

PLS refers to how students subjectively evaluate their academic performance and assess whether they have achieved their learning goals. This evaluation is influenced by multiple factors, including the functionality of the LMS, the quality of instructional design, and the level of support provided throughout the learning process. Bostrom et al. (2014) noted that PLS is closely linked to both emotional and cognitive engagement. When students are both emotionally satisfied and cognitively stimulated, they are more likely to perceive themselves as successful in their educational pursuits. The findings of this study reinforce this concept, indicating that student satisfaction not only boosts emotional engagement but also enhances their perception of learning success.

These results align with Gupta et al. (2010), who highlighted the connection between metacognitive outcomes and PLS. Metacognitive outcomes, such as students' awareness and regulation of their learning processes, significantly impact how they evaluate their academic achievements. When students perceive that the LMS supports their ability to

monitor and regulate their learning, they are more likely to consider their learning experience successful. This implies that institutions should focus on improving tools that enhance metacognitive engagement, such as interactive learning resources and self-assessment features within the LMS.

Furthermore, the positive relationship between LPS and PLS highlights how crucial it is to match technology to kids' learning requirements. According to Bostrom (2009), students are more likely to be happy with the process and confident in their learning results when they see the LMS as a tool that helps them learn. The learning experience can be greatly improved by a seamless integration of LMS elements that support both instructional goals and simple navigation, giving students a sense of competence and achievement.

However, this study found that Faithful LMS Appropriation (FLMSA) did not have a significant effect on PLS ($\beta = -0.099$, $p = 0.300$). This contrasts with the findings of Janson and Leimeister (2017), who suggested that the faithful use of LMS is crucial for both learning satisfaction and success. One possible explanation for this difference is the context of the COVID-19 pandemic, which required students to use LMS in stressful and unprecedented conditions. As Su and Guo (2021) noted, the rapid shift to online learning may have hindered students' ability to fully engage with LMS as intended, diminishing the importance of faithful appropriation in shaping their perception of success. Instead of using all LMS features as designed, students may have focused on task completion, meeting deadlines, and adjusting to a new learning environment, reducing the relevance of FLMSA in this particular setting.

Another potential factor in these findings is the role of self-efficacy, particularly Computer Self-Efficacy (CSE). Students with higher technical confidence may have bypassed LMS instructional strategies, instead navigating the system in ways that suited their immediate needs. This is consistent with Nguyen et al. (2021b), who found that self-efficacy often influences how users' appropriate information systems, affecting their learning outcomes. In this study, students' perceived success may have been more influenced by their ability to adapt to the challenges of remote learning rather than by their faithful use of the LMS.

In summary, Perceived Learning Success (PLS) is strongly influenced by Learning Process Satisfaction (LPS), reinforcing the notion that students' emotional engagement and satisfaction with the learning process are key determinants of their perceived academic success. While FLMSA did not significantly affect perceived success in this study, the findings indicate that satisfaction with the learning process remains a critical driver of success, especially in challenging environments such as those caused by the pandemic. Educational institutions should prioritize creating supportive, satisfying learning environments and ensuring that LMS features align with students' needs, enabling them to feel confident and successful in their academic journey.

The results also underscored the idea that Generation Z (Gen Z) students, who formed the majority of the undergraduate cohort, perceived learning success through their engagement with the learning process. Rothman (2016) described Gen Z students, born after 1995, as digital natives who prefer interactive and visually engaging learning environments over traditional lectures. As Cilliers (2017) highlighted, these students are more likely to thrive in learning environments that incorporate technology and interactive tools, which the LMS provided during the pandemic. This preference for interactive learning experiences, such as games, collaborative projects, and visual organizers, may have contributed to higher PLS when students were satisfied with the learning process.

Research by McLoughlin and Lee (2010) and Mpungose and Khoza (2020) also emphasized the significance of LMS design and usability in influencing students' learning success. Gen Z's comfort with technology meant that an intuitive, easy-to-navigate LMS with interactive tools and multimedia resources facilitated their engagement, thereby contributing to their perceived learning success. Given Gen Z’s familiarity with multitasking and rapid decision-making, a seamless digital learning experience likely enhanced their perception of how effectively they were learning.

6.4.7 Computer Self-Efficacy

In contrast to the hypothesis that stronger computer self-efficacy would have a beneficial effect on LMS appropriation, the analysis showed a significant and negative connection between Computer Self-Efficacy (CSE) and Faithful LMS Appropriation (FLMSA) ($\beta = -0.315$, T-value = 2.603, $p = 0.009$). With the p-value of 0.009 confirming the result as statistically significant and the T-value of 2.603 exceeding the 1.96 criterion for statistical significance, the path coefficient ($\beta = -0.315$) showed a significant negative connection. This result implies that, in contrast to the anticipated beneficial effect, higher levels of computer self-efficacy were linked to lower levels of faithful LMS appropriation.

This unexpected finding suggests that students with higher confidence in their computer skills may not necessarily engage with the LMS in the manner intended by its designers. Instead, they may bypass or underutilize certain features, leading to a lower level of faithful appropriation of the system.

This result contrasts with prior studies, such as Katsarou (2021) and Bressington et al. (2018), which found that students with higher computer self-efficacy tend to engage more deeply with online learning technologies and achieve better learning outcomes. In those studies, higher CSE was associated with more time spent on LMS platforms and a greater likelihood of exploring and utilizing the full range of features available. However, the current findings may indicate that while students feel confident in their ability to navigate technology, this confidence may also lead to a more selective or superficial use of LMS features. Students may feel they do not need to follow the prescribed learning paths or engage with all the functionalities of the system, especially if they believe they can achieve their goals through alternative means.

A possible explanation for the negative relationship between CSE and FLMSA could lie in the unique characteristics of Generation Z (Gen Z) students. As digital natives, members of Gen Z, including the undergraduate population in this study, are accustomed to using a wide range of technologies and navigating digital environments fluidly Cilliers (2017). This

familiarity with technology might lead to overconfidence, where students rely on their pre-existing skills rather than fully engaging with the LMS in the way it was designed. Rothman (2016) suggested that Gen Z students are inclined towards more interactive and visually stimulating learning methods, which may not always align with the structured and task-oriented approach that LMS platforms provide. As a result, these students may skip over important elements of the LMS, believing they can achieve success through their own technological strategies.

Furthermore, research has shown that Gen Z students dislike traditional auditory learning methods and prefer collaborative projects, interactive challenges, and technology-enhanced learning experiences (Cilliers, 2017; Rothman, 2016). This could mean that when faced with LMS environments that are less interactive or engaging than they expect, they may choose to deviate from the intended usage. Instead of following the learning structure provided by the LMS, these students may seek out external resources or rely on their own digital literacy to complete tasks, thereby reducing their faithful appropriation of the system.

The negative relationship between CSE and LMS appropriation can also be linked to the self-efficacy theory, which posits that individuals with higher self-efficacy may approach tasks differently depending on their perceived abilities (Bandura et al., 1999). In this case, students with high computer self-efficacy may feel less obligated to use the LMS as prescribed because they believe they can accomplish the same tasks more efficiently through other means. As noted by Dong et al. (2020), computer self-efficacy reflects a user's confidence in their ability to accomplish tasks using technology. While this confidence typically supports deeper engagement with technology, it may also lead to disengagement from structured systems like LMS if students feel these systems are not critical to their success.

