

**A STRATEGY FOR USING LEARNING MANAGEMENT SYSTEMS IN SCIENCE
TEACHER EDUCATION IN A SOUTH AFRICAN DISTANCE LEARNING UNIVERSITY**

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ABSTRACT

In South Africa's open distance learning (ODL) environment, Learning Management Systems (LMS) play a pivotal role in facilitating teaching and learning. Despite this centrality, research consistently indicates that LMS platforms are underutilised, with educators engaging largely in basic administrative tasks and encountering challenges related to system complexity, limited digital confidence, and inadequate institutional support. Against this backdrop, this study investigated science teacher educators' perceptions of LMS ease of use and usefulness within a South African open distance education university. It further sought to develop, implement, and evaluate a structured strategy aimed at enhancing meaningful LMS adoption.

The study was guided by a conceptual framework integrating the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and an additional construct-familiarity with technology. Employing a qualitative multi-case study design, the research involved four science teacher educators and was conducted in two phases. Phase 1 explored existing LMS practices through questionnaires, semi-structured interviews, and on-site module observations. The findings revealed limited engagement with advanced LMS functionalities and highlighted persistent barriers related to effort expectancy, performance expectancy, social influence, and facilitating conditions. These insights informed the design of a four-step, hands-on LMS enhancement strategy, which was implemented using individual sandbox environments, video-based tutorials, synchronous coaching sessions, and reflective checklists.

Phase 2 examined the influence of the intervention through unstructured post-implementation interviews and follow-up observations. Within the four participating cases, the findings indicated notable shifts across all constructs of the conceptual framework. Participants reported increased confidence, improved understanding of LMS functionalities, enhanced perceptions of usefulness, and a greater willingness to integrate interactive and pedagogically purposeful tools into their modules. The strategy also strengthened facilitating conditions by providing personalised support and reducing perceptions of system complexity. Although institutional and collegial factors continued to

shape adoption behaviours, the intervention significantly enhanced participants' familiarity with technology, enabling deeper and more sustained LMS engagement.

Data were analysed using thematic analysis, guided by constructs from the conceptual framework (TAM, UTAUT and familiarity with technology). Interview transcripts, questionnaire responses, and observation data were systematically coded and organized into categories reflecting perceived ease of use, perceived usefulness, performance expectancy, facilitating conditions, social influence, and technological familiarity. Patterns across cases were compared to identify key themes and shifts in perceptions following the implementation of the LMS strategy

This study contributes a contextually grounded and replicable strategy for strengthening LMS adoption in science teacher education within ODL contexts. It provides insights into how personalised, scaffolded professional development can move educator engagement beyond compliance-driven LMS use toward more pedagogically intentional integration. The study recommends sustained training initiatives, strengthened institutional support structures, and the embedding of reflective, hands-on digital capacity-building within academic development programmes. Limitations relate to the small sample size and contextual specificity of the study, pointing to opportunities for future research on scalability across disciplines and institutional settings.

Overall, the study demonstrates that targeted, practice-based interventions can meaningfully enhance LMS adoption, thereby supporting more effective digital teaching and learning in South African higher education.

Keywords: Learning Management Systems (LMS); Science Teacher Education; Open distance learning; e-Learning, Digital Pedagogy; Perceived ease of use; Perceived Usefulness; South Africa

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Glossary of acronyms

CPD	Continuous Professional Development
ICT	Information and Communication Technologies
LMS	Learning Management System
MCQ	Multiple Choice Question
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology

Chapter 1: An introduction

1.1 Introduction and background

In South Africa, open distance learning (ODL) serves as an important educational approach for widening access to higher education, particularly for university students who face financial barriers related to tuition, accommodation, and living expenses (Mbodila et al., 2023). Globally, many countries have increasingly integrated Information and Communication Technologies (ICTs) into teaching and learning practices (Selvaras, 2020), a trend that is especially pronounced within ODL contexts. In open distance education institutions, ICTs underpin nearly all academic and administrative processes, from course marketing and student admissions to teaching, assessment, and programme completion (Hassan & Mirza, 2020). Central to the integration of ICTs in both distance and blended learning environments is the use of Learning Management Systems (LMS).

A Learning Management System can be described as an internet-based platform that provides access to educational services and resources (Aldiab et al., 2019). These platforms facilitate interaction and communication between learners and educators, thereby supporting teaching and learning in geographically dispersed contexts (Adzharuddin & Ling, 2013). LMS environments offer a range of educational activities and create engaging learning spaces that are accessible across multiple digital devices, effectively removing the constraints associated with physical classroom settings (Simões et al., 2013; Aldiab et al., 2019).

In science teacher education, LMS platforms can support a variety of pedagogical activities, including the distribution of multimedia resources, online discussions, virtual practical activities, formative assessment, collaborative learning, and reflective practice. These affordances are particularly important in science disciplines where learners are often required to engage with abstract concepts, scientific inquiry processes, and practical investigations. Effective LMS use therefore has the potential to enhance both the teaching and learning of science in distance education contexts.

The literature highlights several benefits associated with LMS use, including the mitigation of time and space limitations (Panigrahi et al., 2018), cost effectiveness (Al-Gahtani,

2016; Rajhans et al., 2020), enhanced performance monitoring and analysis (Saidi et al., 2021), and increased levels of teacher motivation (Rajhans et al., 2020). Despite these advantages, the adoption and effective use of LMSs remain uneven. Educators frequently report a need for targeted training, as limited familiarity with the full range of LMS functionalities constrains meaningful use (Eachempati & Ramnarayan, 2020). System complexity further negatively influences educators' perceptions of LMS usability, particularly in relation to the effort required to engage with these platforms (Lavidas et al., 2022). In developing country contexts, additional challenges include unequal access to reliable digital infrastructure and necessary technological resources.

Despite the potential benefits of LMSs, evidence suggests that many teacher educators do not fully utilise available LMS functionalities because of challenges related to usability, training, technological support, and institutional factors. Addressing these challenges requires the development of contextually relevant strategies that can support teacher educators in effectively integrating LMS tools into their teaching practices. In this study, a strategy refers to a structured set of interventions and support mechanisms designed to enhance the adoption and pedagogical use of LMSs by science teacher educators within an ODL environment.

Perceived ease of use refers to an individual's assessment of the amount of effort required to use a system and is a key determinant of attitudes and intentions toward technology adoption (Venkatesh, 2000). This perception is closely linked to perceived usefulness, particularly when users believe that a technology can be effectively employed for instructional purposes (Walker, 2015). Perceived usefulness, in turn, relates to an individual's belief that using a system will enhance job performance (Islam, 2011).

Within the South African higher education sector, institutions operating in ODL environments face unique challenges associated with large student enrolments, diverse student populations, varying levels of digital literacy, and unequal access to technological infrastructure. These contextual factors influence how teacher educators engage with LMS platforms and highlight the need for locally relevant strategies to support effective LMS use. In the context of open distance education, understanding science teacher educators' perceptions of both ease of use and usefulness is therefore critical for

explaining LMS adoption and actual usage. Such understanding provides valuable insight into how LMSs can be more effectively leveraged to support teaching and learning within ODL environments.

1.2 Problem statement

Learning Management Systems (LMSs) have become an integral component of teaching and learning in higher education, particularly within open distance learning (ODL) environments where technology-mediated interaction is essential for educational delivery. Research conducted across both developed and developing countries has highlighted numerous benefits associated with LMS use, including enhanced communication, increased flexibility, improved access to learning resources, and support for student engagement and assessment. Despite these advantages, studies consistently report challenges related to digital literacy, technological infrastructure, system complexity, training, institutional support, and user attitudes, which continue to limit effective LMS adoption and utilisation.

Within developing-country contexts, including South Africa, these challenges are often intensified by socio-economic inequalities, unequal access to digital technologies, and varying levels of technological competence among educators and students. While existing studies have identified factors influencing LMS adoption and use, much of the literature has focused on describing challenges and barriers rather than developing and evaluating interventions that support educators in overcoming them.

Furthermore, limited research has specifically investigated LMS use among science teacher educators within South African ODL institutions. Science teacher education presents unique pedagogical demands, including the teaching of abstract scientific concepts, scientific inquiry, practical investigations, and collaborative learning processes that require effective integration of digital technologies. Although LMSs have the potential to support these pedagogical requirements, little is known about how science teacher educators perceive the usefulness and ease of use of LMSs in this context, or how these perceptions influence their adoption and utilisation of LMS functionalities.

The knowledge gap addressed by this study therefore lies in the limited understanding of LMS use among science teacher educators in a South African ODL context and the

absence of a contextually relevant, empirically informed strategy to enhance LMS adoption and pedagogical utilisation. Despite growing international research on LMS adoption, little empirical research has specifically examined science teacher educators' perceptions of LMS use within South African ODL institutions or evaluated strategy-based interventions designed to enhance LMS adoption in this context. Addressing this gap is important because it contributes to both theory and practice by generating knowledge about the factors influencing LMS use among science teacher educators and by developing and evaluating a strategy designed to support more effective LMS integration in science teacher education.

1.3 Motivation for study

Learning through Information and Communication Technologies (ICT), commonly referred to as e-learning, has become a fundamental component of contemporary higher education (Al-Gahtani, 2016), particularly as many current students are often described as “digital natives” (Hussein, 2016). E-learning can be defined as instruction delivered through electronic devices, where information and learning resources are accessed using a range of digital technologies (Wu et al., 2012). As a result of growing up in a digitally mediated era, students may demonstrate greater confidence and familiarity in using Learning Management Systems (LMSs). In contrast, many tertiary educators may be less technologically fluent, which can render LMS implementation more complex and challenging.

These differing levels of familiarity are reflected in how LMSs are perceived by various user groups. Educators often describe LMSs as “complex” and “multifaceted” systems that require substantial effort to master (Naveh et al., 2010), whereas students tend to view LMSs as platforms that support the gathering, construction, and sharing of knowledge (Lin & Wang, 2012). Such divergent perceptions can influence how LMSs are adopted and utilised within higher education contexts.

Although numerous studies advocate the pedagogical value of e-learning platforms, relatively limited research has examined the factors influencing LMS adoption, particularly from the perspective of educators (Al-Nuaimi & Al-Emran, 2021). Existing research has largely focused on student use and experiences, with considerably less attention given to

educators' implementation practices (Lavidas et al., 2022). While studies conducted in Asia and Europe provide valuable insights, the South African context presents distinct socio-economic, infrastructural, and institutional conditions that give rise to context-specific challenges and opportunities.

Against this backdrop, the present study aimed to investigate science teacher educators' perceptions of LMS use within a South African open distance learning higher education context. The study further sought to develop a strategy to enhance LMS use by addressing and mitigating the challenges perceived by teacher educators in their engagement with these systems.

1.4 Rationale

1.4.1 Personal rationale

My involvement in Learning Management System (LMS) support at a South African distance higher education institution provided valuable insight into the challenges experienced by teacher educators when adopting digital technologies. Although the university offered centralised training through the Centre for Professional Development (CPD), many educators continued to seek individualised, context-specific support to use the LMS confidently in their teaching practice.

These support interactions revealed that many teacher educators possessed a basic understanding of LMS functionality but lacked confidence in applying their knowledge independently. Rather than requiring repeated procedural instruction, educators frequently benefited from practical guidance, reassurance and opportunities to explore LMS features within their own teaching contexts. The introduction of a new LMS in 2022 further highlighted these challenges, as demand for personalised support increased despite extensive institutional training initiatives. These observations prompted an interest in understanding the factors influencing LMS adoption among science teacher educators and provided the impetus for this study.

My own experience of developing LMS competence through self-directed exploration, rather than extensive formal training, reinforced the importance of familiarity, confidence and experiential learning in technology adoption. This perspective informed my interest

in investigating teacher educators' perceptions of LMS use while remaining mindful of the need to distinguish personal experience from research evidence. A more detailed discussion of researcher positionality is presented in Chapter 4.

1.4.2 Academic rationale

The increasing enrolment of students in universities has intensified the demand for higher education globally, including in South Africa (Mtebe & Raisomo, 2014). Examining the factors that influence teacher educators' use of Learning Management Systems (LMS) highlights the need for a targeted strategy that foregrounds both ease of use and perceived usefulness, while simultaneously addressing the challenges associated with LMS adoption. Such a strategy has the potential to enhance meaningful LMS usage among teacher educators.

Remote learning, due to its inherent flexibility, has been shown to overcome several barriers associated with traditional contact-based education (Dhawan, 2020). In particular, the capacity of e-learning to reduce time and space constraints makes the effective and strategic use of LMSs especially valuable in South African open and distance learning contexts (Panigrahi et al., 2018). Learning Management Systems further offer significant advantages through their cost effectiveness (Al-Gahtani, 2016; Rajhans et al., 2020), an important consideration in a context where the affordability of tertiary education remains a persistent challenge (Mbodila et al., 2023).

Within this context, open distance education represents a more accessible and affordable pathway for many students, underscoring the importance of optimising LMS use to support teaching and learning. Developing and implementing a coherent LMS adoption strategy is therefore essential for maximising the pedagogical and economic benefits of remote education in South Africa.

1.5 Aims and Objectives of the study

The study aimed to investigate science teacher educators' perceptions of Learning Management System (LMS) use within a South African higher education open distance learning context, with the goal of developing a strategy to enhance LMS adoption by addressing the challenges educators experience when using the system.

This aim was achieved through realizing the following objectives:

- To identify science teacher educators' perceived ease of use of LMS in open distance education.
- To identify the perceived usefulness of LMS in open distance education.
- Investigating the science teacher educator experiences of the implementation of the developed strategy for using LMS in open distance education.

1.6 Research questions

The main research question of this study is:

1. What are the science teacher educators' perceptions of using LMS in a South African distance university?

The main research question will be answered by answering the following sub questions:

- a. What are the factors that influence science teacher educators perceived ease of use of LMS in open distance education?

In addressing this research question, the study examines both the effort required to use Learning Management Systems (LMS) and the facilitating conditions that support their use. Facilitating conditions encompass the availability of resources, institutional support, and technological infrastructure. Both the perceived effort and the quality of these facilitating conditions are considered in relation to science teacher educators' familiarity with technology.

- b. What are the factors that influence science teacher educators perceived usefulness of LMS in open distance education?

In addressing this question, the study considers the extent to which science teacher educators perceive that Learning Management Systems (LMS) enhance their teaching and learning performance, while also examining their familiarity with technology.

- c. What are the science teacher educator experiences of the implementation of the strategy for using LMS in open distance education?

In addressing this question, the study investigated science teacher educators' experiences with the strategy developed to enhance LMS usage in open distance education.

1.7 Methodology

A qualitative research approach, situated within an interpretivist paradigm, was adopted to explore science teacher educators' perceptions of Learning Management System (LMS) use. A multi-case study design was employed, enabling an in-depth, contextually grounded examination of how teacher educators engage with LMSs.

Data collection was conducted in two phases. Phase 1 focused on understanding existing LMS practices and perceptions, using questionnaires, semi-structured interviews, and module site observations. The findings from Phase 1 informed the development of a strategy aimed at enhancing teacher educators' perceptions and use of LMSs. Phase 2 examined participants' experiences of the implemented strategy through unstructured post-implementation interviews.

Data were analysed thematically, guided by categories derived from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), with an additional construct of familiarity with technology. These constructs were integrated within the conceptual framework introduced in Section 1.7.

Trustworthiness was ensured through triangulation of data sources, rich descriptive accounts, and systematic documentation of the research process. Ethical clearance was obtained prior to data collection, and all participants provided informed consent.

1.8 Conceptual framework

The conceptual framework guiding this study was informed by the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), providing a lens to examine science teacher educators' use of a Learning Management System (LMS) in a South African open distance learning context. The framework was extended by incorporating familiarity with technology as an additional construct, capturing the experiential and contextual variations in system use. This framework informed the formulation of the research questions, the design of data

collection and analysis procedures, and the development of the LMS enhancement strategy. A detailed discussion of the framework is presented in Chapter 3.