This finding is particularly relevant in the context of the COVID-19 pandemic, which forced students to rapidly adapt to remote learning environments. During this transition, many students may have leaned on their technological skills to navigate the abrupt changes in learning modalities. However, as Su and Guo (2021) noted, the rapid shift to online learning

often led to students bypassing intended instructional strategies in favour of quick solutions to meet deadlines and manage workloads. The high levels of CSE observed in this study's Gen Z cohort could have contributed to this behaviour, as students may have felt empowered to deviate from the LMS's intended use, relying instead on their general technological competence to complete tasks.

In contrast, the literature suggests that higher computer self-efficacy typically leads to greater engagement with online learning environments and more positive outcomes (Bressington et al., 2018; Katsarou, 2021). This study's deviation from that pattern could reflect the specific challenges of using LMS platforms during the pandemic. For example, students with high CSE might have been more likely to seek alternative, faster ways of completing tasks without fully exploring the LMS's interactive and instructional tools. This aligns with findings from (Cilliers, 2017), who pointed out that Gen Z students prefer more dynamic and engaging learning methods. When LMS platforms do not meet these preferences, students may choose to adapt their own methods of learning rather than follow the structured pathways provided.

In conclusion, the negative relationship between CSE and FLMSA in this study highlights a potential challenge for educational institutions aiming to promote effective use of LMS platforms. While high CSE is generally considered beneficial for online learning, it may lead to unfaithful appropriation when students rely on their own technological skills to navigate learning environments in ways that deviate from the intended design. To address this, educational institutions should consider incorporating more interactive, engaging elements into LMS platforms that align with the preferences of Gen Z students. Additionally, instructors may need to emphasize the importance of following the instructional strategies embedded in LMS platforms, even for students who feel confident in their technological abilities.

6.4.8 Self-Efficacy for Self-Regulated Learning

The analysis revealed that Self-Efficacy for Self-Regulated Learning (SESRL) significantly and positively influenced Faithful LMS Appropriation (FLMSA) (β = 0.246, T-value = 2.317, p = 0.021), demonstrating that students who are more confident in their ability to self-regulate their learning are more likely to engage with LMS platforms in a manner that aligns with the intended design and instructional goals. The path coefficient (β = 0.246) exceeded the 0.2 threshold, indicating a meaningful relationship, while the T-value of 2.317 surpassed the 1.96 threshold for significance, and the p-value of 0.021 confirmed the result as statistically significant. This suggests that higher self-efficacy in self-regulated learning positively influences students' faithful use of LMS.

This result is in accordance with earlier studies, such those by Bećirović et al. (2022), which emphasised the critical role that self-regulated learning plays in promoting successful academic achievements, especially in online and distant learning settings. SESRL is the term used to describe a student's confidence in their capacity to autonomously plan, track, and assess their learning. During the COVID-19 pandemic, where traditional classroom interactions were limited, the ability to self-regulate learning became even more critical, as students were required to navigate their educational journeys without the same level of direct guidance and oversight from instructors. Research by Qashou, (2021) and Qashou et al. (2018) has shown that self-efficacy for self-regulated learning is a strong predictor of academic success in remote learning environments, as students with higher SESRL are better equipped to stay focused, manage their time effectively, and assess their progress.

In the context of Generation Z (Gen Z), many of whom were born after 1995 and make up a substantial percentage of undergraduate students (Cilliers, 2017; Hernandez-de-Menendez et al., 2020), SESRL is particularly relevant. Gen Z students are known for their comfort with technology and their ability to adapt quickly to new tools and platforms (Cilliers, 2017). This generation is often described as digital natives, accustomed to managing multiple tasks simultaneously and utilizing technology for independent learning. Rothman (2016) pointed out that Gen Z students have developed the cognitive ability to handle complex visual stimuli

and are less reliant on traditional auditory learning methods. Instead, they prefer interactive, technology-enhanced learning experiences, making self-regulated learning a natural fit for their educational styles.

The positive relationship between SESRL and Faithful LMS Appropriation highlights that students who are confident in their ability to self-regulate are more likely to use LMS platforms in line with their intended purpose. These students are better at navigating LMS features, engaging with course materials, and adhering to the prescribed instructional methods. The ability to self-regulate their learning enables them to take full advantage of LMS tools, such as discussion forums, collaborative projects, and self-assessment features, all of which are designed to support independent learning. This aligns with Plessis (2014), who emphasized the importance of creating learning environments that support individual students' needs, particularly through the integration of interactive and engaging technologies.

Moreover, SESRL fosters students' ability to remain focused on their learning goals, which is critical in a remote or online learning context. Trial et al. (2018) and Zawilinski et al. (2020) found that self-regulated learners tend to be more engaged in online learning environments because they can effectively use advanced organizers, collaborative tools, and interactive platforms to enhance their learning outcomes. These tools, when integrated into LMS platforms, help students track their progress and ensure that their actions align with the course's instructional goals, leading to faithful appropriation of the LMS.

The results also demonstrate how crucial SESRL is to adjust to the difficulties posed by the COVID-19 epidemic. Because they could independently manage their learning activities and stay motivated in the absence of face-to-face instruction, students with strong self-efficacy for self-regulated learning performed better in remote learning settings during the pandemic, according to Qetesh et al. (2020). This was especially important because students needed to swiftly adjust to new digital learning settings, frequently with little help from their teachers. The positive influence of SESRL on LMS appropriation in this study

confirms that students with higher self-regulatory skills were better equipped to engage with the LMS effectively, thereby enhancing their learning experiences.

Gen Z's preference for technology-driven, visual learning experiences (Cilliers, 2017; Rothman, 2016) further supports the significance of SESRL. These students tend to favour interactive, challenge-based learning approaches, which align well with the self-regulatory behaviours that SESRL promotes. By actively engaging with LMS features and managing their own learning processes, students are better able to achieve their academic goals, as highlighted by Jamari et al. (2017) and Khan et al. (2021).The ability to collaborate through virtual breakout rooms or discussion forums, for example, aligns with both Gen Z's learning preferences and the independent learning strategies encouraged by SESRL.

In conclusion, the significant positive relationship between Self-Efficacy for Self-Regulated Learning (SESRL) and Faithful LMS Appropriation (FLMSA) reinforces the critical role of self-regulation in promoting effective engagement with online learning platforms. Students with higher SESRL are more likely to use LMS platforms in a manner that aligns with their instructional design, enhancing their overall learning experience. This is particularly important for Gen Z students, who thrive in technology-enhanced learning environments and prefer self-directed, interactive learning methods. Educational institutions should continue to foster self-regulatory skills by incorporating features into LMS platforms that promote independent learning, such as collaborative tools, self-assessment features, and progress tracking mechanisms. These strategies will help students develop the confidence and skills necessary to faithfully appropriate LMS platforms, leading to improved academic outcomes.

6.5 Critical Interpretation of Findings: Mechanisms, Insights, and Implications

Analytical scope. Interpretations below are grounded in a **cross-sectional, PLS-SEM** analysis of self-report data. They concern **associations** among latent variables rather than causal effects. References to mediation are read as **mediated associations** consistent with the structural model; formal indirect paths should be evaluated with bootstrapped confidence intervals in the Results chapter.

High access ≠ deep engagement. Near-daily logins reflected necessity during lockdown (the LMS as the mandated channel for materials, submissions, and assessments). Access frequency alone therefore overstates "engagement." This reinforces the study's focus on **faithful** use and **process quality**, not raw activity counts.