1.9 Delimitation of study

This study focused on one module per science teacher educator, with the sample comprising four educators specialising in Natural Sciences, Physical Sciences, and Life Sciences education modules, despite science teacher education encompassing other science disciplines. All participants were based at the same South African open distance education institution and used a single Learning Management System (LMS). Consequently, the findings should be interpreted as exploratory and context-specific. Given the single-institution, four-participant design, the findings are not intended for broad generalization but rather to provide an in-depth understanding of LMS use among science teacher educators within this particular context. The small sample size was chosen to ensure that data collection remained manageable and feasible while allowing for the collection of rich, in-depth data.

Only data and literature directly aligned with the research questions and conceptual framework were included; irrelevant information was excluded from the final analysis and representations. Data collection took place over a period of four months to avoid particularly stressful periods for science teacher educators, such as examination times, which have been shown to negatively affect LMS use due to increased workload stress (Herdian et al., 2023).

All data were collected and reported solely by the researcher, without research assistants. The researcher also developed and implemented the LMS enhancement strategy, delivering it as a series of personalised sessions with each participant.

1.10 Research structure

The organization of the chapters in this thesis is as follows:

Chapter 1- Introduction

This chapter outlined the research questions, aims, and objectives of the study, and provided a brief background and rationale for the project. It also discussed the study's delimitations and presented the overall research structure.

Chapter 2- Literature review

This chapter examined the complex interplay between e-learning, digital literacy, open distance education, and Learning Management Systems (LMS) within developing countries. It explored the transformative impact and evolution of e-learning, highlighting the crucial role of digital literacy in bridging technology-use gaps among learners. The chapter also traced the historical development and current significance of open distance education, emphasizing the central role of LMS in supporting this mode of learning. Furthermore, it addressed the challenges and opportunities associated with LMS implementation in developing contexts, providing a comprehensive analysis of both barriers and potential strategies for effective integration.

Chapter 3- Theoretical and conceptual framework

This chapter presents the conceptual framework that guided the study. The framework was developed through the integration of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), with familiarity with technology incorporated as a supporting factor influencing LMS engagement. These constructs were used to examine the factors influencing science teacher educators' perceptions and use of Learning Management Systems within a South African open distance learning context. The chapter also acknowledges broader educational perspectives relating to social interaction and technology-enhanced learning, which provide contextual support for understanding LMS use in teaching and learning environments.

Chapter 4- Research methodology

This chapter provides an overview of the research design and methodology employed to address the study's research questions regarding the use of Learning Management Systems (LMS) by tertiary science teacher educators. It outlines the qualitative approach adopted, including data collection methods such as questionnaires, interviews, observations, and a researcher diary, with a focus on understanding participants' experiences and perspectives. The study follows a multi-case study design within an interpretivist paradigm, enabling an exploration of the subjective realities of teacher educators in an open distance learning environment. The chapter also describes the

research setting, population and sampling strategies, and the ethical considerations implemented to ensure the trustworthiness and rigor of the study's findings.

Chapter 5- Phase 1- Data presentation: Science teacher educator perceptions of LMS

Chapter 5 presents the analysis and discussion of Phase One data, focusing on the first two research questions: the factors influencing science teacher educators' perceived ease of use and perceived usefulness of the Learning Management System (LMS) in an open distance education context. The analysis is structured around themes and categories informed by the TAM and UTAUT frameworks-effort expectancy, facilitating conditions, familiarity with technology, performance expectancy, social influence, and digital literacy. Qualitative data are presented on a case-by-case basis for four science teacher educators (Dr K, Mr L, Dr E, and Dr M), supplemented by observations of their LMS module sites. For each case, the chapter examines how interface design, learning curves, institutional and technical support, prior experience, self-efficacy, and contextual constraints shape educators' experiences of LMS usability and usefulness for teaching, assessment, student engagement, and content delivery. The chapter concludes with synthesized findings that illustrate how personal, pedagogical, and institutional factors interact to influence LMS adoption, providing insights that directly informed the design of the LMS enhancement strategy presented in the subsequent chapter.

Chapter 6- Phase 2- A strategy for LMS usage

Chapter 6 presents the development and implementation of the LMS enhancement strategy designed for science teacher educators at a South African open distance learning university. The strategy was directly informed by the conceptual framework-an integration of TAM, UTAUT, and the additional construct of familiarity with technology-and was designed to address the barriers identified in Phase 1, including limited use of LMS functionalities, perceptions of system complexity, low digital confidence, and insufficient structured support. The chapter outlines the strategic aim of progressively enhancing educators' awareness, confidence, and skills in using LMS tools through a hands-on, scaffolded process delivered over four guided sessions and supported by LMS sandpit practice environments. It details the pre-implementation orientation, the four-step

implementation phase, and the post-implementation reflections that captured changes in perceived ease of use, perceived usefulness, and adoption behaviour. Overall, the chapter positions the strategy as a contextually responsive professional development model aligned with TAM/UTAUT constructs, laying the foundation for analysing its impact in Chapter 7.

Chapter 7- Phase 2- Data presentation: Science teacher educator experiences of the LMS strategy

Chapter 7 presents the findings from the post-implementation phase of the study, drawing on interviews with the four teacher educators to evaluate the impact of the LMS enhancement strategy on their perceptions of ease of use, usefulness, performance expectancy, facilitating conditions, behavioral intention, and familiarity with technology. The chapter provides a detailed, case-by-case analysis aligned with the conceptual framework, illustrating how the strategy influenced educators' LMS adoption behaviors and engagement.

Chapter 8- Summary of findings and conclusion

Chapter 8 provides a synthesis of the study by summarizing the key findings from both research phases and demonstrating how these findings collectively address the research questions. It evaluates the impact of the LMS enhancement strategy on science teacher educators' adoption of the LMS, integrating insights from the conceptual framework (TAM, UTAUT, and Familiarity with Technology). The chapter further highlights the study's contributions to science teacher education in open distance learning contexts, offers practical and theoretical recommendations, acknowledges the study's limitations, and presents concluding reflections that situate the findings within broader discussions on digital pedagogy and LMS integration.

1.11 Chapter summary

This chapter introduced the study by outlining the context, rationale, and purpose of investigating the use of Learning Management Systems (LMS) by science teacher educators within a South African open distance learning (ODL) institution. It highlighted the importance of LMS in supporting flexible, scalable, and technology-enhanced

teaching, particularly in environments where geographical distance, financial constraints, and large student enrolments present ongoing challenges. While LMS platforms offer significant affordances for communication, content delivery, assessment, and interaction, the chapter emphasised that their effective use depends on teacher educators' perceptions of usefulness, ease of use, confidence, and digital familiarity. These challenges provided the basis for situating the study within the TAM and UTAUT frameworks, extended with the construct of familiarity with technology to capture the unique realities of the ODL context.

The chapter also outlined the personal, institutional, and academic motivations underpinning the study, particularly the researcher's experience in supporting colleagues with LMS navigation and observing consistent barriers to adoption among science teacher educators. The research problem and questions were presented, focusing on identifying factors influencing LMS acceptance and developing a contextually responsive strategy to enhance LMS use. Finally, the chapter delineated the study's scope and limitations-focusing on an in-depth, qualitative exploration of four science teacher educators-and provided an overview of the thesis structure, establishing the foundation for the literature review, methodology, findings, and LMS enhancement strategy presented in the subsequent chapters.

Chapter 2: A review of literature

2.1 Introduction

This chapter provides a critical review of the literature underpinning this study on the use of Learning Management Systems (LMS) in science teacher education within a South African open distance education context. It begins by situating the study within broader pedagogical and technological shifts that have driven the rise of e-learning and LMS integration, with particular attention to the realities of developing-country contexts. The chapter then examines e-learning as an instructional approach, followed by a discussion of digital literacy as a foundational competence for effective technology use. It also traces the evolution of open distance education and highlights the central role of LMS as platforms that support teaching, communication, and assessment in online learning environments. The review further explores LMS adoption in developing countries, identifying both the opportunities and persistent challenges that shape implementation. Specific attention is given to LMS use in science teacher education, alongside contemporary pedagogical approaches-such as flipped learning and online collaborative learning-that intersect with and are strengthened by LMS environments. Collectively, this body of literature provides a foundation for understanding the factors influencing LMS adoption and underscores the need for a contextually responsive strategy to enhance its use among science teacher educators.

Although a substantial body of literature exists on LMS adoption and implementation in higher education, limited research has examined LMS use among science teacher educators within South African open distance learning institutions. Furthermore, much of the existing literature focuses on identifying barriers and enabling factors rather than developing and evaluating contextually relevant strategies to enhance LMS use. This chapter therefore reviews the literature related to LMS adoption, use, opportunities, challenges, and pedagogical applications in order to identify the knowledge gap addressed by this study and provide a foundation for the development of an LMS enhancement strategy for science teacher educators.

2.2 Setting the stage

Rapid technological advancements and shifting pedagogical paradigms have significantly transformed the contemporary educational landscape. E-learning has emerged as a major influence on educational practices worldwide, functioning as a dynamic instructional approach that leverages Information and Communication Technologies (ICTs). Enhancing learning opportunities and creating effective pedagogy requires attention to multiple factors, including digital literacy and the unique challenges posed by open distance learning. At the centre of this transformation lies the crucial role of Learning Management Systems (LMS), which orchestrate the integration of technology and education.

With particular emphasis on adoption in developing nations, this literature review provides a comprehensive analysis of e-learning, digital literacy, open distance education, and LMSs. The subsections examine how these elements interact, highlighting both opportunities and challenges. Digital literacy, as a fundamental competency for the digital age, lays the groundwork for the effective integration of e-learning tools and resources. Building on this foundation, open distance learning emerges as an innovative approach that expands educational access beyond geographical limitations. The review then examines LMSs, highlighting their central role in designing e-learning experiences by facilitating communication, content delivery, and assessment.

The use of LMSs in developing countries presents a unique set of opportunities and challenges shaped by contextual factors. This review draws on studies from nations including Kenya, India, Tanzania, and South Africa to provide insights into the regional dynamics of integrating technology in education, identifying the specific challenges encountered and lessons learned through LMS adoption. LMSs offer numerous benefits, including convenience, flexibility for learners, cost-effectiveness, and opportunities for pedagogical innovation. These systems can reshape the educational landscape, enhance student engagement, and motivate learning. However, challenges such as limited access, technical skills, institutional support, socioeconomic constraints, educators' attitudes, students' perceptions, and cultural barriers must also be addressed.

In summary, this literature review examines the complex interplay of e-learning, digital literacy, open distance learning, and LMSs in developing-country contexts, with particular attention to distance teacher education. It aims to provide a nuanced understanding of the opportunities, challenges, and pathways for effective LMS integration, contributing to ongoing discussions about the evolving role of technology in education.

2.3 E-Learning

E-learning is an instructional approach that uses Information and Communication Technologies (ICTs) to deliver information, educational materials, and teaching online, supporting students in enhancing their learning (Al-Emran & Teo, 2020; Ellis et al., 2009). These tools include computers, software, and internet-based resources (Mwakyusa & Mwalyagile, 2016). E-learning can also be defined as instruction that involves interacting with digital content through communication networks, services, and teacher guidance in a remote learning setting (Markus, 2008; Song & Tang, 2024).

Initially, e-learning was broadly defined as the mere adoption of any electronic media in education. Over time, the definition evolved to emphasize using electronic media specifically to support the learning process itself (Tavangarian et al., 2004) through networked, interactive content with teacher guidance in remote settings (Adnan & Sayadi, 2021). For instance, using a microphone in a lecture does not constitute true e-learning. Today, e-learning encompasses both pedagogy and technology as essential components (Moore et al., 2011). Effective online teaching requires prioritizing digital teaching skills and providing robust student support as online learning becomes increasingly integrated into higher education (Kordrostami & Seitz, 2022). Technological advancements allow teachers and students to access a wide variety of information in multiple formats, enabling learners to tailor their education according to their preferred time, environment, and study materials (Henderson et al., 2017).

E-learning can be seen as a natural progression of remote learning, which has continually leveraged emerging technologies to enhance educational delivery (Sangrà et al., 2012). Learning Management Systems (LMS) are central to this progression, linking online learning with institutional efforts to provide dynamic, interactive, and structured educational experiences (Ahmed et al., 2021). Higher education institutions are

increasingly investing in ICT infrastructures and emphasizing e-learning (Alshehri et al., 2019). LMSs supplement course content with features such as discussion boards, forums, chats, and online grade posting (Coskuncay & Ozkan, 2013). Implementing appropriate technological tools can enable more dynamic teaching and learning, yet successful adoption requires expertise and careful planning, as failures are common when systems are poorly implemented (Ramadhani et al., 2019; Legris et al., 2003).

Reflecting on the evolution of e-learning, it is evident that this instructional approach has undergone a transformative journey shaped by the convergence of pedagogy and technology. E-learning has shifted from passive integration of electronic media to active engagement with digital content in virtual classrooms guided by educators. This evolution aligns with the changing landscape of remote learning, emphasizing the combination of digital teaching skills and strong student support. Such an approach empowers students to optimize their learning according to their unique preferences and contexts.

In the context of this study, understanding the evolution of e-learning is crucial because the participating science teacher educators operate within an open distance learning institution where technology-mediated teaching is not optional but essential. LMSs are pivotal in this environment, enabling institutions to enhance course content with interactive and administrative features. However, successful implementation demands more than technological access; it requires careful pedagogical integration and support for educators navigating these systems. This body of literature underscores that LMS adoption is not merely a technical add-on but a pedagogical shift that science teacher educators must be guided and supported to manage effectively.

The literature on e-learning demonstrates that effective online teaching extends beyond the mere availability of technology and requires meaningful integration of digital tools into pedagogical practice. While e-learning has expanded educational opportunities and transformed teaching and learning globally, successful implementation depends on educators' ability to utilise technological systems effectively. Within ODL institutions, LMSs serve as the primary mechanism through which e-learning is operationalised. However, the literature suggests that successful LMS use requires more than access to technology; it requires educator competence, confidence, and support. These findings

highlight the importance of understanding how science teacher educators engage with LMSs and what support mechanisms may enhance their use within a South African ODL context.

2.4 Digital literacy

Law et al. (2018) define digital literacy as the ability to successfully use digital technologies to access, manage, integrate, and communicate information-a skill closely linked to the effective use of LMSs for facilitating e-learning. Digital literacy equips individuals with the competencies needed to use technology effectively and responsibly (Edeh et al., 2022). Martin (2008) further describes digital literacy as the combination of knowledge, attitude, and skills with digital tools that enables a person to find, access, manage, integrate, assess, and apply new resources.

Despite its importance, research indicates that many educators are not highly proficient in using digital technologies (Hassan & Mirza, 2020). Saripudin et al. (2021) note that younger educators tend to exhibit higher levels of digital literacy due to greater exposure to digital technologies, while digital literacy often declines with increased length of employment, affecting more experienced, older teachers. Additionally, low levels of digital literacy in the broader community-often stemming from the absence of digital literacy education in schools-further compound this challenge (Saudi et al., 2018). Strong digital literacy skills are essential for educators to function effectively in the 21st century (Edeh et al., 2022).

Calvani et al. (2008) identify three key components of digital literacy: technological skills (TS), cognitive skills (CS), and ethical knowledge (EK). TS reflects a user's flexibility in experimenting with new technologies. CS refers to the ability to access, select, analyze, and critically evaluate information. EK encompasses the responsibilities and ethical considerations associated with engaging in ICT.

This literature is particularly relevant to my study because Phase One revealed that digital literacy among science teacher educators is unevenly distributed, and this unevenness significantly influenced their engagement with the LMS. The skills required to navigate the digital landscape are multifaceted and critical for effective interaction with modern educational technologies. Digital literacy not only enables educators to access and

manage information but also to communicate, integrate, and utilize it effectively within LMS environments.

Incorporating these perspectives underscores that any LMS-enhancement strategy must view digital literacy as both a prerequisite for and an outcome of successful LMS adoption, ensuring that educators are supported to develop the competencies needed for effective technology-mediated teaching.