Self-regulated learning as a proximal correlate of faithful use. Self-efficacy for self-regulated learning (SESRL) appears closely **associated** with faithful LMS appropriation. Students who can plan, monitor, and adjust study activities seem better able to translate LMS affordances (calendars, checklists, quizzes, submission workflows) into **intended** behaviours. Under emergency remote learning, these metacognitive capacities likely reduced the organizational load of studying online and aligned day-to-day actions with course requirements. Practically, institutions should **scaffold SRL** within course sites (micro-planning prompts, progress dashboards, reflective check-ins) rather than assume that "digital natives" self-organize by default.

Learning-process quality as the hinge to perceived success. The pattern of associations indicates that students' perceptions of success relate more to the **quality of the learning process** than to compliance with platform pathways alone. Predictable navigation, coherent workload, timely and transparent feedback, and visible instructor presence appear central. This is **consistent with** a mediated association—SESRL → faithful use → **learning-process satisfaction (LPS)** → perceived learning success (PLS)—in which **process**

quality links platform use to the sense of achievement. Design efforts should prioritize standardized layouts, clear workflow conventions, communication/feedback service levels, and assessments that reward consistent **on-platform** engagement.

Why computer self-efficacy underperformed (and turned counter-intuitive). The negative association between general computer self-efficacy (CSE) and appropriation fidelity is plausibly explained by **overconfidence and off-platform workarounds**. Highly confident students may perceive LMS pathways as slow or restrictive and "multi-home" across external tools. Two measurement considerations may contribute: (i) **general** CSE does not ensure **LMS-specific** competence; and (ii) a Gen-Z sample can show **range restriction** (many already confident), weakening positive linear links. Design responses include making the **pedagogical rationale** for required LMS paths explicit and building **on-path advantages** (e.g., auto-feedback, gradebook integration, analytics-based participation credit). Advanced, still-on-platform workflows (rich annotation, versioning, APIs) can channel high-CSE energy without eroding fidelity.

Why interactivity did not directly relate to appropriation. Interactivity often supports engagement, yet under crisis conditions its **direct** association with following intended LMS paths can be weak. Students prioritized essentials—content, assessments, deadlines—over optional forums; orchestration quality varied across modules; bandwidth constraints discouraged synchronous activity; and "forum fatigue" emerged when prompts felt perfunctory. Interactivity may therefore act **indirectly** by improving **LPS**, rather than dictating adherence to prescribed workflows. Use interactive tools **selectively and purposefully** (graded, well-facilitated prompts) to lift the learning-process experience instead of adding generic "engagement" features.

Why task–technology fit appeared weak. In a rapid pivot, students often adapted tasks to tools rather than evaluating fit. Heterogeneous course practices blurred alignment perceptions, and minimum LMS functionality (content access, basic submissions) was treated as non-negotiable utility. As with interactivity, task–technology fit (TTF) likely operates **indirectly**—by smoothing workflows and thereby improving learning-process

satisfaction (LPS)—rather than **directly** determining appropriation fidelity. Institutions should first secure a **minimum viable fit**—stable access and simple submission/feedback loops—then iteratively build **richer alignment**, such as rubric-based marking, version control, and structured feedback cadences.

What this implies about Gen-Z learning. Digital fluency did not automatically yield faithful use or perceived success. Gen-Z learners value speed and personalization; without clear structure and visible **on-path benefits**, they will route around the LMS. At the same time, they are highly responsive to **process quality**—clarity, coherence, and feedback—confirming that well-designed, scaffolded experiences matter more than feature abundance.

Refining the extended FAM (associational adjustments).

1. **Elevate SESRL** as a proximal antecedent of appropriation under volatile conditions.
2. Treat **IT Support** as enabling infrastructure that conditions other effects in resource-constrained contexts.
3. Model **Interactivity** and **TTF** as **indirect/context-dependent** influences that often act through **LPS**.
4. Recast **CSE** as a **conditional** factor (potentially non-linear or moderating), where very high confidence can erode fidelity unless design incentives keep learners on-path.
5. **Centre LPS** as the key mediator from appropriation to perceived success (SESRL → faithful use → **LPS** → **PLS**).

Implications for practice. Build SRL capacity in the LMS (planning templates, milestone nudges, reflective prompts). Make process quality tangible (standardized course sites, simple navigation, clear assessment calendars, feedback timelines, active instructor presence). Strengthen visible IT support (rapid ticket resolution, bandwidth-sensitive

materials, device/data support). Keep confident users on track with **advanced yet on-platform** workflows. Measure **depth**, not just frequency—feature diversity, sequence adherence, turnaround times—and pair analytics with brief pulse surveys.

Methodological reflection. High daily LMS access during lockdown often reflected **necessity** (the LMS as the sole channel for materials and submissions), not discretionary engagement. The study also relies on **retrospective self-report** from the COVID-19 period; recall can drift. Future work should triangulate surveys with **LMS telemetry** (time-on-task, pathway adherence) and **light qualitative probes** to sharpen inferences about how appropriation relates to process quality and perceived success.

Bottom line. The most important story is not "more features," but **better processes** supported by **self-regulated learning** and **institutional scaffolding**. When the learning process is designed and supported well, students experience success—even if interactivity and perceived fit are uneven. When it is not, even faithful use feels unrewarding, and the most confident students may simply chart their own course.

6.6 Conclusion

The discussion clarifies how Gen-Z students engaged with the LMS under emergency remote teaching and refines the extended FAM accordingly. **SESRL** and **ITS** emerge as the most reliable levers for **faithful appropriation**, while **LPS** is the hinge between platform use and **perceived success**. The counter-intuitive association of **CSE** with lower fidelity is intelligible once overconfidence and off-platform workarounds are recognised. Meanwhile, **Interactivity** and **TTF** mattered **indirectly** through the **quality of the learning process** rather than as direct drivers of fidelity. The conceptual takeaway is a model that centres **self-regulation and process quality**, positions **IT Support** as enabling infrastructure, and treats **CSE** as conditional rather than uniformly beneficial.

6.7 Summary of the Chapter

This chapter interpreted, rather than restated, the statistical results from Chapter 5. It explained why certain relationships likely appeared as they did, what they reveal about Gen-Z learners' LMS practices, and how they **refine the extended FAM**. The analysis underscored that **process quality and self-regulation**—enabled by robust institutional support—are the critical links to perceived learning success, whereas feature counts and raw access frequency are poor proxies for impact. The next chapter translates these insights into **practical implications and recommendations** for institutional policy, LMS design, and pedagogy, and outlines limitations and directions for future research.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Purpose Revisited and Problem Re-engaged

This study set out to understand how Gen Z students at a South African university used the LMS during the COVID-19 pivot, and which factors most meaningfully related to their perceived learning success. Re-engaging the problem: institutions did not only need "more technology," they needed technology use that reliably supports learning processes for digital-native students under pressure. The evidence across Chapters 5–6 converges on a clear message: perceived success hinges less on *what* features exist and more on *how well the learning process is scaffolded and supported* on the LMS. In this cohort, Learning Process Satisfaction (LPS) strongly explained Perceived Learning Success (PLS), while Faithful LMS Appropriation (FLMSA) did not directly do so. Appropriation was, however, shaped by enablers (IT Support, SESRL) and was *reduced* by high Computer Self-Efficacy (CSE). Interactivity and Task–Technology Fit (TTF) were not significant direct drivers of appropriation in this context. These patterns shift the conversation from "feature lists" to "process quality and self-regulation," addressing the core problem of how to support Gen Z students effectively through LMS platforms.