The literature consistently identifies digital literacy as a critical factor influencing educators' ability to adopt and utilise educational technologies effectively. Although digital literacy encompasses a range of technological, cognitive, and ethical competencies, studies suggest that these competencies are unevenly distributed among educators. Consequently, variations in digital literacy may contribute to differences in LMS use and adoption. These findings are particularly relevant to science teacher education, where educators are expected to integrate multiple digital tools and resources into their teaching practices. The literature therefore suggests that digital literacy should be considered a key factor when exploring LMS use and developing strategies to enhance technology integration.

2.5 Open distance education

Open distance education (ODE) is a modality of learning in which students receive instruction without being physically present in a traditional classroom, creating a physical separation between educators and learners (Ahmed et al., 2021; Sangi & Ahmed, 2015). This approach provides opportunities for learners of diverse ages and abilities (Sangi & Ahmed, 2015) and has been shown to help students manage the costs of higher education (Ahmed et al., 2021). In an ODE context, students often include those already in the workforce as well as learners in remote areas who, despite their willingness to study, face barriers to accessing conventional classroom-based learning (Dzandu & Tang, 2015).

Through ODE, many individuals are prepared for future opportunities without geographic or temporal restrictions (Chen et al., 2018), fundamentally transforming the ways in which higher education is accessed and degrees are completed (Daniel, 2017). The roots of distance education date back centuries, with the earliest example in the United States

using mail for remote instruction in 1728 (İşman, 2011), and the formal implementation of open distance education occurring at the University of Wisconsin in 1892 (Kaya et al., 2002). Today, ODE is widely employed across the globe and has been significantly expanded over the past decades, driven by strong pedagogical frameworks and rapid technological advancements (COL, 2020).

As a researcher at a South African distance university, this literature is particularly meaningful, as it contextualizes the systemic pressures faced by teacher educators and underscores why distance teaching environments demand intentional, well-designed digital support frameworks. By employing alternative delivery methods, ODE effectively bridges the geographic and temporal gaps between learners and educators (Hussain et al., 2018). Learning Management Systems (LMSs) have emerged as one of the primary software platforms supporting teaching and learning in this context (Ahmed et al., 2021).

Open distance education has reshaped the educational landscape, transcending physical boundaries to provide knowledge to a diverse range of learners. It democratizes access to education by accommodating different ages, learning capacities, and financial constraints (Sangi & Ahmed, 2015; Ahmed et al., 2021), and serves populations often underserved by traditional classrooms, including working professionals and those in remote regions (Dzandu & Tang, 2015). Situating this study within the historical and contemporary evolution of ODE reinforces the argument that LMS training for teacher educators cannot be assumed; it must be carefully designed to address the complexities of modern distance teaching practice.

The literature highlights the increasing reliance of ODL institutions on technology-mediated teaching and learning. As physical interaction between educators and students is limited, LMSs become essential for communication, content delivery, assessment, and learner support. However, the effectiveness of these systems depends largely on how educators utilise available LMS functionalities. The reviewed literature therefore suggests that understanding educator experiences and perceptions of LMS use is essential for improving teaching and learning within ODL environments and for informing contextually relevant support strategies.

2.6 Learning management systems

A Learning Management System (LMS) is a collection of software tools that leverage online communication to connect learners and educators (Snowball & Mostert, 2010; Adzharuddin & Ling, 2013) and is widely used in higher education for teaching and learning (Al-Nuaimi & Al-Emran, 2021). LMSs facilitate both synchronous and asynchronous instruction (Dahlstrom et al., 2014), making them particularly suitable for open distance education, which has been implemented in tertiary institutions since 2003 (Al-Sharhan et al., 2020). Today, LMSs are a common feature across institutes of higher learning (Kakasevski et al., 2008).

For the purposes of this study, LMSs are conceptualized not merely as technical platforms but as pedagogical ecosystems. This perspective emphasizes the role of LMSs in mediating teaching and learning, reflecting the focus of this research on how science teacher educators experience, engage with, and utilize these tools to support effective science instruction.

2.6.1 LMSs in developing countries

In this study, developing countries are defined as those where the population has only basic expertise in applying ICT solutions and where ICT resources are limited. The gap between these countries and those with sufficient access to digital technologies is often referred to as the digital divide (Ssekakubo et al., 2011). Simply put, the digital divide is the “inequality of access to digital technologies” (van Dijk, 2002). In the context of e-learning, the digital divide encompasses disparities in access to, preparation for, and ability to use computers and the Internet, as well as the capacity to effectively employ these technologies to deliver comprehensive teaching and learning experiences (ANTA, 2002). Khan et al. (2010) note that developing countries lag significantly behind wealthier nations in implementing e-services, and that this digital divide continues to widen over time.

Studies across African countries

In the early 2010s, the use of Learning Management Systems (LMS) at African institutions grew significantly, with Moodle, an open-source platform, emerging as a leading choice. By 2011, most Tanzanian institutions had integrated LMS into their instructional infrastructure, with Moodle accounting for more than 78% of usage (Munguatosha et al., 2011). In Sudan, approximately 25% of tertiary institutions had adopted Moodle by 2013 (Elmubark et al., 2013). Other institutions across the continent, including the Catholic University of Mozambique, Kenyatta University, the University of Dar es Salaam, the University of Education in Ghana, and the Universities of Ibadan and Jos in Nigeria, were also found to use Moodle as their preferred LMS (Hoosen & Butcher, 2012).

This widespread adoption reflects a regional commitment to enhancing educational delivery and accessibility through technology. Moodle's popularity can be attributed to its flexibility, cost-effectiveness, and robust support network, all critical factors in resource-constrained environments. Although Sudan's adoption rate was lower than Tanzania's, it signals a growing trend toward integrating technology into education despite potential challenges such as political instability and infrastructural limitations. These patterns indicate increasing recognition of LMS as a tool for modernizing educational practices, creating dynamic learning environments, and reducing educational inequalities across socioeconomic contexts.

Further evidence of Moodle's adoption is seen in a survey of five African universities, including Makerere University in Uganda, Nelson Mandela Metropolitan University, the University of Zambia, and the University of Nairobi (Ssekakubo et al., 2011). While Internet access was acknowledged at all five institutions, the survey also revealed a gap in training provision: educators and management received formal training, whereas students were largely excluded, highlighting an area for improvement in equitable LMS implementation.

2.6.1 Kenya

In a study conducted in Kenya by Tarus et al. (2015) involving 127 higher education instructors, several challenges to using ICTs for successful e-learning were identified. The most frequently reported challenge, cited by 92% of respondents, was inadequate ICT infrastructure, followed closely by financial constraints (87%). A substantial proportion of respondents (71%) indicated that educators' lack of technical skills hindered effective e-learning and e-content development. Additionally, 66% highlighted a lack of interest and commitment among some educators. One respondent noted that certain lecturers feared e-learning could render their roles redundant, which contributed to reluctance in adopting it as an alternative teaching method.

Despite these challenges, the study emphasizes that e-learning presents a significant opportunity for Kenyan institutions to expand access to higher education. Among its recommendations, the study advocates for comprehensive training programs for educators and strategies to encourage and motivate them to develop and utilize e-learning content effectively.

2.6.2 India

The Indian Open Distance Education Bureau recognized the evolving needs of the education sector and responded by adopting a Learning Management System (LMS) as a technical platform to enhance the quality of open distance learning programs. The initiative aimed to support students' skill development and employability by facilitating and supplementing educational opportunities, including professional and vocational programs (Kant et al., 2021).

The LMS was designed to incorporate essential instructional elements such as class sessions, learning materials, virtual laboratories, and assessments. Additionally, the system was developed to offer content in multiple major Indian languages, thereby expanding access to a broader range of learners. Provisions were also made for educators to introduce new instructional materials, enriching the overall learning experience for students (IGNOU, 2011).

2.6.3 Tanzania

At the Open University of Tanzania, the implementation of LMS was investigated, revealing several significant challenges (Bhalalusesa et al., 2013). One major issue was that educators primarily used the LMS only when physically on campus due to unreliable internet connectivity. This limited use was compounded by the assumption that students would not access content on Moodle because of connectivity difficulties. Another challenge was that many staff members, particularly recently recruited educators, were unfamiliar with Moodle and therefore did not utilize the system. The lack of adequate training further contributed to educators' reluctance to engage with the LMS. Providing training was particularly difficult in a distance education context, where educators are dispersed across the country. Frequent LMS updates added another layer of complexity, making it challenging for staff to keep up with modifications and for new users to receive timely guidance. Moreover, no tracer studies were conducted to assess the effectiveness of the training programs. Educators also faced heavy workloads, leaving them with limited time to explore or use the LMS effectively.

2.6.4 South Africa

South Africa possesses one of the strongest higher education systems in Africa (Manda & Dhaou, 2019). The three most used LMSs in the country are Sakai, Moodle, and Blackboard. While younger universities tend to use Blackboard, Sakai accommodates significantly more students due to the large enrolments in the institutions that employ this platform (Swart, 2015).

A case study conducted at a South African open distance learning (ODL) institute revealed that both student engagement and support within electrical engineering modules were closely linked to academic achievement (Swart, 2015). The study analyzed LMS usage data and pass rates across six modules, finding that higher LMS engagement generally correlated with improved pass rates, although some modules exhibited an inverse relationship. These findings suggest that the effective use of LMS by both educators and students has the potential to enhance throughput rates, which may, in turn, increase government funding for institutions.

Although the studies reviewed originate from different developing-country contexts, several common patterns emerge. Across Kenya, Tanzania, India, and South Africa, LMS implementation is consistently influenced by factors such as technological infrastructure, digital literacy, training opportunities, institutional support, and user confidence. While the specific manifestations of these challenges differ according to local socio-economic and institutional conditions, inadequate support structures and limited familiarity with LMS functionalities repeatedly constrain meaningful adoption and use. At the same time, the reviewed studies highlight the potential of LMS platforms to enhance access, communication, learner engagement, and educational quality when these barriers are effectively addressed.

A notable distinction between the reviewed contexts relates to the level of institutional investment and support available to educators and students. However, despite differences in implementation approaches, the literature consistently focuses on identifying barriers to LMS adoption rather than evaluating interventions designed to address them. Furthermore, limited attention has been given to science teacher educators operating within South African open distance learning environments, where the pedagogical demands of science education may require specialised approaches to LMS integration. This gap provides the rationale for the present study, which seeks not only to understand science teacher educators' perceptions of LMS use but also to develop and evaluate a contextually relevant strategy to enhance LMS adoption and pedagogical utilisation.

2.7 Recent LMS use

The literature on Learning Management Systems (LMS) highlights their significant evolution as educational technologies, particularly in enhancing learning experiences and improving administrative efficiency across diverse educational contexts. As instructional tools, LMS have become essential resources that streamline teaching and learning processes while supporting a wide range of pedagogical strategies.

The integration of LMS within educational frameworks facilitates greater engagement and interaction between educators and learners. Damanik et al. (2023) demonstrate that LMS can enhance student creativity and motivation, particularly in community education

settings, by providing engaging online access to learning materials. Similarly, Sobri et al. (2024) emphasize that LMS innovations in the digital era-referred to as “Society 5.0”-create more dynamic and interactive learning environments while improving the management of teaching processes. Alshammari (2020) further underscores that LMS offer comprehensive administrative functionalities, including course management, online resource provision, and student performance tracking, which collectively enhance both educational outcomes and operational efficiency.

The impact of LMS on teaching modalities, such as online and blended learning, is equally significant. Research indicates that LMS use can positively influence instructional methods and overall academic performance (Sulaiman, 2023). During the COVID-19 pandemic, LMS were crucial in maintaining instructional continuity, enabling universities to deliver educational programs despite widespread disruptions. By supporting both synchronous and asynchronous learning, LMS allow educators to accommodate diverse learner preferences and needs, which is increasingly important in today's complex educational landscape (Fearnley & Amora, 2020).

The use of LMS also aligns with transformational frameworks such as the Technology Acceptance Model (TAM), which emphasizes the importance of perceived ease of use and perceived usefulness in technology adoption. Buabeng-Andoh and Baah (2020) found that pre-service teachers' willingness to adopt LMS technologies is strongly influenced by these perceptions, highlighting the critical role of user attitudes in successful implementation. Furthermore, LMS success depends heavily on institutional support, including technical assistance and training for educators and students (Bervell & Arkorful, 2020), underscoring the need for careful strategic planning in LMS selection and deployment (Kant et al., 2021).

Despite these benefits, challenges remain. Studies report that LMS use can lead to distractions and engagement issues among students, particularly during high-stress periods such as pandemic lockdowns (Opoku, 2021). These findings highlight the importance of complementing LMS deployment with robust instructional design and learner support mechanisms.

In conclusion, recent literature underscores the pivotal role of LMS in enhancing educational outcomes and institutional effectiveness. With ongoing technological advancements, including artificial intelligence and personalized learning pathways, LMS are becoming increasingly adaptable to diverse learners' needs, offering promising prospects for the future of education.

Recent literature demonstrates that LMSs continue to evolve as sophisticated educational platforms capable of supporting diverse pedagogical approaches and enhancing learning experiences. Despite advances in functionality and increasing institutional investment, successful LMS adoption remains dependent on user perceptions, institutional support, and technological competence. These findings reinforce the argument that the availability of an LMS alone does not guarantee meaningful use. Rather, targeted interventions are required to support educators in integrating LMS functionalities into their teaching practices effectively.

2.8 Opportunities of LMS's

Many educational institutions have adopted Learning Management Systems (LMS) to provide course management and delivery services and to enhance communication between teachers and students (Alshehri et al., 2019). Advanced institutions have extended the use of LMS to train academic and administrative staff as well as to educate students (Alameen & Dhupia, 2019). Initially, there were concerns that online teaching might disrupt traditional face-to-face instruction (Altun et al., 2019). However, with the growth of online and remote learning, numerous prestigious universities worldwide have launched initiatives such as online courses, professional certificates, and full degree programs using LMS platforms (Ohliati & Abbas, 2019).

Traditional physical classrooms are increasingly complemented-or even replaced-by online learning environments, reflecting the rising demand for e-learning (Holmes & Prieto-Rodriguez, 2018). Open distance learning (ODL) has effectively leveraged technological advancements to provide supportive learning environments for students who face limitations within conventional education systems (Kant & Anjali, 2020). For educational institutions, integrating technology into teaching and learning represents the most practical and effective approach to implementing e-learning (Hussein, 2016).

Moreover, the success and usefulness of e-learning courses heavily depend on teachers, who play a central role in facilitating and guiding learning (Selim, 2007).

2.8.1 Convenience, ease and adaptability

As demand for traditional face-to-face learning declines, students increasingly embrace online and open distance education, valuing the convenience of accessing their courses from the most accessible locations at minimal cost (Gómez & Rodríguez-Marciel, 2012). Learning Management Systems (LMS) provide a flexible environment that allows students to control both the pace and content of their learning (Perraton, 2012). A key advantage of LMS is that students can access course materials at any time, supporting self-directed learning (Swart, 2015).

For educators, LMS simplifies course administration, enabling them to upload materials, provide feedback, and monitor the entire teaching and learning process efficiently (Ahmed et al., 2021). Many educators have reported that LMS supports adaptability to diverse learning styles, encourages innovation, and facilitates the monitoring and documentation of teaching activities (Rajhans et al., 2020). Additionally, the flexibility in lesson scheduling, the ability to work remotely, and the capacity to maintain teaching continuity during urgent or unforeseen situations have been cited as factors that enhance educators' satisfaction with LMS platforms.

2.8.2 Cost-effectiveness

A recurring theme in the literature is the cost-effectiveness of using Learning Management Systems (LMS) to deliver educational content (Rajhans et al., 2020; Al-Gahtani, 2016). By integrating e-learning services into their pedagogical practices, some academic institutions have been able to reduce the costs of course delivery while simultaneously increasing revenue (Ho & Dzeng, 2010). Proper implementation and strategic use of LMS are key factors in achieving these cost reductions (Andersson & Grönlund, 2009).

2.8.3 Desirability

LMSs provide an engaging learning environment, particularly for younger learners. Incorporating gamification or educational video games within these platforms can enhance motivation and performance, appealing to both school-aged children and young adults (Aldiab et al., 2019).

2.8.4 Features

LMSs provide educators with the ability to effectively monitor and track students' activities, fostering greater collaboration and interaction between students and teachers (Emelyanova & Voronina, 2014). These platforms offer a variety of functionalities, including announcements, assignments, forums, quizzes, and chat features, among others (Bacow et al., 2012). Many of these functions can be used asynchronously, which benefits distance learners and facilitates communication between students and educators (Venter et al., 2012). In this context, the role of the educator shifts from being the sole transmitter of knowledge to serving as a facilitator of learning (Makrakis & Kostoulas-Makrakis, 2012). Another key advantage of LMS adoption is that it allows both educators and students to easily integrate real-world activities into the course schedule, enhancing the relevance and applicability of learning experiences (Swart, 2015).

2.8.5 Motivation in students

An advantage of using an LMS is that it promotes active learning and problem-solving among students, which in turn enhances their motivation to learn (Swart, 2015). Another benefit is the accelerated feedback on submitted assignments or self-assessments, allowing students to engage more actively in the learning process without long delays waiting for results (Watson & Watson, 2007). Highlighting these opportunities underscores why strengthening LMS adoption is a valuable pursuit and why supporting science teacher educators in this area can transform both teaching practices and student learning experiences. These advantages also informed the selection of tools prioritized in my enhancement strategy, with a focus on functionalities that directly facilitate interaction, accessibility, and pedagogical clarity.

The literature clearly demonstrates that LMSs offer substantial benefits for both educators and students, including flexibility, accessibility, cost-effectiveness, enhanced communication, and increased learner engagement. These opportunities are particularly valuable within ODL contexts where technology serves as the primary medium of interaction. However, the realization of these benefits depends on educators' willingness and ability to utilise LMS functionalities beyond basic administrative tasks. This suggests that strategies aimed at increasing LMS adoption should focus not only on system access but also on encouraging meaningful pedagogical engagement with available tools.

2.9 Challenges of LMS's

Naveh et al. (2010) describe LMSs as complex and multifaceted, suggesting that their effective use can also be challenging. In South Africa, the country continues to face a shortage of skills required for the Fourth Industrial Revolution, largely due to inefficiencies in the post-school education and training system (Manda & Dhaou, 2019). In developing countries, the challenges associated with LMS use are often less about the technology itself and more about how institutions implement these systems to support, enhance, and facilitate authentic, real-world student learning (Ssekakubo et al., 2011).

2.9.1 Access and infrastructure

In South Africa, the high cost of internet services (Kimotho, 2018) and limited access to ICT infrastructure pose significant barriers to effective teaching and learning (Mills, 2008). Access to devices and reliable internet connectivity has been consistently identified as a constraint in e-learning (COL, 2020). Low internet speeds impede the implementation of online learning (Andersson & Grönlund, 2009), and frequent power outages further exacerbate the problem (Mtebe & Raisamo, 2011). Load shedding, which occurs when electricity demand exceeds supply, temporarily cuts off access to electricity and, consequently, to ICT resources, unless stakeholders have established backup solutions (Malik et al., 2022). These challenges reflect the broader digital divide between developed and developing countries, where those in developed regions generally have more consistent access to ICT infrastructure (Hussain et al., 2018).

Beyond connectivity issues, technological infrastructure limitations are also prevalent (Maphalala & Mpofu, 2018). For instance, accessing the e-learning environment often

requires logging into an LMS via a computer, even though students frequently rely on mobile devices. This mismatch delays access to learning materials and can impede timely engagement with course content (Maphalala & Mpofu, 2018). Without adequate tools, equipment, and technological resources, students' ability to learn and perform effectively is severely constrained (Ahmed et al., 2021).

2.9.2 Technical expertise

In developing countries such as South Africa, computers are often used primarily for basic activities, including sending emails, accessing the internet, and creating documents with Microsoft applications (Nawaz & Kundi, 2010). This limited use contributes to lower engagement with ICT systems for effective e-learning (Ssekakubo et al., 2011). Although LMS platforms have the potential to enhance teaching and learning, teachers and students frequently use only the basic features, rarely exploring the more sophisticated functionalities (Dahlstrom et al., 2014). Dahlstrom et al. (2014) also noted that LMS users reported the highest satisfaction with these basic features.

Studies from other developing countries reflect similar patterns. In Malaysia, Azlim et al. (2014) found that instructors generally underutilized the diverse functionalities of LMS. Likewise, research in Saudi Arabia by Alghamdi and Bayaga (2016) confirmed low usage of advanced LMS features and revealed that many participants experienced apprehension toward using the system. A study in Kuwait similarly showed that users favoured basic administrative functions over interactive capabilities, indicating low adoption of the LMS's full potential (Al-Sharhan et al., 2020). These findings suggest that LMS adoption requires technical skills, which can be a barrier for instructors due to the platform's complex and technical nature (Kanninen, 2008).

2.9.3 Support and training

The lack of technical and managerial support for LMS has been frequently cited as a significant barrier to effective usage (Sife, Lwoga, & Sanga, 2007; Mtebe & Raisamo, 2011; Kisanga & Ireson, 2015), often resulting in low confidence among educators and limiting their ability to use the systems optimally (Mwakyusa & Mwalyagile, 2016). Adequate support and training can stimulate curiosity and engagement, whereas their absence fosters fear and disinterest in integrating ICT into teaching and learning (Tarus

& Gichoya, 2015). It is increasingly evident that simply introducing a technology and assuming it will be adopted is ineffective (Lynch & Szorenyi, 2005). Many educators are discouraged by the effort required to use LMS when they lack the necessary technical knowledge, a consequence of insufficient training (Bhalalusesa et al., 2013).

Edeh et al. (2022) emphasize the critical need for consistent and structured technology training, particularly for teachers supporting students with functional diversity. Their study found that while many educators possess basic digital skills, such as document editing, internet browsing, and data protection, they often lack proficiency in advanced tools, including multimedia presentation design, virtual classroom platforms like Google Classroom or Zoom, and digital content creation. This skills gap is attributed to infrequent training opportunities and limited access to ICT facilities. Consequently, the authors recommend biannual professional development sessions on emerging digital technologies to ensure that teachers remain equipped for inclusive teaching in the digital era. Sustained training, they argue, is essential not only for enhancing teacher competence but also for fostering equitable and effective learning experiences for all students.

2.9.4 Exposure

In most higher education institutions in South Africa, enrolments in Science, Engineering, and Technology (SET) fields account for only 29% of the total student population (Manda & Dhaou, 2019). This proportion is relatively low compared to countries such as India and Brazil, where SET enrolments represent 42.6% and 33.9%, respectively. Historically disadvantaged groups, identified by Statistics South Africa (2018), make up most unskilled and semi-skilled workers in the country and have long faced socio-economic disadvantages, largely due to limited access to quality education (Manda & Dhaou, 2019).

A study in Tanzania revealed that only 28.9% of academic staff were familiar with Moodle, the country's LMS, and consequently did not use the system (Bhalalusesa et al., 2013). Although training programs were implemented to upskill these educators, no follow-up or tracer studies were conducted to explore whether participants were able to effectively use the LMS after training. Moreover, frequent updates to the LMS required educators to attend repeated training sessions to stay current with new features and modifications.

2.9.5 Poverty

Without adequate financial support, students from low-income families in South Africa face significant barriers to academic success (Machika & Johnson, 2014). Research indicates that, on average, students who drop out of higher education come from families with low economic status, with the majority belonging to historically disadvantaged groups (Letseka & Maile, 2008). In terms of IT skills, the needs of developing countries differ markedly from those of developed nations (Lynch & Szorenyi, 2005). In lower-income regions, limited access to devices and reliable internet has been well-documented, and this restricted access often confines training to basic ICT skills rather than more advanced applications. Individuals living in poverty typically have limited exposure to technology, resulting in lower baseline digital competencies compared to their counterparts in higher-income regions. Consequently, the complex use of ICTs remains largely out of reach for those who are still developing foundational technical skills.

2.9.6 Attitudes of educators

Learning outcomes are influenced by instructors' attitudes toward a particular technology (Webster & Hackley, 1997), making this a critical factor to consider when implementing LMS in teaching and learning. Academics often face multiple daily responsibilities, and integrating LMS into their workload can be challenging. Many perceive the use of LMS as time-consuming, which can limit their engagement with the system and affect its effective adoption (Narayan et al., 2010).

2.9.7 Students' perceptions

There is a common misconception among new and prospective students that open distance learning is more difficult than traditional face-to-face learning (Lonn & Teasley, 2009). However, the thoughtful use of technology to design and deliver appropriate learning materials can help dispel these perceptions and make distance learning more accessible and manageable.

2.9.8 Cultural challenges

Many information systems were developed in Western contexts and are therefore often biased toward these cultures, particularly the dominant cultural norms within those

societies (Pauleen & Murphy, 2005). Research suggests that culture plays a significant role in the adoption of information systems (Grant & Neill, 2001). Resistance to using these systems frequently arises from the perception that acquiring IT literacy represents a departure from one's cultural identity. Consequently, individuals who prioritize their cultural affiliations may be hesitant to engage with technology. Language barriers provide a concrete example: the lack of content and training in a user's indigenous language can impede understanding and adoption of information systems (Curtain, 2004).

A study conducted in Fiji illustrates this cultural dynamic. Urbanization has created tensions between indigenous Fijians and community members who value education and migration prospects for future generations (Lynch & Szorenyi, 2005). A clear divide emerged between more modernized individuals, who embraced IT as a tool for progress, and those who believed computer use was limited to women performing administrative roles. This perspective reflected the limited visibility of IT across the island, where computers and internet access were primarily confined to businesses or government offices. As a result, many individuals lacked exposure to IT, which restricted their understanding of its potential benefits and contributed to low adoption rates.

2.9.9 Complexity

A major challenge in the effective use of Learning Management Systems (LMS) lies in the complexity of their tools and interfaces, which can significantly impede adoption, particularly among educators with limited digital fluency. LMS platforms typically offer a wide array of features-including content delivery, communication tools, assessment modules, and analytics dashboards-but their non-intuitive layouts, inconsistent navigation, and multi-layered designs can increase cognitive load and reduce usability. Consequently, many users engage only with basic functions, such as uploading content or posting announcements, while avoiding more advanced features perceived as difficult. Dahlstrom et al. (2014) argue that although LMSs are functionally rich, they often fail to support deeper learning due to inflexible and cumbersome interfaces, resulting in dissatisfaction among both staff and students. Addressing LMS complexity through intuitive design, targeted training, and responsive technical support is therefore essential to ensure these systems enhance teaching and learning in digital environments.

Kakasevski et al. (2008) conducted an in-depth usability evaluation of Moodle, a widely used open-source LMS, to explore the challenges users encounter when interacting with its modules. Their study found that despite Moodle's broad functionality-including lessons, forums, quizzes, assignments, and wikis-users often experienced confusion due to the system's complexity and the sheer number of available tools. This overabundance of features can hinder effective teaching and learning, as both students and instructors struggle to identify which modules are best suited for specific tasks. Teachers reported difficulties using advanced tools like the Lesson module, while students struggled with assignment submissions and collaborative tools such as wikis. The study highlights that usability issues-non-intuitive navigation, overwhelming interface design, and varying levels of digital literacy-undermine the potential of LMS platforms to support pedagogical objectives. The authors recommend simplifying module selection, improving user training, and customizing system design to meet user needs in order to mitigate these barriers and enhance overall effectiveness.

These documented challenges closely mirror the barriers identified in phase one of my data collection, reinforcing the need for a structured, personalized strategy to build confidence and reduce complexity for science teacher educators. LMS challenges should not be interpreted as individual shortcomings but rather as systemic constraints that must be addressed through intentional design, support, and training.

Through diverse educational contexts, the literature consistently identifies challenges related to infrastructure, digital literacy, technical expertise, training, institutional support, attitudes, and system complexity as barriers to effective LMS use. While these challenges have been widely documented, many studies focus primarily on describing barriers rather than proposing and evaluating practical solutions. Furthermore, limited attention has been given to how these challenges influence science teacher educators within South African ODL institutions. This gap suggests the need for contextually relevant interventions that can address identified barriers and support more effective LMS adoption and pedagogical use.

2.10 LMS in science teacher education

LMS enables students to study science from any location, provided they have access to the internet and a computer (Cavus & Alhih, 2014). E-learning further enhances opportunities for student interaction, allowing for the accommodation of diverse learning styles and fostering more personalized engagement than traditional large lectures. Additionally, it supports the development of internet and computer skills, which are valuable for students' future careers, while also helping learners gain confidence and take responsibility for their own learning (Pandey & Pandey, 2009). A study by Ekici et al. (2012) demonstrated that the use of LMS improves the teaching of basic physics for science teacher candidates, who reported positive perceptions of these systems. Similarly, research on hybrid instruction in science revealed that LMS integration contributes to improved learning outcomes (Quarless & Nieto, 2012). In essence, integrating LMS into science education has not only democratized access to knowledge but also enriched learning experiences, shaping both pedagogical approaches and student achievement.

Although the literature indicates that LMSs can positively influence science teaching and learning, relatively few studies have focused specifically on science teacher educators as users of these systems. Much of the existing research concentrates on school learners, pre-service teachers, or general higher education contexts. Consequently, there remains limited understanding of how science teacher educators in South African ODL institutions perceive and utilise LMSs in their teaching practice. Addressing this gap is important because science teacher educators play a critical role in modelling effective technology integration for future science teachers.

2.11 Approaches to learning

I include the following approaches to illustrate how LMS tools can intentionally support science teacher education, highlighting that Moodle's potential extends beyond mere content storage to foster more interactive, constructivist learning experiences.

2.11.1 Flipped learning

Flipped learning, also referred to as the flipped classroom model, is an instructional approach that reverses the traditional sequence of learning activities (Heo & Chun, 2016). In conventional classrooms, new material is presented during class, while exercises or homework are completed outside of class to reinforce learning. In contrast, flipped learning leverages LMS platforms to deliver instructional content outside of class, freeing up class time for collaborative, application-oriented activities. This approach fosters a more student-centered and interactive learning environment, emphasizing engagement, critical thinking, and active participation.

2.11.2 Online collaborative learning

Technology-supported collaborative learning, a constructivist approach described by Kirschner et al. (2004), emphasizes the development of tools and strategies that foster collaboration in engaging and motivating environments. These methods often combine blended teaching and learning strategies with the affordances of technology and the internet. Harasim et al. (1995) define online collaborative learning as a process in which individuals work together to construct meaning. Collaborative and cooperative learning involves active engagement, where the educator serves as a facilitator and students take responsibility for their own learning, developing reflective skills and social competencies (Kirschner, 2001). This aligns with the constructivist perspective of Piaget, which emphasizes learning as a fundamentally social process. The learning sciences further highlight the importance of flexible learning environments that are not constrained by time or location (Resta & Laferrière, 2007). By integrating traditional pedagogical methods with technological tools such as LMS, educators can harness the power of the internet to enhance interaction, engagement, and motivation among learners. These models directly informed the design of my strategy, particularly in emphasizing communication tools, synchronous engagement, and student-centered interactions.

2.12 Conclusion

Collectively, the literature reviewed demonstrates that Learning Management System adoption is influenced by individual, institutional, technological, and contextual factors. Existing research consistently highlights the importance of perceived usefulness,

perceived ease of use, facilitating conditions, social influence, and technological competence in shaping educators' willingness to integrate LMS into their teaching practice. Although relatively few studies have examined LMS adoption specifically among science teacher educators within African open distance learning contexts, the available regional evidence demonstrates that challenges relating to digital confidence, institutional support, infrastructure, and pedagogically meaningful technology integration remain consistent across ODL environments. This highlights the need for contextually responsive strategies tailored to the unique pedagogical requirements of science teacher education. These identified gaps informed the development of the conceptual framework presented in Chapter 3 and justified the need to investigate science teacher educators' perceptions of LMS use and to develop a contextually relevant strategy to enhance meaningful LMS adoption.