7.2 Research Gaps Addressed and Remaining

7.2.1 Gaps this study addresses

From adoption to appropriation under crisis. Prior LMS work has largely centered on adoption/acceptance. Far fewer studies examined how students adapted **to and used** LMSs under emergency remote teaching. This study fills that gap by modelling **appropriation fidelity** and unpacking the **nuanced ways** students engaged with the LMS during the

pandemic, showing that **frequent access does not equal meaningful, on-path engagement**.

Process quality as the missing mechanism. The literature tends to underplay the role of the **learning process experience**. Our results show that **Learning Process Satisfaction (LPS)**—not mere feature compliance—is the **proximal driver** of **Perceived Learning Success (PLS)**. In practical terms, LMSs must move beyond enabling **task completion** to intentionally supporting **cognitive engagement** and **self-regulation** (clear workflows, predictable feedback, progress visibility).

Faithful use decoupled from success in emergencies. While earlier studies stressed the importance of **faithful LMS appropriation**, in this context **faithful use did not significantly predict learning success**. Under pandemic pressure, students **prioritized adaptability and getting tasks done** over prescribed use of all features. This **contextual deviation** challenges traditional technology-adoption models that assume linear benefits from compliance and **underscores the flexibility required in crisis learning**.

Self-regulation over tech confidence. Research often assumes **computer self-efficacy (CSE)** is uniformly beneficial. We nuance this by finding a **negative association** between CSE and appropriation—consistent with overconfidence and off-platform workarounds—while **Self-Efficacy for Self-Regulated Learning (SESRL)** emerges as a **positive antecedent** of fidelity. Metacognitive capability, not generic tech confidence, is what travels through to better use.

Global South, Gen-Z context. Evidence from a South African HEI broadens a literature dominated by Global North settings. It highlights how **bandwidth, device/data support, and visible institutional IT scaffolding** condition effective LMS use for **Gen-Z learners**, who are digitally fluent yet highly sensitive to process quality, structure, and on-path incentives.

7.2.2 Remaining gaps and an agenda for future work

- **Volition vs. necessity in LMS use.** Disentangle compulsory access (e.g., LMS as the gatekeeper for materials/assessments) from volitional engagement. Future work should develop and validate a brief **Perceived Compulsion to Use (PCU)** scale and link it to FLMSA and LPS. Designs: multi-course samples with variation in "LMS-as-gatekeeper" policies; model PCU as a mediator/moderator of FLMSA–LPS.
- **Process-centric mediation, tested properly.** Formally test indirect pathways—particularly **SESRL → FLMSA → LPS → PLS**—using **longitudinal, multi-institutional** designs with bootstrapped indirect effects and temporal separation between waves (e.g., T1: SESRL; T2: FLMSA; T3: LPS; T4: PLS). Where feasible, use cross-lagged panel or latent growth models to confirm ordering and stability.
- **Non-linear and moderating roles of CSE.** Examine whether CSE exhibits **curvilinear (inverted-U)** effects on FLMSA and whether its impact depends on context (e.g., **CSE × SRL scaffolds**, **CSE × on-path advantages** such as auto-feedback/gradebook integration). Methods: polynomial terms, interaction models, and Johnson–Neyman plots for interpretation.
- **Interactivity and TTF as context-dependent.** Specify *when* Interactivity and Task–Technology Fit matter—e.g., under strong instructor orchestration, assessment alignment, adequate bandwidth/low latency—and *how* they operate (primarily **via LPS** rather than directly on FLMSA). Methods: multi-group analyses by orchestration strength; moderated-mediation models with bandwidth as a moderator.
- **On-platform vs. off-platform "multi-homing."** Map learners' parallel use of external tools (cloud drives, chat apps, collaborative editors) and test whether **on-platform incentives** (auto-feedback, analytics-based participation credit, gradebook sync) reduce leakage and improve fidelity. Pair **telemetry logs** with short diaries to capture cross-tool flows.
- **Telemetry–survey triangulation.** Combine LMS trace data (feature diversity, sequence adherence, feedback turnaround time) with validated surveys (SESRL, FLMSA, LPS, PLS)

to mitigate recall bias. Use **data fusion** approaches (e.g., latent variable models with multiple indicators from logs and questionnaires).

- **Equity and enabling infrastructure.** Model **IT Support** (device/data provision, zero-rating/low-bandwidth design, help-desk SLAs) as a **conditioning variable** and test heterogeneous effects across socio-economic groups, residence (on/off-campus), and bandwidth tiers. Methods: interaction terms, **finite mixture PLS/SEM**, or **multilevel models** when students are nested in courses/faculties.
- **Design experiments on SRL scaffolds.** Conduct randomized or quasi-experimental evaluations of **embedded SRL supports** (planning prompts, progress dashboards, reflective check-ins, analytics-based nudges). Outcomes: FLMSA and LPS (primary), PLS and achievement (secondary). Include fidelity and cost-to-deliver measures for implementation science relevance.
- **Comparative platform and pedagogy studies.** Compare **course sites with different process standards** (navigation conventions, feedback cadences, assessment workflows) across LMSs to separate orchestration quality from platform brand. Use **standardized rubrics** for course-shell quality and test their associations with LPS/PLS.
- **Measurement invariance and subgroup robustness.** Establish **configural/metric/scalar invariance** for core constructs across gender, year of study, discipline, and bandwidth conditions. Where invariance holds, compare path coefficients; where not, refine items or adopt **alignment optimization** to improve generalizability.

Bottom line for the agenda. The next wave of research should move from "who uses the LMS and how often" to **why learners stay on-path, under what conditions, and through which processes**—with designs that separate necessity from volition, pair telemetry with surveys, and test concrete SRL-and process-quality interventions at scale.

7.3 Answers to the Research Questions: What the Results *Mean*

Main RQ: *How did students use LMS in their learning process during the pandemic at a higher learning institution in SA?* Students used the LMS intensively and universally as the *necessary conduit* for courses. Yet high access frequency did not automatically translate into high-quality engagement. Appropriation fidelity varied, and—crucially—did not by itself determine perceptions of success. What mattered most for success was students' satisfaction with the learning process *as enacted on the LMS* (e.g., clarity of workflow, timely feedback, predictable navigation, visible instructor presence). Thus, the LMS functioned as essential infrastructure; the *quality of process* delivered on that infrastructure separated merely "using the LMS" from "feeling successful."

SRQ1: *How did LMS use impact learning success during the pandemic?* **Indirectly and conditionally**. LPS had a strong, significant association with PLS; FLMSA did not. Interpreting together, LMS use led to perceived success *when* the learning process felt coherent, supportive, and well-orchestrated on the platform. Where process quality was weak, even faithful on-path use felt unrewarding.

SRQ2: *What factors hindered learning success while using LMS?* Barriers operated upstream of success by shaping appropriation. **IT Support** facilitated appropriation; **SESRL** (students' confidence to plan/monitor their study) also supported appropriation; unexpectedly, higher **CSE** was associated with ***lower* fidelity**—consistent with overconfidence and off-platform workarounds. **Interactivity** and **TTF** were not significant direct drivers of appropriation here, likely because students prioritized core access, assessments, and deadlines under emergency conditions. Together, these findings point to a practical hierarchy: *support self-regulation and remove friction first; don't assume technical confidence or additional interactive features will, on their own, improve outcomes*.

7.4 Addressing the Research Objective

7.4.1 Primary Objective

To investigate how students utilized and adapted to LMS in their learning process during the COVID-19 pandemic at a higher learning institution in SA.

To investigate how students utilised and adapted to LMS in their learning process during the COVID-19 pandemic at a higher learning institution in South Africa. This objective was achieved. Adoption was near-universal (all 81 respondents used the LMS; 73 used it daily), with **Canvas** as the dominant platform. However, **frequency did not equal faithful appropriation**: FLMSA item means were low (~2.16–2.74/7), indicating that many students engaged pragmatically for access to materials, submissions, and assessments rather than following the intended, feature-rich pathways. In other words, under emergency conditions the LMS functioned as a gatekeeper (necessity) more than a site of volitional, deep engagement. Adaptation was shaped by **enablers and skills** rather than mere exposure: **IT Support** ($\beta = 0.367$, $p = 0.001$) and **Self-Efficacy for Self-Regulated Learning (SESRL)** ($\beta = 0.246$, $p = 0.021$) increased fidelity, while **Computer Self-Efficacy (CSE)** related **negatively** to fidelity ($\beta = -0.315$, $p = 0.009$), consistent with overconfidence and off-platform workarounds. **Interactivity** and **Task–Technology Fit** were **not significant** predictors in this crisis context, underscoring that students prioritised task completion over prescribed interactive features. Consequently, enhancing LMS effectiveness should focus less on "adding more interactivity" and more on **process-centred design and support**: embed SRL scaffolds (planning prompts, progress dashboards, reflective check-ins), ensure visible, bandwidth-sensitive **IT enablement**, and create **on-platform advantages** (auto-feedback, gradebook integration, analytics-based participation credit) that make the intended LMS route the fastest, clearest, and most rewarded path.

7.4.2 Secondary Objectives

1. *To determine the influence of LMS use on students' learning success during the COVID-19 pandemic at a higher learning institution in SA.*

LMS use influenced success **via process quality**. LPS strongly predicted PLS (β = 0.551, p = 0.000; R^2(PLS) ≈ 0.28), while FLMSA did not directly predict PLS (β = −0.099, p = 0.300) and was only marginally related to LPS (β = 0.276, p = 0.054; R^2(LPS) ≈ 0.08). The lever is **well-orchestrated processes**—clear navigation, predictable workflows, timely/transparent feedback, visible instructor presence.

2. *To identify the factors that affect students' learning success using LMS during the COVID-19 pandemic at a higher learning institution in SA.*

The study identified **IT Support**, **Computer Self-Efficacy**, and **Self-Efficacy for Self-Regulated Learning** as critical factors influencing LMS use and learning success. The negative relationship between **Computer Self-Efficacy** and **LMS appropriation** indicates that students who were confident in their computer skills may not have fully engaged with the LMS, which could hinder their learning success. Additionally, the lack of a significant impact of **Interactivity** and **Task-Technology Fit** highlights potential limitations in how well the LMS supported collaborative and task-oriented learning during the pandemic.

7.5 Study Intended Contributions

This study offers actionable guidance for practice, policy, and scholarship. Drawing on evidence from a South African HEI during emergency remote teaching, it prioritises process quality, institutional scaffolding, and self-regulated learning (SRL) over "more features," and reframes how IS research models faithful LMS appropriation.

7.5.1 Practical Implications (University A)

The insights gained from this study are directly applicable to University A's learning and teaching strategies. By understanding how Gen Z students utilized and adapted to LMS during the pandemic, University A can tailor its LMS implementation to better meet students' needs.

- **Process-focused LMS usability (not more "interactive" add-ons).** Because **Interactivity → FLMSA** was non-significant (β = −0.024, p = 0.846) while **LPS → PLS** was strong (β = 0.551, p = 0.000), prioritize **standardized structure or sites, clear navigation, assessment calendars, feedback service levels**, and **low-bandwidth access** to lift the learning process (LPS) rather than adding generic "engagement" tools. Use interactive features **selectively**—only when **assessment-aligned and instructor-orchestrated** to enhance LPS.
- **Embed SRL at the point of use.** Because **SESRL → FLMSA** was positive (β = 0.246, p = 0.021), build **micro-planning prompts, milestone nudges, progress dashboards, reflective check-ins** into course sites. These supports raise appropriation fidelity (FLMSA) and, via process quality, should contribute to perceived success (PLS).
- **Strengthen visible IT enablement.** With **IT Support → FLMSA** significant (β = 0.367, p = 0.001), invest in **help-desk SLAs**, **bandwidth-sensitive materials**, **device/data support** (zero-rating, data bundles, loan schemes), and **clear uptime/outage comms**. This directly improves faithful use.
- **Keep high-CSE students on-path.** Because **CSE → FLMSA** was **negative** (β = −0.315, p = 0.009), counter off-platform workarounds by making on-path behaviour pay: **auto-feedback, gradebook integration, participation credit via analytics, rubric-based commenting**, and **advanced yet on-platform workflows** (rich annotation, versioning, API-enabled tooling). Explain the **pedagogical rationale** for required LMS pathways.
- **fidelSecure minimum viable fit first.** As **TTF → FLMSA** was non-significant (β = 0.014, p = 0.908), guarantee **stable access** and **simple submission/feedback**

loops as a baseline; iterate toward richer alignment (e.g., **rubrics, version control, structured feedback cadences**) primarily to **improve LPS**, not because TTF alone drives fidelity.

- **Prioritize timely feedback and instructor presence.** Given the strong **LPS → PLS** link, set **feedback turnaround SLAs**, use **transparent rubrics**, schedule **regular announcements/updates**, and maintain **visible instructor presence** to lift process satisfaction.
- **Measure depth, not just frequency.** Daily access was high, but fidelity and **LPS R^2** were modest; replace "logins" as a proxy with **feature diversity, sequence adherence, feedback turnaround** and pair LMS telemetry with **brief LPS pulse surveys**.
- **Design for equity and bandwidth.** Context matters. Treat **connectivity, zero-rated domains, offline-enabled/low-bandwidth formats**, and **device loans** as core academic infrastructure to enable FLMSA—especially for data-constrained students.
- **Use assessment-aligned interactivity.** Since Interactivity did not predict FLMSA, deploy forums/live sessions **only when graded, well-facilitated, and tightly tied to task outcomes** so their primary contribution is via **better LPS**.
- **Targeted orientation and micro-training.** Offer **just-in-time walkthroughs** for core workflows (submissions, feedback, dashboards) and **SRL micro-skills** to help students convert platform affordances into faithful, on-path use.

Bottom line for practice: your results point away from "more tools" and toward **better processes**, **SRL scaffolding**, and **enabling infrastructure**—the levers most likely to lift satisfaction with the learning process and, in turn, perceived success.

7.5.2 Contribution to Policymakers

The findings speak directly to policy levers that improve equity and learning outcomes in digitally mediated higher education—without over-claiming beyond the data.