Chapter 3: Conceptual and theoretical framework

3.1 Introduction

Understanding how tertiary science teacher educators utilize Learning Management Systems (LMS) is essential for enhancing educational practices and outcomes. To systematically investigate this issue, a robust conceptual framework is required. A conceptual framework provides a coherent structure for organizing, interpreting, and making sense of research data. It is developed by linking key concepts from the literature, thereby justifying the significance of the research topic. As Maxwell (2005) notes, a conceptual framework is constructed by synthesizing components from multiple sources, rather than existing in a fully formed state prior to research.

To address the main research question of this study--“

“What are the science teacher educators’ perceptions of using LMS in a South African distance university?”– the collected data has been systematically organized within the proposed conceptual framework. This framework serves both as a foundation for data interpretation and as a guide for the analytical process.

This chapter presents an overview of the conceptual framework employed to answer the research question. It also discusses the theoretical foundations relevant to the study, demonstrating how these perspectives inform the research design and analysis. By integrating these theoretical insights, the chapter provides a comprehensive understanding of how tertiary science teacher educators engage with LMS to facilitate teaching and learning.

3.2 Technology acceptance Model

To assess how organizations adopt and utilize computer-based information systems, researchers often employ the Technology Acceptance Model (TAM) (Zurinah et al., 2013). TAM, developed by Davis (1989), was derived from the broader Theory of Reasoned Action (Fishbein & Ajzen, 1975). The model focuses on two key factors: **Perceived Usefulness (PU)** and **Perceived Ease of Use (PEU)**. PU refers to the degree to which a user believes that employing a system will enhance their performance within an organizational context, while PEU describes the extent to which a user perceives a

computer system as easy to understand and operate (Davis, 1989). The diagram in figure 3.1 illustrates how PU and PEO influence behavioural intention and ultimately actual system use.

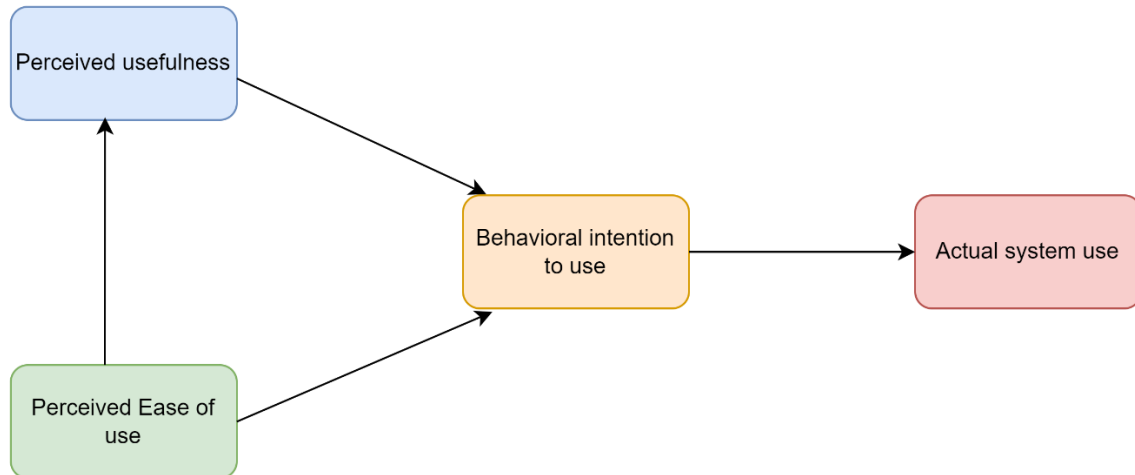


Figure 3.1 A diagrammatical representation of the Technology acceptance Model

Perceived Ease of Use (PEU) suggests that users are more likely to engage with an LMS if they believe the system is simple to use and they can quickly become proficient with it. Perceived Usefulness (PU), on the other hand, refers to the likelihood of using an LMS when it is considered effective in achieving the desired teaching and learning objectives (Zurinah et al., 2013). Extending the traditional TAM, some researchers have proposed including perceived enjoyment as a factor (van der Heijden, 2000), arguing that a positive and enjoyable experience when using an LMS encourages repeated use (Zurinah et al., 2013).

egris, Ingham, and Colletette (2003) critically examined TAM, originally developed by Davis (1986), to explain why individuals adopt or reject information technology. Their meta-analysis of 22 empirical studies confirmed that both perceived usefulness (PU) and perceived ease of use (PEU) significantly influence users' behavioural intention to adopt technology. However, they found inconsistencies across studies, and TAM was shown to explain only about 40% of system usage. This suggests that technology adoption is influenced by factors beyond individual perceptions alone. Similarly, Bagozzi (2007) argues that TAM oversimplifies the complexity of technology adoption by focusing primarily on individual cognitive processes while paying insufficient attention to social,

organisational, and contextual influences. These limitations indicate the need for broader models that incorporate human, social, and organisational factors. Consequently, Legris et al. (2003) recommended integrating TAM with other frameworks, such as innovation diffusion theory and task-technology fit, to provide a more comprehensive understanding of technology adoption across diverse contexts. This criticism supports the integration of TAM with UTAUT in the present study, enabling consideration of both individual perceptions and the wider contextual factors that may influence LMS adoption among science teacher educators.

3.3 Unified Theory of Acceptance and Use of Technology

To develop a comprehensive and integrative model, the Unified Theory of Acceptance and Use of Technology (UTAUT) incorporate human and social factors alongside constructs drawn from earlier information systems theories (Venkatesh et al., 2003). The model identifies four key constructs-Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC)-which collectively provide a robust framework for assessing users' behavioural intentions and actual technology use (Alshehri et al., 2020). The definitions of the four constructs are captured in table 3.1.

Table 3.1 Definition of the constructs of the UTAUT model

Construct	Definition
<i>Performance Expectancy (PE)</i>	The degree to which individuals believe that using the technology will enhance their performance or effectiveness
<i>Effort Expectancy (EE)</i>	The perceived ease of use and the level of effort required to use the technology
<i>Social Influence (SI)</i>	The influence of others' opinions, norms, and expectations on an individual's decision to use the technology
<i>Facilitating Conditions (FC)</i>	The availability of resources, support, and infrastructure that enable individuals to use the technology

The UTAUT model proposes that these constructs collectively shape an individual's behavioral intention to use technology, which subsequently determines their actual use of the system. Figure 3.2 illustrates the relationship between the constructs of the UTAUT model.

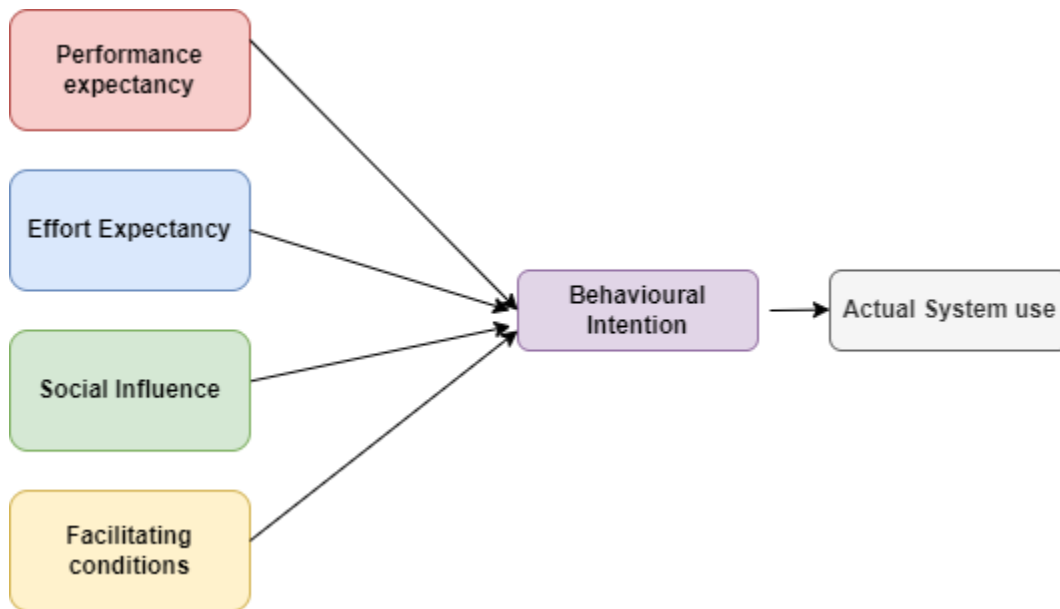


Figure 3.2 A diagrammatical representation of the UTAUT model

The UTAUT model also incorporates demographic characteristics such as gender, age, voluntariness, and experience, which enhance its ability to explain users' acceptance and usage of technology (Venkatesh et al., 2003). User differences may influence perceptions regarding how a system can be used (Burton-Jones & Hubona, 2006).

In a recent study, Alshehri et al. (2019) applied the UTAUT model to examine students' perceptions of LMS adoption in Saudi Arabian higher education. The findings revealed that 80% of participants had prior experience with the LMS, yet 64.3% had never received any formal training. The study highlighted that providing robust technical support and creating conducive facilitating conditions are crucial for encouraging LMS adoption. Administratively, this underscores the importance of offering efficient, timely, and structured training and support, as inadequate guidance can hinder user acceptance.

Overall, the study indicated that students perceived clear benefits in using the LMS. Specifically, social influence (SI), performance expectancy (PE), and technical support significantly affected students' intention to use the LMS. Additionally, demographic factors

such as age, gender, and prior experience may further shape behavioural intention and, consequently, the actual use of the system.

Despite its strong explanatory power, UTAUT has also been criticised. Bagozzi (2007) argues that the model incorporates numerous constructs and moderating variables, resulting in increased complexity and potential challenges in interpretation. Furthermore, UTAUT has been criticized for paying limited attention to cultural and contextual factors that may influence technology adoption in diverse educational settings. These limitations suggest that technology adoption should be interpreted within the broader organizational and contextual environment in which it occurs.

3.4 Development of the conceptual framework

The conceptual framework for this study was developed through the integration of constructs from the Technology Acceptance Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The integration was undertaken because neither framework independently provided sufficient explanatory power to address the specific focus of this study, namely understanding and enhancing LMS use among science teacher educators within a South African open distance learning context.

TAM was selected because of its strong emphasis on perceived usefulness and perceived ease of use, which have consistently been identified as key predictors of technology adoption in educational settings. However, TAM primarily focuses on individual perceptions and does not adequately account for contextual and institutional factors that may influence LMS use.

UTAUT was therefore incorporated to extend the explanatory scope of the framework. UTAUT includes additional constructs such as performance expectancy, effort expectancy, social influence, and facilitating conditions, enabling consideration of organisational, social, and infrastructural influences on technology adoption. These factors were particularly relevant within the South African ODL context, where access to resources, institutional support, and collegial influence may affect educators' engagement with LMS technologies.

The integration process involved retaining the TAM constructs of perceived usefulness and perceived ease of use because these constructs aligned directly with the study objectives and research questions. From UTAUT, performance expectancy, effort expectancy, social influence, and facilitating conditions were retained because of their relevance to understanding educator experiences and institutional influences on LMS use. UTAUT moderating variables such as age, gender, experience, and voluntariness of use were not included as primary constructs because the study focused on perceptions and experiences rather than demographic differences in technology adoption.

In addition, familiarity with technology emerged repeatedly in the literature as an important factor influencing LMS engagement and was therefore incorporated into the conceptual framework as a supporting construct. The resulting framework provided a comprehensive lens through which both individual perceptions and contextual influences on LMS use could be explored. This integrated approach enabled the study to move beyond explaining LMS adoption towards informing the development of a contextually relevant strategy for enhancing LMS use among science teacher educators.

Within the adapted conceptual framework, perceived ease of use, effort expectancy, facilitating conditions, and familiarity with technology collectively influence educators' confidence and willingness to engage with LMS technologies. Perceived usefulness, performance expectancy, and social influence contribute to educators' perceptions of the value of LMS use for teaching and learning. Together, these constructs provide a holistic understanding of both the individual and contextual factors that influence LMS adoption and use among science teacher educators within an ODL environment.

3.5 Presentation of an adapted conceptual framework

The integration of TAM and UTAUT resulted in an adapted conceptual framework that combines individual perceptions of technology use with contextual and institutional influences on LMS adoption. The framework incorporates perceived usefulness and perceived ease of use from TAM, together with performance expectancy, effort expectancy, social influence, and facilitating conditions from UTAUT. Familiarity with technology is included as a supporting factor due to its influence on educators' engagement with LMS technologies. Collectively, these constructs provide a

comprehensive lens for examining LMS use among science teacher educators and for informing the development of an LMS enhancement strategy. Figure 3.3 presents the adapted conceptual framework used in this study.

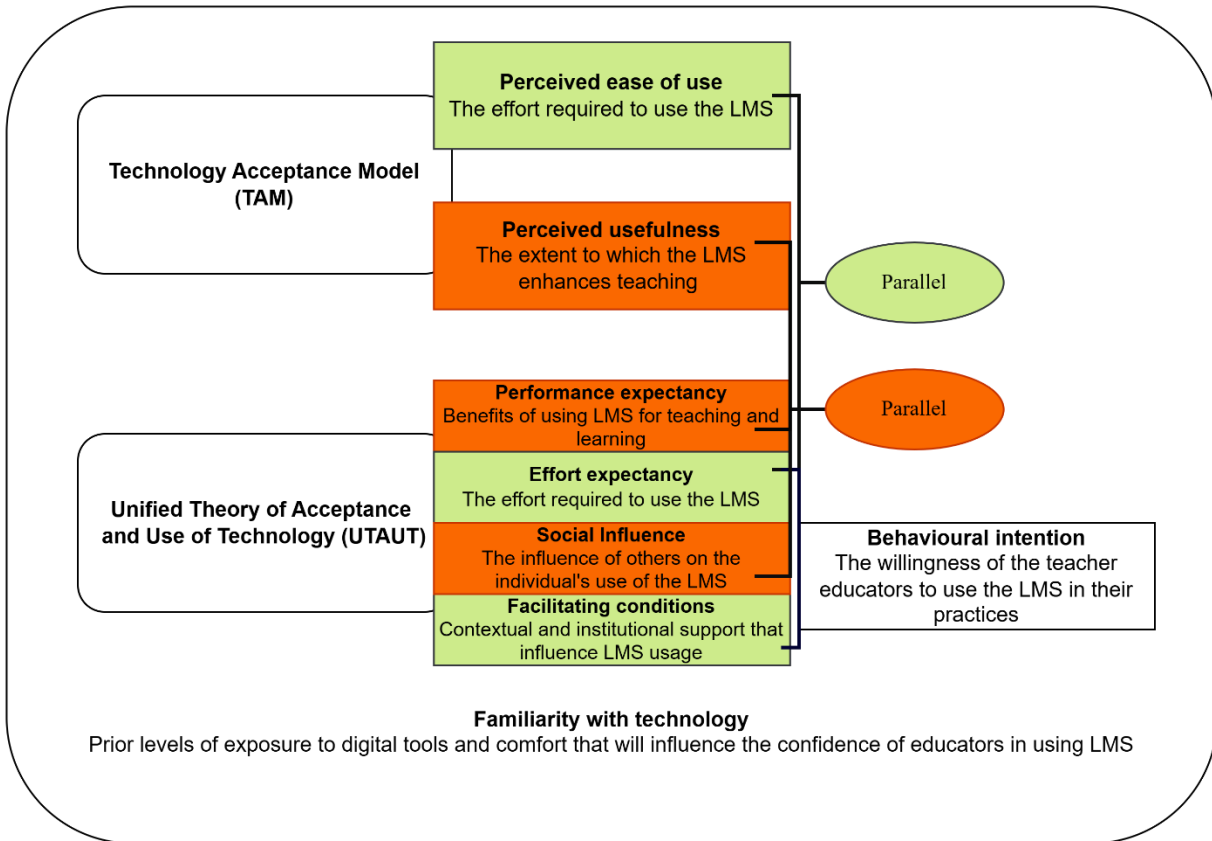


Figure 3.3 A diagrammatical representation of the adapted conceptual framework

3.5.1 Defining the constructs of the conceptual framework

Each construct of the conceptual framework must be clearly understood to identify the factors that influence it and to examine how each construct contributes to the teaching and learning practices of teacher educators in distance science education. The constructs are defined in table 3.2.