- **Advancing SDG 4 (Quality Education).** Evidence from this study shows that learning success is most strongly associated with the **quality of the learning process (LPS)** rather than simple platform access or feature counts. Policies that fund **reliable IT support**, **low-bandwidth design**, and **device/data provision** (e.g., zero-rating, data bundles, loaner devices) will enable faithful LMS use and improve the student experience—especially for vulnerable groups—thus advancing inclusive and equitable quality education.
- **Supporting South Africa's NDP 2030.** The NDP's emphasis on innovation and capability-building is operationalized here through two demonstrably impactful levers: (i) **institutional IT scaffolding** (help-desk responsiveness, uptime standards, and bandwidth-sensitive materials) and (ii) **self-regulated learning (SRL) supports** embedded in course sites (planning prompts, progress dashboards, reflective check-ins). Prioritizing these process-centric investments aligns with national objectives by improving learning continuity and perceived success at scale.
- **Monitoring what matters.** The study cautions against using logins or access frequency as proxies for learning quality. Policymakers should encourage **process-quality metrics** (feedback turnaround times, pathway adherence, feature diversity) and **regular student pulse surveys** to track learning experience, not just platform usage.
- **Contextual equity.** Results from a Global South university underscore that **enabling infrastructure** conditions all other effects. Policy frameworks should explicitly budget for and evaluate **connectivity, devices, and responsive support** as core academic infrastructure, not add-ons.

7.5.3 Contribution to the Information Systems Research Community

This study contributes theoretically, methodologically, and contextually to IS scholarship on technology use in education, particularly under crisis conditions.

- **Refining the Faithful Appropriation Model (FAM).** We show that **Self-Efficacy for Self-Regulated Learning (SESRL)** is a positive antecedent of **faithful LMS appropriation**, whereas **Computer Self-Efficacy (CSE)** can relate **negatively** to fidelity—nuancing assumptions that "more tech confidence is always better." We also position **Learning Process Satisfaction (LPS)** as the **proximal driver** of **Perceived Learning Success (PLS)**, suggesting a process-centric pathway (SESRL → FLMSA → LPS → PLS) to be tested formally in future work.
- **From adoption to appropriation.** By modelling **appropriation fidelity** rather than adoption/acceptance, and by showing that high access does not equal on-path engagement, the study advances IS theorizing toward **use quality** and **on-platform orchestration**.
- **Crisis and context sensitivity.** Evidence from a South African HEI broadens a literature dominated by Global North samples, foregrounding **bandwidth, device/data support, and IT service levels** as conditioning variables in IS models of use.
- **Methodological directions.** The work motivates a research agenda that (i) distinguishes **volitional** from **compulsory** LMS use; (ii) tests **non-linear and moderating** roles of CSE; (iii) integrates **telemetry with survey** measures to mitigate recall bias; and (iv) evaluates **SRL scaffolds** and **on-platform incentives** (e.g., auto-feedback, gradebook integration) through randomized or quasi-experimental designs.
- **Evidence-based practices.** Practically, the study offers design principles that IS researchers can operationalize and test: **strengthen IT scaffolding**, **embed SRL supports**, **make on-path behaviours pay off**, and **treat interactivity and task–**

technology fit as context-dependent levers that act primarily by improving the learning process rather than directly increasing appropriation.

7.5.4 Theoretical Contributions

This study **extended and challenged** the Faithful Appropriation Model (FAM) by shifting it from a feature-centric account of "using the system as intended" to a **process-first, context-conditional** account of how LMS use related to learning outcomes under emergency remote teaching.

How the study extended FAM

1. **Process quality as the proximal mechanism.** The results showed a strong positive association from Learning Process Satisfaction to Perceived Learning Success (LPS → PLS: β=0.551, p<.001), while the direct path from faithful appropriation to perceived success was non-significant (FLMSA → PLS: β=−0.099, p=.300) and the path from FLMSA to LPS was only marginal (β=0.276, p=.054). On this basis, the study **repositioned LPS as the key mediator**, modelling **SESRL → FLMSA → LPS → PLS** as the dominant chain in this context.

2. **Self-regulation as a proximal antecedent of fidelity.** Self-Efficacy for Self-Regulated Learning significantly predicted appropriation (SESRL → FLMSA: β=0.246, p=.021). The study therefore **incorporated learner self-regulation inside FAM** as a proximal driver of on-path use under volatile conditions.

3. **Computer self-efficacy as conditional rather than uniformly positive.** Computer Self-Efficacy related **negatively** to appropriation (CSE → FLMSA: β=−0.315, p=.009). The study theorized an **overconfidence/multi-homing mechanism**, and consequently treated CSE as potentially **non-linear and/or moderating**, rather than a monotonic enabler.

4. **Enabling infrastructure as a boundary condition.** IT Support showed a clear positive effect on appropriation (ITS → FLMSA: β=0.367, p=.001). The study **extended FAM** to include institutional scaffolding (help-desk responsiveness, bandwidth-sensitive materials, device/data provision) as an **enabling layer** that conditioned other effects in resource-constrained settings.

5. **Interactivity and TTF as indirect, context-dependent levers.** Interactivity and Task–Technology Fit did not directly predict appropriation (both ns). The study **re-located** these constructs to primarily **indirect roles via LPS**, with influence expected when orchestration quality was high (assessment alignment, feedback cadences) and adequate connectivity.

Challenges to core FAM assumptions

- The findings **challenged** the assumption that adding interactive features necessarily increases fidelity or success; interactivity appeared **process-contingent**, not universally causal.

- The findings **challenged** the assumption that higher technology confidence reliably improves appropriation; high CSE could **undermine** fidelity without on-platform incentives.

Scope conditions and methodological constraints (theory-relevant)

Daily access was likely **necessity-driven** (the LMS as gatekeeper) rather than volitional engagement, which decoupled frequency from fidelity and outcomes. The cross-sectional, retrospective self-report design introduced **recall bias**, and the single-site sample (n=81) constrained external validity. Accordingly, the theoretical claims advanced here were **associational** and **context-bounded** to emergency remote teaching at a South African HEI.

Result-anchored refinements (testable propositions)

Based on the evidence, the study **proposed** the following for future testing:

- **P1 (Process mechanism):** LPS mediates the association between FLMSA and PLS; the direct FLMSA → PLS path remains weak when orchestration quality is uneven.
- **P2 (Self-regulation driver):** SESRL positively predicts FLMSA across crisis contexts.
- **P3 (Conditional CSE):** The CSE → FLMSA association is **inverted-U** and/or moderated by **on-platform advantages** (e.g., auto-feedback, gradebook integration).
- **P4 (Infrastructure boundary):** ITS functions as an enabling condition; effects of SESRL and Interactivity on FLMSA are **stronger at higher ITS levels**.
- **P5 (Context-dependent Interactivity/TTF):** Interactivity and TTF primarily predict LPS (not FLMSA) when prompts are assessment-aligned and bandwidth is adequate.

Bottom line (theory). The extended FAM that best **fit the data** was **process-first and context-conditional**: self-regulated learners, supported by visible IT scaffolding, were more likely to follow intended paths; when those paths yielded a coherent, well-orchestrated process, students reported success—even when interactivity and perceived fit were uneven. Conversely, without process quality and enabling infrastructure, even faithful use felt unrewarding, and high-CSE students tended to route around the LMS.

7.6 Study Limitations

While the study provided useful evidence on LMS use during emergency remote teaching, several limitations should be noted.

- **Sample size and single-site context.** The sample (n=81) came from one South African HEI, which limited external validity. Findings should be generalized cautiously beyond similar contexts.

- **Retrospective, cross-sectional design (recall bias).** Data was collected between **November 2023 and May 2024** and relied on students' recall of pandemic-era behaviour. The cross-sectional, self-report design constrained temporal inference and introduced potential recall bias.

- **Common source and measurement scope.** All constructs were self-reported, which introduced common-method variance risk despite standard validity checks. The study did not include LMS telemetry (e.g., feature-level traces, sequence adherence), which limited the ability to distinguish **frequency** of access from **fidelity** of on-path use and to separate **volitional engagement** from **compulsory gatekeeping** access.

- **Indicator pruning and content validity.** Several indicators—especially within CSE and TTF—were removed for low loadings in the measurement refinement phase. Although reliability and AVE met thresholds, these deletions may have narrowed construct coverage and attenuated relationships (particularly for Interactivity and TTF).

- **Model specification and causal scope.** PLS-SEM estimates were **associational**. The study did not conduct formal indirect-effect tests (e.g., bootstrapped SESRL → FLMSA → LPS → PLS), and the estimated model showed uneven global fit (e.g., SRMR for the estimated model exceeded conventional cut-offs). Causal claims were therefore out of scope.

- **Unmeasured enabling conditions.** Key contextual factors (device access, bandwidth variability, study space, socio-economic constraints) were not directly modelled, even though the results and discussion suggested that **IT Support** operated as an enabling boundary condition.

- **Period- and platform-specificity.** Findings reflected a pandemic pivot and the local Canvas implementation; effects may differ in non-crisis semesters or under different orchestration standards.

7.7 Future Research Recommendations

To advance a process-first, context-conditional extension of FAM and address the limitations above, future work should:

- **Separate necessity from volition.** Develop and validate measures of **perceived compulsion** (e.g., "LMS required to access assessments") and link them to appropriation fidelity and LPS.
- **Triangulate surveys with telemetry.** Combine trace data (feature diversity, pathway adherence, feedback turnaround) with self-reports to reduce recall bias and to distinguish **access** from **on-path engagement**.
- **Formally test the process mechanism.** Use multi-institutional, longitudinal designs to test **SESRL → FLMSA → LPS → PLS** via bootstrapped indirect effects and to establish temporal ordering.
- **Model conditional and non-linear CSE.** Examine **inverted-U** and moderation (e.g., CSE × on-platform advantages; CSE × IT Support) to explain when high confidence erodes fidelity through off-platform "multi-homing."
- **Treat Interactivity and TTF as context dependent.** Specify conditions under which these constructs matter (e.g., strong orchestration, assessment alignment, adequate bandwidth), modelling their **primary influence via LPS** rather than directly on FLMSA.
- **Map off-platform tool use.** Document learners' use of external tools (cloud drives, messaging apps) and test whether **on-platform incentives** (auto-feedback, gradebook integration, participation credit) reduce leakage and improve fidelity.

- **Equity and enabling infrastructure.** Model **IT Support** (device/data provision, low-bandwidth design, help-desk SLAs) as a conditioning variable and test heterogeneous effects across socio-economic groups.

- **Design experiments on SRL scaffolds.** Run randomized or quasi-experimental evaluations of embedded planning prompts, progress dashboards, reflective check-ins, and analytics-based nudges to establish causal gains in FLMSA and LPS.

- **Compare orchestration, not just platforms.** Conduct comparative studies of **course-template standards** (navigation conventions, assessment calendars, feedback cadences) across courses/LMSs to isolate process design from platform brand.

- **Test measurement invariance.** Assess invariance across gender, year of study, discipline, and bandwidth tiers to strengthen generalizability.

Pursuing this agenda will move the field beyond counting logins to understanding processes—clarifying when and for whom LMSs deliver value—and will inform equity-conscious, SRL-centred designs that measurably improve learning at scale.

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APPENDIXES:

9.1 Ethics Clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF BUSINESS SCIENCES ETHICS COMMITTEE
CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: CBUSE2139**
PROJECT TITLE	The Use and Adaptation of Learning Management System by Undergraduates (Gen Z) at a Higher Learning Institution in South Africa During a Pandemic.
INVESTIGATOR	Zamani Mbhele
SCHOOL/DEPARTMENT OF INVESTIGATOR	School of Business Sciences
DATE CONSIDERED	15 September 2023
DECISION OF THE COMMITTEE	Approved Unconditionally
RISK LEVEL	Minimal Risk
EXPIRY DATE	31 December 2026

ISSUE DATE OF CERTIFICATE 12 September 2023 **CHAIRPERSON** _____
(Neetu Ramsaroop)

cc: Supervisor: Samwel Mwapwele

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

_____ 19 / 09 / 2023
Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

9.2 Permission Letter

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

OFFICE OF THE DEPUTY REGISTRAR

12 October 2023

Zamani Mbhele
Student Number (1792283)
Master of Commerce
School of Business Sciences

TO WHOM IT MAY CONCERN

"The Use and Adaptation of Learning Management System by Undergraduates (Gen Z) at a Higher Learning Institution in South Africa During a Pandemic."

This letter serves to confirm that the above project has received permission to be conducted on University premises, and/or involving staff and/or students of the University as research participants. In undertaking this research, you agree to abide by all University regulations for conducting research on campus and to respect participants' rights to withdraw from participation at any time.

If you are conducting research on certain student cohorts, year groups or courses within specific Schools and within the teaching term, permission must be sought from Heads of School or individual academics.

Ethical clearance has been obtained. (Protocol number: CBUSE2139)

Research Expiration: (31 December 2026)

Nicoleen Potgieter
University Deputy Registrar

Private Bag 3, WITS, 2050, South Africa | **T** +27 11 717 1204/8 | **E** nicoleen.potgieter@wits.ac.za | www.wits.ac.za
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9.3 Participant Information Letter

University of the Witwatersrand, Johannesburg

1 Jan Smuts Ave., Braamfontein, Johannesburg, 2017

Researcher: Zamani Mbhele

Student Number: 1792283

Date: August 2, 2023

Good day, Sir or Madam.

My name is Zamani Mbhele. I am a Master's student (student number:1792283) enrolled at the University of the Witwatersrand, Johannesburg. Under the esteemed guidance of my supervisor Dr. Samwel Mwapwele, I am embarking on a crucial research endeavour. The focus of my research study is to investigates how the use and adaptation of learning management systems (LMS) by undergraduates (Gen Z) in their learning process during a pandemic has impacted their learning success. The study title is "*The Use and Adaptation of Learning Management Systems by Undergraduates (Gen Z) at a Higher Learning Institution in South Africa During a Pandemic*."

I am inviting you to take part in answering a questionnaire. If you decide to take part, your participation in this research study will last about 15–20 minutes. The questionnaire will be online and can be accessed through an internet connection using a mobile device, personal computer, laptop, and/or tablet.

With your permission, I would like to record all your responses for research study analysis and reporting activities. This data will be stored on my student OneDrive account for 3 years and/or deleted after 3 years. Only myself and my supervisor will have access to the data. During the research activity, I will need to ask for some personal information about you, including your age, gender, and year of study.

The questionnaire will be confidential and anonymous, and your participation will be kept as such to the extent provided by law. When I share the results of the research study, I will not include your name or anything else that could identify you. With your permission, other researchers may use the data collected from this research study, but your name and any personal information will not be used or passed on.

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits, or rights you would normally have if you decided not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

The risks for this research study are no more than what happens in everyday life. This research study will be written up as a research report and/or publication. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor using the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, or email hrecnon-medical@wits.ac.za.

Yours sincerely,

Researcher: Zamani Mbhele, 1792283@students.wits.ac.za, +27 76 725 3721

Supervisor: Samwel Mwapwele, samwel.mwapwele@wits.ac.za, +27 11 717 8305

9.4 Questionnaire

The Use and Adaptation of LMS by Undergraduates (Gen Z) at a HEI in SA During a Pandemic

Please provide the required personal details, then indicate as honestly as possible your agreement or disagreement with statements regarding the use and adaptation of learning management systems (LMS) by your higher learning institution (HEI) during the COVID-19 pandemic.