Table 3.2 Defining the constructs of the conceptual framework

Construct	Definition	Construct	Definition
<i>Performance Expectancy (PE)</i>	The degree to which individuals believe that using the LMS will enhance their performance or effectiveness of teaching and learning activities	Perceived usefulness	The degree to which individuals believe that the use of LMS will improve their teaching and learning activities
<i>Social Influence (SI)</i>	The influence of others' opinions, norms, and expectations on an individual's decision to use the LMS, especially those in teaching and learning management.		
<i>Effort Expectancy (EE)</i>	The perceived level of difficulty and effort required to use the LMS for the intended purpose of teaching and learning.	Perceived ease of use	The level of difficulty encountered when using the LMS for teaching and learning activities
<i>Facilitating Conditions (FC)</i>	The availability of resources, support, and infrastructure that enable individuals to use the LMS		

3.5.2 Familiarity with technology

As suggested by the UTAUT model, certain demographic factors can influence the use of LMS. In this conceptual framework, familiarity with technology is explored as a key demographic factor. This factor reflects an individual's level of technological proficiency and comfort, which can significantly affect their engagement with and effective use of an LMS in an educational context. Sub-factors that contribute to familiarity with technology may include age, educational level or specialty, cultural background, and prior exposure to LMS, among others. Attention will also be given to the implications of the digital divide.

3.6 Conclusion

This chapter presented the conceptual framework that guided the study. The framework was developed through the integration of constructs from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) to provide a comprehensive understanding of the factors influencing LMS use among science teacher educators in a South African open distance learning context. The chapter justified the selection and integration of the two models, explained the constructs retained from each framework, and highlighted the inclusion of familiarity with technology as a supporting factor influencing LMS engagement. Together, these constructs provided a lens through which participants' perceptions and experiences of LMS use could be explored and analysed. The conceptual framework further informed the development of the data collection instruments, data analysis process, and the design of the LMS enhancement strategy. The next chapter presents the research methodology employed to investigate science teacher educators' perceptions and experiences of LMS use.

Chapter 4: Research methodology

4.1 Introduction to Research design

This chapter outlines the research methodology employed in this study to address the research questions. The choice of research design is informed by the researcher's ontological and epistemological perspectives, as well as by the various methodological approaches that shape how data is collected (Nieuwenhuis, 2019). Prior to data collection and analysis, it is essential to establish a clear plan detailing how and why the data will be gathered (Babbie, 2020).

The chapter further maps out the procedures followed to collect the data necessary for addressing the two primary research objectives of the study:

- Identifying science teacher educators' perceived ease of use of Learning Management Systems in open distance education.
- Identifying the perceived usefulness of Learning Management Systems in open distance education

Thereafter, the data collection process will be outlined to address the study's final research objective:

- Investigating the science teacher educator experiences of the implementation of the developed strategy for using Learning management systems in open distance education.

This research framework was designed to generate data capable of addressing the study's main research question and associated sub-questions. Through the use of multiple qualitative data collection instruments across two phases, the study explored science teacher educators' perceptions of LMS use and their experiences of the implemented LMS enhancement strategy.

The main research question is:

- What are the science teacher educators' perceptions of using LMS in a South African distance university?

4.2 Research approach

For a clear understanding of how research will be conducted, the chosen research approach must be explained (Mouton, 2001). This study employed a qualitative methodology to generate naturalistic data and explore social environments and the behaviours of their participants (Berg, 2007). Qualitative research seeks to understand how individuals interpret and make meaning of their experiences within particular social contexts (Denzin & Lincoln, 2018). Qualitative research, often referred to as linguistic research, relies on verbal rather than numerical data (Polkinghorne, 1989) and is well-suited to exploratory questions that seek in-depth understanding rather than closed-ended responses (Elliot & Timulak, 2007). It also facilitates dialogue between the researcher and participants (De Vos et al., 2002).

A qualitative approach was appropriate for this study because it enabled the researcher to explore science teacher educators' perceptions, experiences, and meanings related to LMS use in depth. Since the study sought to understand how participants perceived the ease of use and usefulness of LMSs, as well as how they experienced the implementation of the LMS enhancement strategy, qualitative inquiry provided a suitable means of generating rich, contextualized data within the natural setting of open distance education. The research setting is discussed in Section 4.5

4.3 Research design

The study adopted a multi-case study research design, treating each science teacher educator as a distinct case. This design was chosen because the aim was not to compare participants but to gain an in-depth understanding of how each individual experienced and interpreted LMS use within a South African open distance learning context. The focus was on illuminating the complexity of teacher educators' perceptions, behaviours, and interactions with the LMS rather than generalizing across a large population. A case study is therefore appropriate, as it allows the researcher to investigate a bounded system in real-world conditions and to explore contemporary experiences in depth (Yin, 2003).

A multi-case study design further strengthens the trustworthiness of the research by supporting analytic generalization rather than statistical generalization. Each case

provides a unique lens, and collectively, the cases offer a richer, more nuanced understanding of LMS adoption.

This design required sustained engagement with participants. The researcher interacted closely with teacher educators throughout two distinct phases of data collection, reflecting the intensive nature of case study inquiry. In Phase 1, baseline interviews and non-participant module-site observations were conducted to document current LMS use and perceptions. These observations allowed the researcher to understand existing LMS practices without influencing or altering participants' natural behaviours.

- **Phase 1** was *explanatory*, as it sought to understand and explain teacher educators' initial perceptions of LMS ease of use, usefulness, and the contextual barriers affecting adoption.
- **Phase 2** was *exploratory*, as it examined how teacher educators engaged with the LMS strategy and how their experiences, perceptions and intentions evolved after the intervention.

By structuring the research design in this way, the study moves beyond static description to provide a dynamic, development-focused understanding of LMS adoption. The multi-case design enabled the researcher to trace changes over time, capture individual variations, and generate a holistic picture of how a structured LMS strategy can influence digital confidence, technological familiarity, and actual usage among science teacher educators.

4.4 Research paradigm

A research paradigm refers to the philosophical framework and assumptions that guide a researcher's approach to conducting a study and interpreting its findings. It shapes the choice of research methods and influences the way data is understood by framing and constraining the meanings derived from it (Kivunja & Kuyini, 2017). This study adopted the interpretivist paradigm, also known as anti-positivism, which has gained prominence across various research domains, particularly the social sciences. Interpretivism emphasizes understanding individual experiences and uncovering the underlying truths of social phenomena (Pathak & Thapaliya, 2022; Maree, 2010). Denzin and Lincoln

(2018) argue that interpretivist qualitative inquiry seeks to understand social reality through the meanings individuals assign to their lived experiences. It emerged as a response to the dominance of positivism and is closely associated with qualitative research methods (Pulla & Carter, 2018).

Case study methodology is rooted in a constructivist paradigm, which assumes that reality is socially constructed and best understood through the meanings individuals assign to their experiences. This paradigm aligns with the study's aim: to understand teacher educators' perspectives regarding LMS ease of use, usefulness, and digital confidence. Constructivist case studies acknowledge multiple realities and emphasize the co-construction of meaning between researcher and participant, while still enabling systematic and rigorous analysis (Yin, 2003).

Interpretivism is particularly relevant to this qualitative study, which aimed to explore science teacher educators' perceived ease of use and usefulness of Learning Management Systems (LMS) and to develop a strategy for enhancing LMS adoption. Its focus on understanding subjective experiences and hidden realities aligns with the study's goal of capturing the educators' perspectives and experiences. The paradigm allows for a deep exploration of the social phenomena and subjective realities experienced by science teacher educators when using LMS (Pulla & Carter, 2018). Moreover, interpretivism's emphasis on understanding social dynamics and underlying complexities makes it well-suited for uncovering the intricate challenges and opportunities associated with LMS use in science education (Pathak & Thapaliya, 2022).

Consistent with the interpretivist paradigm, the study sought to understand and interpret participants' perceptions and experiences of LMS use within their natural institutional context rather than to measure variables, test hypotheses, or establish causal relationships. Consequently, the language and methodological decisions adopted throughout the study reflect an emphasis on meaning-making, context, and the co-construction of knowledge between the researcher and participants.

4.5 Research setting

The participants of this study are teacher educators at an open distance university in South Africa. The institution's key strategy for maintaining its competitive advantage is a strong focus on innovative instructional approaches (Ramdass & Masithulela, 2016). One of its mandates is to employ integrated marketing and communication strategies to establish itself as a leading, inclusive provider of open distance learning (ODL) (Prinsloo & Nthebolang, 2021).

The university leverages various technologies to deliver modules to students, emphasizing open distance education and technology-enhanced learning. The primary platform for content delivery is the Learning Management System (LMS). Each module has its own site within the LMS, managed by the responsible educators, and sometimes supported by secondary educators when student numbers are high. Educators are responsible for creating and uploading content-including documents, slideshows, videos, live lessons, images, and discussion forums-while also facilitating teaching and learning by responding to student queries, posting announcements, and marking assignments.

In cases where modules have large enrolments, sometimes numbering in the thousands, educators receive additional support from teaching assistants, e-tutors, and external markers who provide guidance and feedback on content and assignment submissions. The LMS also serves as a portal for administering and submitting assignments, examinations, and portfolios. Administrative staff assist technically by linking educators to their module sites and monitoring teaching activities.

While students and educators may occasionally communicate via email or social media, formal teaching and learning predominantly occur within the LMS. Module design is another critical component of teaching, with educators regularly updating content to align with current educational trends. Administrative staff often assist with formatting and editing content before it is uploaded, and educators may seek support from module design specialists when technical challenges or workload constraints arise.

The university's emphasis on innovative learning environments, mobile learning, and distance education demonstrates a strong commitment to technology use. These approaches allow students who cannot attend traditional on-campus sessions to access

flexible and inclusive education. Furthermore, the university's adoption of digital learning environments aligns with global trends in higher education.

Given the online nature of teaching at this institution, science teacher educators may be located across all nine provinces of South Africa, as teaching and learning occur via the LMS and are not restricted to a single physical location. The university serves over 300,000 students (Lekhetso, 2021). Within the science teacher education department, there are approximately 54,000 unique student registrations across more than 35 modules, with enrolments ranging from three to 15,000 students per module. Science teacher educators are responsible for delivering these modules to students enrolled in diverse programs, including higher certificates, bachelor degrees, postgraduate qualifications, and advanced diplomas, all ultimately preparing students for careers in education.

4.6 Sampling

Sampling refers to the process of selecting participants from a larger population for inclusion in a study (Johnson & Christensen, 2000). This study employed purposeful criterion sampling, a technique commonly used in qualitative research to identify information-rich participants who possess direct experience of the phenomenon under investigation (McMillan & Schumacher, 2001). Purposeful sampling was considered appropriate because the study sought in-depth insights into the use of Learning Management Systems (LMS) by science teacher educators rather than statistically representative findings.

Four science teacher educators were purposively selected from the Department of Science and Technology Education at a South African open distance learning university. Participants were selected according to predetermined inclusion criteria. Firstly, participants had to be responsible for teaching a science education module that made active use of the LMS. Secondly, participants had to have a minimum of two years' experience teaching within the department to ensure familiarity with institutional LMS practices. Thirdly, the selected participants were required to represent different student cohorts and qualification levels to ensure diversity of experiences across the science teacher education programme. Finally, participants had to be willing to participate in both

phases of the study, including the implementation and evaluation of the LMS enhancement strategy.

The use of purposeful criterion sampling ensured that participants possessed sufficient experience and contextual knowledge to provide detailed information regarding LMS use, perceived usefulness, perceived ease of use, and experiences of the implemented strategy.

Table 4.1 provides an overview of the four participants selected through purposeful criterion sampling. The participants were chosen to represent different qualification levels, student cohorts, and science education specializations within the Department of Science and Technology Education. This variation enabled the study to capture a range of perspectives and experiences relating to LMS use across diverse science teacher education contexts within the institution.

Table 4.1 An overview of the research participants and module profiles

Case	Participant	Years experience	Module NQF level	Module credits	Approximate students	Module Specialization
Case A	Dr K	3	7	12	1000	Life Sciences Education
Case B	Mr L	4	6	12	4000	Natural Sciences Education
Case C	Dr E	2	7	12	100	Natural Sciences methodology
Case D	Dr M	4	5	12	3500	Higher certificate module for prospective science education students

4.7 Cases

For the development of the LMS strategy, each science teacher educator and their respective module site will be treated as an individual case. To ensure confidentiality, the participants will remain anonymous, and pseudonyms will be used throughout the study. The teacher educators are responsible for preparing study materials for the students registered in their modules, as well as for navigating their module sites to facilitate teaching, learning, and assessment activities.

Case 1: Dr K

Dr K is a science teacher educator in the Department of Science and Technology Education and has three years of teaching experience at the institution. She is responsible for a Life Sciences Education module offered at NQF Level 7 and carrying 12 credits. The module is typically taken by students in the final year of the Bachelor of Education qualification and enrolls approximately 1,000 students annually. The module is offered fully online and serves students specializing in Life Sciences Education.

Case 2: Mr L

Mr L is a science teacher educator within the Department of Science and Technology Education and has four years of teaching experience at the institution. He is responsible for a second-year Natural Sciences Education module offered at NQF Level 6. The module carries 12 credits and enrolls approximately 4,000 students annually. It is delivered through a blended learning approach, where core content is provided through study materials and supplemented by LMS-based teaching and learning activities.

Case 3: Dr E

Dr E is a science teacher educator in the Department of Science and Technology Education and has two years of teaching experience at the institution, with more than five years of experience in tertiary education. He is responsible for a Natural Sciences Methodology module offered at NQF Level 7 and carrying 12 credits. The module enrolls approximately 100 students annually and is offered to students specialising in science education. The relatively small class size allows for greater interaction with students and provides a contrasting context to the larger undergraduate modules included in this study.

Case 4: Dr M

Dr M is a science teacher educator in the Department of Science and Technology Education and has four years of teaching experience at the institution. He is responsible for a first-year science education module offered at NQF Level 5 and carrying 12 credits. The module enrolls approximately 3,500 students annually and serves as a foundational module for students registered for a Higher Certificate and prospective science education students. The module is offered fully online and provides students with an introduction to key concepts and practices in science education.

4.8 Data management

The following section outlines the methods used for data collection, detailing how the data was gathered, interpreted, analyzed, and presented.

4.8.1 Data collection techniques

This section outlines the data collection techniques employed in each phase of the study. In Phase 1, data were gathered through questionnaires and observations, while Phase 2, conducted after the development and implementation of the strategy, involved interviews and on-site observations.

4.8.1.1 Phase 1- Data collection

The initial data collection made use of two instruments. Questionnaires and semi-structured interviews.

Questionnaires

Questionnaires are widely regarded as an effective tool for basic profiling and gathering baseline information, particularly because they are quick to administer, cost-effective, and allow for easy comparison across participants (Chiwome & Thondlana, 1992). In this study, questionnaires played a foundational role in the initial data collection process by providing a structured method for capturing the science teacher educators' demographic information, prior LMS experience, and preliminary perceptions of LMS use.

The questionnaire (Appendix D) was developed by the researcher and administered electronically using Microsoft Forms. It consisted of 30 predominantly closed-ended items

organised into three sections. The first section collected biographical information, including age, gender, years of tertiary teaching experience, and previous LMS training. The second section focused on perceived ease of use and included items related to effort expectancy, facilitating conditions, and familiarity with technology. The third section explored perceived usefulness and included items relating to performance expectancy, social influence, and familiarity with technology. Responses were primarily collected using five-point Likert-type scales. Examples of questionnaire items included: “How would you rate the user-friendliness of the LMS interface?” and “How do you rate the contribution of the LMS to the efficient planning of your lessons?” The questionnaire was used to establish participant profiles, identify areas requiring further exploration, and inform the development of the semi-structured interview questions.