* Required

Demographic Data

1. Are you a student at the University of the Witwatersrand, Johannesburg? *

- ◯ Yes
- ◯ No

2. Age *

3. Gender *

- ◯ Female
- ◯ Male
- ◯ Prefer not to say

4. Year of Study *

- ◯ YOS 1
- ◯ YOS 2
- ◯ YOS 3

LMS Utilization During COVID-19

5. Did you use an LMS for educational purposes during the COVID-19 pandemic? *

- ◯ Yes
- ◯ No

6. If yes, which LMS platform did you use? *

7. How frequently did you use the LMS during the pandemic? (Choose one) *

- ◯ Daily
- ◯ Weekly
- ◯ Monthly
- ◯ Rarely

8. Did you receive training or guidance on how to use the LMS effectively? *

- ◯ Yes
- ◯ No

9. IT Support *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongl Disagre
The LMS used improved communicati on between students and instructors.	◯	◯	◯	◯	◯	◯	◯
The LMS improved the possibility of exchanging ideas with each other.	◯	◯	◯	◯	◯	◯	◯
The LMS used had a clearer course structure.	◯	◯	◯	◯	◯	◯	◯
The LMS used enabled me to create a structured learning environment.	◯	◯	◯	◯	◯	◯	◯
The LMS used made learning process easier to understand.	◯	◯	◯	◯	◯	◯	◯
The technical support team was easily accessible when I encountered issues with LMS.	◯	◯	◯	◯	◯	◯	◯
The response time of the technical team in resolving my LMS-related problems was satisfactory.	◯	◯	◯	◯	◯	◯	◯
I received clear instructions and guidance	◯	◯	◯	◯	◯	◯	◯

on how to address technical issues with the LMS.	◯	◯	◯	◯	◯	◯	◯

10. Interactivity *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strong Disagre
I focused on the lecture sessions conducted with the LMS, e.g., by asking questions).	○	○	○	○	○	○	○
I took part in the lecture sessions conducted with the LMS.	○	○	○	○	○	○	○
I took part in discussion forums between my peers through the LMS.	○	○	○	○	○	○	○
I took notice of important announcements made through the LMS.	○	○	○	○	○	○	○
The LMS provided opportunities for collaboration and engagement with peers and instructors.	○	○	○	○	○	○	○
I actively participated in discussions and interactive activities within the LMS.	○	○	○	○	○	○	○
I felt connected to my classmates and instructors 12 despite the	○	○	○	○	○	○	○

despite the physical distance through the interactive features of the LMS.

11. Task-Technology Fit *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
The LMS was user-friendly and easy to navigate for accomplishing my learning activities.	○	○	○	○	○	○	○
The used LMS was easy to learn.	○	○	○	○	○	○	○
Did the LMS provided the information accurately?	○	○	○	○	○	○	○
Did you receive up-to-date information from the LMS?	○	○	○	○	○	○	○
Did you receive the information you require in time from the LMS?	○	○	○	○	○	○	○
Did the LMS used produced results that are almost exactly what you need?	○	○	○	○	○	○	○
The features and tools available in the LMS aligned with my learning tasks' requirements.	○	○	○	○	○	○	○
The functionalities of the LMS supported my learning tasks effectively.	○	○	○	○	○	○	○

12. Faithful LMS Appropriation *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
I used the LMS improperly. *	◯	◯	◯	◯	◯	◯	◯
My use of the LMS would be considered inappropriate by the instructor. *	◯	◯	◯	◯	◯	◯	◯
I did not use the LMS the way I was supposed to. *	◯	◯	◯	◯	◯	◯	◯
I didn't use the LMS in the most appropriate way possible. *	◯	◯	◯	◯	◯	◯	◯

13. Learning Process Satisfaction *

	Extremely efficient	Very efficient	Moderately efficient	Slightly efficient	Slightly Inefficient	Moderately inefficient	Extremely inefficient
How would you describe your learning process on a bipolar scale: efficient–inefficient?	◯	◯	◯	◯	◯	◯	◯

14. *

	Extremely coordinated	Very coordinated	Moderately coordinated	Slightly coordinated	Slightly uncoordinated	Moderately uncoordinated	Extremely uncoordinated
How would you describe your learning process on a bipolar scale: coordinated–uncoordinated	◯	◯	◯	◯	◯	◯	◯

15. *

	Extremely fair	Very fair	Moderately fair	Slightly fair	Slightly unfair	Moderately unfair	Extremely unfair
How would you describe your learning process on a bipolar scale: fair–unfair	◯	◯	◯	◯	◯	◯	◯

16. *

	Extremely satisfying	Very satisfying	Moderately satisfying	Slightly satisfying	Slightly dissatisfying	Moderately dissatisfying	Extremely dissatisfying
How would you describe your learning process on a bipolar scale: satisfying–dissatisfying	◯	◯	◯	◯	◯	◯	◯

17. Perceived Learning Success *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongl Disagre
I'm more confident in expressing my thoughts on information technology.	◯	◯	◯	◯	◯	◯	◯
I had a solid grasp of the basic concepts of my course material.	◯	◯	◯	◯	◯	◯	◯
My ability to think critically about technology has improved.	◯	◯	◯	◯	◯	◯	◯
My ability to integrate facts and develop generalizations from the course material has improved.	◯	◯	◯	◯	◯	◯	◯
My ability to critically analyse issues has increased.	◯	◯	◯	◯	◯	◯	◯
I have learned to identify the central issues of the course.	◯	◯	◯	◯	◯	◯	◯
I have learned to interrelate the important issues in the course material.	◯	◯	◯	◯	◯	◯	◯
I have learned to value other points of	◯	◯	◯	◯	◯	◯	◯

18. Computer Self-Efficacy *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strong Disagr
I was confident using the LMS.	○	○	○	○	○	○	○
I was confident in using the LMS communicati on tools.	○	○	○	○	○	○	○
I was confident when downloading study material on the LMS.	○	○	○	○	○	○	○
I was confident when completing the assessment on the LMS.	○	○	○	○	○	○	○
I was confident when engaging with my peers on the LMS discussion forums.	○	○	○	○	○	○	○
I was confident in my ability to use computers and digital devices for online learning.	○	○	○	○	○	○	○
I was comfortable performing tasks such as accessing course materials, submitting assignments	○	○	○	○	○	○	○

assignments, and participating in online discussions on the LMS.							
I could quickly learn and adapt to new technology tools and platforms used for online learning.	○	○	○	○	○	○	○

19. Self-Efficacy for Self-Regulated Learning *

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strong Disagr
I was able to complete my assignment by the deadlines.	○	○	○	○	○	○	○
I was able to study even when there are other interesting to do.	○	○	○	○	○	○	○
I was able to pay attention in lecture sessions.	○	○	○	○	○	○	○
I was able to plan my work.	○	○	○	○	○	○	○
I was able to organize my work.	○	○	○	○	○	○	○
I was able to motivate myself to do my assignments.	○	○	○	○	○	○	○
I was confident in setting goals and managing my time effectively in an online environment.	○	○	○	○	○	○	○
I could monitor my progress and adjust my learning strategies based on my goals.	○	○	○	○	○	○	○
I could seek help and resources independentl							

y when faced with challenges or difficulties in online learning.	◯	◯	◯	◯	◯	◯	◯