The questionnaire functioned as a diagnostic instrument, eliciting initial insights into participants’ confidence levels, familiarity with different LMS tools, and the extent to which they perceived the LMS as supporting or hindering their teaching practices. These initial perceptions were critical not only for understanding participants’ engagement with the LMS but also for guiding subsequent phases of data collection.

Importantly, the questionnaire responses informed the structure and focus of the Phase 1 semi-structured interviews. Items where teacher educators selected neutral, uncertain, or negative responses were used to generate targeted interview probes, enabling the researcher to explore underlying reasons, contextual factors, and practical examples that could not be captured through closed-ended questions alone. In this way, the questionnaire and interviews were intentionally integrated, with the former providing an evidence-based foundation for deeper qualitative inquiry.

Additionally, the questionnaire responses served as a point of triangulation during analysis, enhancing the credibility and trustworthiness of the findings. By comparing questionnaire trends with interview narratives and on-site module observations, the researcher was able to identify consistencies, contradictions, and areas requiring further clarification, all of which contributed to the design of the LMS enhancement strategy presented later in the study.

Interviews

An interview is a two-way, interactive dialogue in which the interviewer poses questions to a participant with the aim of eliciting information and gaining an in-depth understanding of their thoughts, beliefs, views, opinions, and behaviours (Nieuwenhuis, 2019). Interviews allow for the collection of rich, descriptive data that offers insight into participants' social realities and lived experiences-forms of understanding that are difficult to capture through other data collection methods. In qualitative research, interviews are therefore essential for revealing the meanings participants attach to phenomena within their professional contexts. In this study, semi-structured interviews were employed during the initial phase of data collection to corroborate the information gathered through questionnaires and to explore new lines of inquiry specifically related to science teacher educators' perceived ease of use and perceived usefulness of the LMS. The questions were developed by the researcher, guided initially by the conceptual framework, but further expanded on as a result of the questionnaire responses. Before conducting interviews, the data from the questionnaire was organized to reveal concepts that required further exploration.

The semi-structured format provided both structure and flexibility: predetermined questions ensured alignment with the research objectives and conceptual framework, while open-ended questions allowed participants to elaborate freely on their experiences. Where responses were broad, ambiguous, or particularly insightful, the researcher used probing questions to elicit clarification, further detail, or examples. This approach ensured that nuanced perspectives were captured and that the complexity of participants' interactions with the LMS was represented accurately.

The Phase 1 interviews aimed to identify teacher educators' perceptions of LMS usage in their modules, including their confidence levels, challenges, and the contextual factors influencing their engagement with LMS tools. Several interview questions were informed directly by questionnaire responses, enabling the researcher to explore issues requiring further clarification or deeper explanation. This strategy enhanced the credibility of the findings through methodological triangulation.

The Phase 2 interview guide is included in Appendix E. These interviews were unstructured and reflective in nature and were conducted following implementation of the LMS enhancement strategy. The interview guide consisted of 13 broad questions designed to explore participants' experiences of the strategy, changes in LMS use, perceived usefulness of the intervention, confidence in using LMS tools, and recommendations for future implementation. Example questions included: "How would you describe your overall experience of participating in the LMS enhancement strategy?" and "Which tools or practices from the strategy are you most likely to continue using, and why?"

All interviews were conducted synchronously via Microsoft Teams, accommodating the geographically dispersed nature of participants within the open distance learning environment. With prior informed consent from both the institution and individual participants, the interviews were recorded to ensure accuracy in transcription and analysis. These recordings provided a verbatim account of participants' responses, supporting a rigorous and trustworthy analytic process in subsequent phases of the study.

Observations

On-site observation refers to the systematic examination of a naturally occurring setting to collect accurate, context-specific data about behaviours, processes, or practices as they unfold in real environments (Gittinger et al., 2022). In this study, on-site observations were conducted directly on each participant's LMS module site-without the participants being present-to ensure that the data reflected genuine, unaltered usage patterns rather than behaviours influenced by observation or interaction with the researcher.

Observations were guided by four implementation checklists (Appendix H) corresponding to the stages of the LMS enhancement strategy: orientation, content uploading, communication tools, and the use of BigBlueButton for online teaching. Each checklist contained specific tasks, completion indicators, and reflective prompts that enabled the researcher to document participant engagement with LMS tools and monitor progress throughout the intervention. Observation data were recorded using structured field notes and were used to corroborate questionnaire and interview findings.

The purpose of these observations was twofold. First, they provided an authentic account of how teacher educators were engaging with their LMS sites, including the types of tools used, the structure of course pages, the frequency and nature of communication, and the extent to which LMS functionalities were leveraged for teaching and learning. Second, the observations served to corroborate and deepen insights obtained from the questionnaires and interviews conducted in Phase 1. By comparing participants' self-reported perceptions with their observable LMS practices, the researcher was able to validate the data through methodological triangulation, enhancing both the trustworthiness and credibility of the findings.

Importantly, the insights generated from these observations directly informed the development of the LMS enhancement strategy implemented in Phase 2. For example, limited use of advanced functionalities, reliance on basic content-upload tools, and the absence of synchronous teaching features such as BigBlueButton highlighted specific gaps that the strategy needed to address. Thus, the on-site observations not only provided a descriptive baseline of existing LMS use but also played a critical role in shaping a targeted, needs-responsive intervention aligned with both the conceptual framework and the realities of the open distance education environment.

4.8.1.2 Phase 2- Data collection

Phase 2 data collection occurred after the implementation of the LMS enhancement strategy and aimed to capture participants' post-intervention perceptions and experiences. In this phase, semi-structured reflection interviews were conducted to explore how the strategy influenced teacher educators' views on LMS ease of use, perceived usefulness, and overall adoption. These interviews were complemented by on-site module observations, which verified and contextualized the reported changes in LMS practices. Together, the interviews and observations provided rich, triangulated data that informed a comprehensive evaluation of the strategy's effectiveness.

Interviews

Following the development and implementation of the LMS enhancement strategy, unstructured reflection interviews were conducted to explore participants' experiences and to gain deeper insight into how the strategy influenced their use of the LMS in their

modules. Unstructured interviews were particularly appropriate at this stage, as they allowed participants to express their perceptions, challenges, and changes in practice freely, without being constrained by predetermined response categories. This openness enabled the researcher to capture nuanced reflections on the strategy's relevance, usability, and impact on teaching practices.

These interviews complemented the subsequent on-site observations by providing personal accounts that contextualized and explained observable changes in LMS usage. All interviews were conducted via Microsoft Teams and recorded with prior institutional and participant consent to ensure accuracy during transcription and analysis.

4.9 Data collection procedure

Prior to data collection, permissions were obtained from the institution, and informed consent was secured from all participants, including consent to record the interviews. Once approvals were granted, the researcher arranged an online meeting to explain the data collection process to the identified participants. Subsequently, the four science teacher educators received a link to complete the questionnaire online via Microsoft Forms.

After analysing the questionnaire responses into categories (described in chapter 5) to identify further lines of inquiry, the researcher scheduled individual online interviews with each participant using Microsoft Teams. During these semi-structured interviews, participants were asked a series of open- and closed-ended questions to explore their perceptions of LMS use prior to the implementation of the enhancement strategy.

To conclude Phase 1, the researcher conducted on-site observations of each participant's LMS module site. These observations provided an authentic view of how teacher educators were engaging with the LMS and allowed the researcher to corroborate the information collected through questionnaires and interviews.

The insights gained from Phase 1, together with findings from the relevant literature, informed the development of the LMS enhancement strategy.

One component of the LMS enhancement strategy involved the use of BigBlueButton , a web-conferencing tool integrated within the Learning Management System.

BigBlueButton supports synchronous and asynchronous teaching by enabling virtual classrooms, live presentations, screen sharing, breakout rooms, and session recordings. The inclusion of BigBlueButton was informed by Phase 1 findings, which revealed limited use of LMS communication and engagement tools among participants. The tool was therefore incorporated into the strategy to strengthen interaction, communication, and online teaching practices within the LMS environment.

An overview of the entire research process is presented in figure 4.1.

Figure 4.1 A diagrammatical representation of the research process

4.10 Data analysis and interpretation

The case study method allows for the use of multiple data collection approaches and a variety of data analysis techniques, providing researchers with opportunities to triangulate the data and thereby strengthen the validity and reliability of their findings and conclusions (Creswell et al., 2019; Creswell & Creswell, 2023). To move beyond participants' initial perceptions and enhance the accuracy and trustworthiness of the results, researchers must remain open to emerging insights and new perspectives throughout the data review and analysis process.

4.10.1 Phase 1: Interviews

To understand the participants' reasoning and perspectives, all recorded interviews were first transcribed verbatim and analysed using a systematic qualitative approach. The researcher gained an overall sense of the participants' experiences through repeated readings of the transcripts before proceeding to code the data. The coding process employed thematic analysis (TA), as described by Clarke and Braun (2015), which provides a rigorous method for identifying, analysing, and interpreting meaningful patterns-or "themes"-within qualitative data. TA enabled the researcher to move beyond the surface content of the interviews to uncover deeper perceptions of LMS use, challenges, and influencing factors. Significant statements were identified and grouped into categories aligned with the constructs of perceived ease of use, perceived usefulness, performance expectancy, social influence, effort expectancy, and facilitating conditions. This approach allowed for a structured yet flexible interpretation of participants' initial experiences with the LMS, forming the analytical foundation for the development of the LMS enhancement strategy.

4.10.2 Phase 1: Questionnaires

The data collected from the questionnaires were analysed to establish a baseline profile for each participant and to provide an initial diagnostic understanding of their perceptions regarding LMS usefulness and ease of use. This baseline was instrumental in shaping the semi-structured interview questions, ensuring that the interviews addressed the individual contexts, challenges, and levels of LMS engagement reported by each teacher educator.

During the analysis of the questionnaire responses, descriptive patterns were identified to highlight areas where participants demonstrated confidence, uncertainty, or limited prior exposure to LMS functionalities. As Creswell et al. (2019) note, qualitative data analysis does not rely on predetermined themes; rather, patterns emerge through the systematic examination of responses—a process known as pattern matching. In this study, the emerging patterns from the questionnaires informed the refinement of the thematic framework later applied in the interviews, maintaining an iterative, coherent, and conceptually aligned data collection process.

Thus, the questionnaire analysis served a dual purpose: it provided an initial understanding of participants' baseline perceptions and acted as an analytical bridge, linking preliminary findings to the more exploratory, in-depth insights obtained through the interviews. This layering of data enhanced the rigor of Phase 1 by enabling the triangulation of participants' self-reported perceptions with their interview narratives and subsequent on-site observations.

4.10.3 Phase 1: Observations

The field notes generated from the Phase 1 on-site observations were systematically analysed and coded in alignment with the themes derived from the conceptual framework. These observations were conducted directly on the participants' LMS module sites without their presence, allowing the researcher to capture authentic patterns of LMS usage as they naturally occurred. Coding involved a careful, line-by-line examination of the qualitative data, breaking it into meaningful analytical segments to support deeper interpretation (Creswell et al., 2019). In this study, the coding process focused on identifying evidence related to perceived ease of use, perceived usefulness, performance expectancy, facilitating conditions, and familiarity with technology, as outlined in the TAM and UTAUT models guiding the research.

Through this process, the field notes were organised into thematic categories reflecting both observable teaching practices and patterns of LMS engagement. For example, instances of minimal functionality use, reliance on basic tools, or avoidance of interactive features were coded under effort expectancy or perceived complexity, whereas evidence of well-organized content or innovative tool use reflected perceived usefulness or

performance expectancy. By mapping observable behaviours onto the theoretical constructs, the observation analysis provided an objective account of how participants engaged with the LMS prior to the strategy's implementation. These insights were instrumental in informing the design of the LMS enhancement strategy, ensuring that each component of the intervention directly addressed the barriers and gaps identified in Phase 1 observations.

4.10.4 Phase 2: Interviews

The Phase 2 interviews, conducted after the implementation of the LMS enhancement strategy, were analysed to gain an in-depth understanding of how participants experienced the strategy and how it influenced their perceptions and use of the LMS. As in Phase 1, all interviews were recorded-with full institutional and participant consent-and transcribed verbatim to ensure accuracy and preserve the nuances of participants' reflections and interpretations. The analysis followed a rigorous qualitative approach, grounded in thematic analysis (TA), which is well-suited for examining complex experiential data (Clarke & Braun, 2015).

The transcribed interviews were read repeatedly to ensure immersion in the data and to develop a holistic understanding of each participant's post-implementation experience. A systematic coding process was then undertaken, labelling data segments according to meaning, relevance, and alignment with the conceptual framework. Coding focused on constructs from the Technology Acceptance Model (TAM)-perceived ease of use and perceived usefulness-and the Unified Theory of Acceptance and Use of Technology (UTAUT)-performance expectancy, effort expectancy, social influence, and facilitating conditions-along with the contextual factor of familiarity with technology identified in Phase 1. The coding was both deductive, guided by these predetermined constructs, and inductive, capturing emergent insights or unexpected patterns from the data.

After coding, the data were organized into thematic categories reflecting participants' experiences with the LMS strategy, changes in their perceptions, and evolution of their behavioral intentions regarding LMS use. The analysis examined not only shifts in perceptions but also the mechanisms driving these changes, such as increased confidence, reduced anxiety, exposure to new tools, improved clarity, or enhanced

pedagogical alignment. This approach moved beyond descriptive reporting to provide an explanatory understanding of the strategy's influence on LMS adoption.

Data analysis was guided by the adapted conceptual framework developed from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). A deductive thematic analysis approach was employed, whereby the themes and categories were informed by the constructs of the conceptual framework. During Phase 1, two overarching themes were identified, namely perceived ease of use and perceived usefulness. Within perceived ease of use, the categories effort expectancy, facilitating conditions, and familiarity with technology were identified. These categories included sub-categories such as intuitive design, learning curve, complexity, technical support, resource accessibility, infrastructure, prior experience, technology training, and self-efficacy. Within perceived usefulness, the categories performance expectancy, social influence, and familiarity with technology were identified. These categories included sub-categories such as teaching efficiency, student engagement, content delivery, collegial endorsement, institutional support, recognition, digital literacy, and innovativeness. The conceptual framework therefore provided a structured lens through which participant responses were coded, organised, and interpreted. A detailed representation of the themes, categories, and sub-categories used during data analysis is provided in Appendix I (Data Analysis Scheme). The Phase 2 interviews thus generated rich, reflective, and explanatory accounts that complemented the observational data, enabling a holistic understanding of the strategy's impact. These findings formed the foundation for the cross-case analysis and the broader discussion presented in subsequent chapters.

4.11 Trustworthiness and the Pilot Study

Establishing trustworthiness is a fundamental consideration in qualitative research, ensuring that the methods used for data collection and analysis produce findings that are credible, dependable, and grounded in participants' lived experiences. Lincoln and Guba (1985) identify four key criteria for trustworthiness: credibility, transferability, dependability, and confirmability. These criteria serve as a framework for demonstrating that the study's interpretations authentically reflect the phenomenon under investigation, rather than being influenced by researcher bias or methodological shortcomings.

4.11.1 Establishing trustworthiness

In qualitative research, the rigor of a study is typically evaluated through the concept of trustworthiness rather than the quantitative notions of reliability and validity. Lincoln and Guba (1985) propose four criteria for establishing trustworthiness, namely credibility, dependability, confirmability, and transferability. These criteria provide a framework for ensuring that the findings accurately reflect participants' experiences and that the research process is transparent, systematic, and defensible. In this study, trustworthiness was enhanced through multiple strategies, including pilot testing, methodological triangulation, prolonged engagement with participants, reflexive practice, and the maintenance of a clear audit trail.

4.11.2 The pilot study

To ensure methodological rigor and enhance the credibility, dependability, and overall trustworthiness of the study, a pilot study was incorporated at multiple stages of the research process. Rather than serving as a one-time pretest, the pilot functioned as an iterative and developmental mechanism, enabling the researcher to refine both the data collection instruments and the LMS intervention strategy. This approach aligns with Lincoln and Guba's (1985) assertion that trustworthiness in qualitative research is strengthened when the study design remains responsive and adaptive to emerging insights.

4.11.2.1 Phase 1:

A formal pilot study was conducted after ethical clearance was obtained but prior to Phase 1 data collection. A science teacher educator who met all inclusion criteria participated in the pilot, allowing the initial questionnaire, interview guide, and on-site observation checklist to be tested under real conditions. This phase of the pilot served to evaluate the clarity, relevance, and practical applicability of the instruments, ensuring they were appropriate for capturing meaningful data from the study participants:

- Clarity, relevance, and alignment of the questionnaire with the research questions
- The effectiveness of the semi-structured interview guide in eliciting detailed perceptions of LMS use

- The appropriateness and comprehensiveness of the observation criteria used on the participant's LMS module site

The pilot study contributed significantly to methodological refinement. Several questionnaire items were reworded to improve clarity and reduce ambiguity, while overlapping interview questions were revised to minimise repetition and encourage more focused responses. The observation checklist was expanded to ensure stronger alignment with the constructs of the conceptual framework and to improve consistency in recording LMS practices across cases. These refinements enhanced the quality, relevance, and coherence of the data collection instruments before their implementation in the main study.

4.11.2.2 Phase 2:

A second, more nuanced form of pilot testing took place after Phase 1, once the LMS strategy had been developed. In this stage, the pilot participant served as a developmental test case, enabling the researcher to refine each step of the strategy before implementing it with the main study participants. This process was intentionally iterative, allowing adjustments to be made in response to emerging insights and practical considerations:

1. Each step of the strategy was first implemented with the pilot case alone.
2. The pilot participant completed feedback and reflection tasks immediately after each step.
3. The researcher analysed this feedback to identify areas requiring improvement—such as unclear instructions, technical limitations, workload expectations, or overlooked LMS features.
4. The step was then revised accordingly.
5. Only *after* these revisions were in place was the step rolled out to the four main study participants.
6. The same process was repeated for every subsequent step of the strategy.

The iterative pilot process also strengthened the LMS enhancement strategy by identifying practical challenges prior to implementation with the main participants. Feedback from the pilot participant resulted in clearer instructions, improved sequencing of activities, refinement of support materials, and more realistic expectations regarding participant workload and engagement. As a result, the final strategy was more contextually appropriate, user-friendly, and responsive to the needs of science teacher educators operating within an open distance learning environment.

4.11.2.3 Rationale

This iterative pilot process offered several methodological advantages:

- **Enhanced reliability:** By testing each step before full implementation, the researcher ensured consistency and accuracy in how instructions and activities were understood and completed.
- **Improved validity:** The strategy was continually checked against real-world challenges and adjusted to better align with educator needs and the study's conceptual framework.
- **Greater feasibility:** Potential barriers were identified early, allowing the researcher to refine logistical and technical aspects of the strategy.
- **Increased credibility:** The strategy was shaped organically in response to lived experiences, which strengthened its authenticity and practical relevance.

4.11.2.4 Outcome of pilot study:

The iterative pilot process ultimately produced a strategy that was:

- Thoroughly tested
- Contextually aligned to the realities of distance-based science teacher educators
- Methodologically robust
- Directly informed by the conceptual framework and research questions

This strengthened the rigor of Phase 2 data collection and ensured that post-implementation interviews reflected genuine educator experiences with a well-developed, systematically validated LMS intervention.

4.11.3 Credibility

Credibility refers to the extent to which the findings of a qualitative study are believable and accurately reflect the realities of the participants (Flanagin & Metzger, 2007). In this study, credibility was ensured by grounding all interpretations firmly in the data collected through interviews, questionnaires, and on-site observations. The findings were therefore not imposed by the researcher but emerged inductively from participants' accounts and observable LMS practices, ensuring that the results faithfully represent the lived experiences of science teacher educators in an open distance learning context.

A key strategy for enhancing credibility was establishing early familiarity with participants and maintaining deliberate, purposeful engagement throughout the research process. As Kuechle (1995) notes, prolonged engagement and rapport-building support the collection of authentic and trustworthy data. After ethical clearance was obtained, the researcher initiated informal contact with participants to outline the study, clarify procedures, and answer questions before obtaining formal consent. This early interaction served multiple purposes: it reduced anxiety, enhanced transparency, and signalled respect for participants' time and expertise.

Given the study's multi-phase and iterative design, maintaining strong working relationships with participants was critical. The extended process of interviews, observations, strategy implementation, and reflective discussions enabled the researcher to develop trust and mutual understanding, which in turn encouraged openness and honest reflection. Positive researcher-participant relationships are essential for eliciting rich, descriptive data and ensuring that participants feel comfortable sharing both challenges and successes without fear of judgment.

By foregrounding communication, ethical engagement, and respect, the researcher created an environment where participants could share genuine experiences of LMS use. This relational foundation strengthened the authenticity of the data and enhanced the overall credibility of the study's interpretations. Ultimately, these practices ensured that

the study's conclusions were methodologically sound and deeply aligned with the real-world experiences of science teacher educators navigating online teaching.

4.11.4 Confirmability

Confirmability refers to the extent to which the findings of a qualitative study are shaped by the participants' experiences rather than by the researcher's biases, assumptions, or predispositions (Lincoln & Guba, 1985). It ensures that the interpretations presented are firmly grounded in the data and not influenced by the researcher's personal views. As Maree and Pieterse (2007) note, achieving confirmability requires transparency, reflexivity, and explicit acknowledgment of the researcher's positionality within the study.

Several strategies were employed in this study to enhance confirmability. First, the researcher made a conscious effort to bracket personal assumptions when engaging with participants and analysing data. Throughout the study, the researcher remained explicit about her role in LMS training and support within the institution and reflected continuously on how this positionality might shape interpretation. By acknowledging potential biases and responding reflexively, the researcher ensured that participants' voices-not preconceived expectations-guided the study's outcomes.

Second, all interview transcripts and direct quotations were presented verbatim in the analysis. This approach preserved the integrity of participants' perspectives and provided transparent evidence for all interpretations. Including verbatim excerpts also ensured that the researcher did not selectively choose statements to support a particular argument but instead represented the full breadth and nuance of participant experiences.

Together, these strategies ensured that the findings remained firmly anchored in participants' authentic experiences. They contributed significantly to the study's confirmability by establishing a clear and transparent audit trail from raw data to interpretation, allowing readers to trace how conclusions were derived.

4.11.5 Dependability

In qualitative research, dependability refers to the stability, consistency, and reliability of data over time and across research conditions. Maree and Pieterse (2007) note that data can be considered dependable when readers can clearly recognise that the researcher's account is accurate, grounded, and convincingly reflects the phenomenon under study. In this sense, dependability in qualitative research is conceptually similar to reliability in quantitative inquiry, as both emphasise the extent to which findings are supported by a clear, logical, and traceable research process.

To ensure dependability, this study maintained a detailed and transparent record of all procedures followed during data collection and analysis. As Bertram and Christiansen (2014) argue, systematic documentation of methodological decisions enables future researchers-or auditors-to replicate the process and arrive at similar interpretations, even if not identical findings. The audit trail included the development and refinement of research instruments, the sequence of data collection activities, coding procedures, and iterative adjustments informed by pilot testing.

Dependability was further strengthened through the multi-case study design, which Yin (2009; 2018) describes as enabling internal replication. Each participant constituted an independent case, and the consistency of findings across cases served as an internal reliability check. All participants were exposed to the same research instruments-the same questionnaire, interview guides, and observation criteria-ensuring that any variation in findings reflected genuine differences in participants' experiences rather than inconsistencies in the data collection process.

Moreover, iterative pilot testing preceding each major phase of the study contributed to a more stable and reliable design. By testing instruments in advance, the researcher was able to identify and resolve ambiguities, refine procedures, and ensure that the tools were robust before implementation with the main sample. Together, these measures enhanced the study's dependability by ensuring that the research process was logical, transparent, and consistently applied throughout.

4.11.7 Transferability

Transferability refers to the extent to which the findings of a qualitative study can be applied or adapted to other contexts, settings, or populations (Lincoln & Guba, 1985). Unlike generalisability in quantitative research, transferability is not achieved through statistical representativeness. Instead, it is made possible when the researcher provides rich, detailed descriptions of the research context, participant characteristics, and methodological processes. These “thick descriptions” allow readers to determine for themselves whether the findings may be meaningful or relevant in another setting (Creswell & Poth, 2016).

In this study, transferability was supported through comprehensive descriptions of the institutional context, the nature of open distance learning at a South African ODeL university, and the specific technological and pedagogical factors influencing science teacher educators’ use of the LMS. Detailed participant profiles were developed during Phase 1 to clarify each educator’s background, module characteristics, digital readiness, and teaching responsibilities. These descriptions situate the findings within a clearly defined environment, enabling readers-such as researchers, teacher educators, policy-makers, or instructional designers-to evaluate the relevance of the results to their own institutional contexts.

Furthermore, the step-by-step documentation of the LMS strategy implementation-including its structure, content, and iterative refinement-enhances transferability by providing a transparent blueprint that could be adapted in similar settings. While the study does not claim universal applicability, the detailed account of how science teacher educators engaged with the LMS strategy offers practical insights that may be useful in other open distance education institutions, particularly those facing comparable challenges related to digital literacy, training, and LMS adoption.

By providing thick contextual descriptions and a clearly articulated methodological trail, the study allows readers to make informed judgments about the potential applicability of the findings to their own contexts, thereby strengthening transferability.

4.12 Positionality of the researcher

In qualitative research, the researcher is regarded as an integral part of the research process, and it is therefore important to acknowledge the researcher's position in relation to the study and participants. At the time of the study, the researcher was employed as a lecturer within the Department of Science and Technology Education at the institution where the research was conducted. The researcher was also involved in initiatives aimed at supporting the use of Learning Management Systems (LMS) within the department.

This position provided the researcher with valuable contextual knowledge of the institutional environment, the LMS platform, and the challenges experienced by science teacher educators in open distance learning. However, it also created the potential for researcher bias and assumptions regarding LMS use and implementation.

To minimise the influence of personal beliefs and prior experiences on the research process, several measures were implemented. These included the use of multiple data collection methods, member checking of interview transcripts, and applying a consistent data analysis framework across all cases. Participants were also assured that their responses would remain confidential and would not influence their professional relationships within the department.

To minimize the potential influence of researcher bias, the researcher engaged in ongoing reflection throughout the study and regularly discussed emerging interpretations, methodological decisions, and findings with the supervisor. These discussions provided opportunities to challenge assumptions and consider alternative explanations of the data. In addition, the pilot study served as an important mechanism for refining research instruments and procedures prior to implementation, ensuring that data collection tools were aligned with the conceptual framework rather than the researcher's preconceptions. Methodological decisions, instrument refinements, and modifications to the LMS strategy were systematically documented throughout the research process, thereby enhancing transparency, consistency, and confirmability.

4.13 Ethical considerations

Ethical conduct is a fundamental requirement in research, reflecting the researcher's responsibility to act with integrity, honesty, and respect for all participants. Punch and Oancea (2014) describe research ethics as the practice of conducting inquiry in a morally responsible and truthful manner, while Wilson (2013) emphasizes that ethical practice directly contributes to the trustworthiness and reliability of a study. In this research, ethical considerations were maintained at every stage to ensure that participants' rights, dignity, and well-being were fully protected.

Formal permission to conduct the study was obtained from the institution's research ethics committee, followed by informed consent from each participating science teacher educator. Participation was entirely voluntary, and all individuals were informed of their right to withdraw from the study at any point without penalty. The purpose of the study, the nature of data collection procedures, and participant expectations were clearly communicated prior to obtaining consent, ensuring transparency and adherence to ethical research norms.

Confidentiality and anonymity were rigorously maintained throughout the study. Participants' names were replaced with pseudonyms (e.g., Dr K, Dr E, Dr M, Mr L), and no identifying information was included in reporting the findings. All data files—including interviews, questionnaires, and observational notes—were securely stored in password-protected digital folders accessible only to the researcher.

Although initial consent for audio-recording interviews was obtained, the researcher maintained ongoing ethical sensitivity by verbally reminding participants at each session that the interview would be recorded and reaffirming their willingness to proceed. This practice reinforced autonomy and ensured continuous informed consent rather than treating it as a one-time formality.

Finally, care was taken to ensure that participants were not exposed to any form of harm—psychological, professional, or reputational. The study focused on their LMS practices rather than evaluating personal competence, and findings were presented respectfully, emphasizing system-level barriers rather than individual shortcomings. This approach

reflects a commitment to ethical, responsible scholarship that prioritizes the dignity, safety, and well-being of all participants.

4.14 Conclusion

This chapter presented a detailed account of the research methodology employed in this study, covering the philosophical grounding, research design, data collection methods, data analysis procedures, and strategies used to ensure both trustworthiness and ethical integrity. The study adopted a qualitative multi-case study design within a constructivist paradigm to explore science teacher educators' perceptions of LMS use and to examine how a structured LMS enhancement strategy influenced their engagement with the platform. The use of multiple data collection instruments-including questionnaires, semi-structured interviews, unstructured post-implementation interviews, and on-site observations-was justified to generate rich, triangulated data capable of addressing the research questions comprehensively.

The chapter also detailed the iterative pilot study process, which played a critical role in refining research instruments and validating the step-by-step strategy prior to full implementation. This developmental pilot approach ensured that each phase of data collection was feasible, contextually grounded, and aligned with the conceptual framework. Procedures for analysing both Phase 1 and Phase 2 data were described, including thematic coding and categorization guided by the TAM and UTAUT models, along with the additional construct of familiarity with technology.

To strengthen the rigor of the study, the chapter addressed the four criteria of trustworthiness-credibility, dependability, confirmability, and transferability-outlining the strategies employed to ensure that findings were authentic, consistent, and firmly grounded in participants lived experiences. Ethical considerations were also elaborated to demonstrate adherence to institutional guidelines and responsible research practice.

Overall, Chapter 4 established the methodological foundation for the study. It clarified how data were generated, validated, analyzed, and safeguarded, thereby providing a solid basis for the presentation and discussion of the Phase 1 and Phase 2 findings in the subsequent chapters.

Chapter 5: Science teacher educator perceptions of LMS

5.1 Introduction

This chapter presents the data collected for this study, specifically focusing on Phase 1 of the data collection. The chapter analyses the data in detail and reports the corresponding findings.

This study was guided by the following research questions:

- What are the factors that influence science teacher educators perceived ease of use of LMS in open distance education?
- What are the factors that influence science teacher educators perceived usefulness of LMS in open distance education?
- What are the science teacher educator experiences of the implementation of the strategy for using learning management systems in open distance education?

This chapter will however only present the data and findings focused on the first two research questions:

- What are the factors that influence science teacher educators **perceived ease of use** of LMS in open distance education?
- What are the factors that influence science teacher educators **perceived usefulness** of LMS in open distance education?

The data will be presented on a case-by-case basis and organized according to themes. A brief overview of the cases is provided in the table 5.1:

Table 5.1: An overview of the cases

Case	Participant	Background information
Case A	Dr K	A science teacher educator responsible for an NQF level 7 module where student teachers are specializing in Life Sciences education.
Case B	Mr L	A science teacher educator responsible for an NQF level 6 module where student teachers are specializing in Natural sciences education.
Case C	Dr E	A science teacher educator responsible for an NQF level 7 module, a methodology module for final year Natural Sciences student teachers.
Case D	Dr M	A science teacher educator responsible for an NQF level 5 module for student teachers who are completing a higher certificate.

The findings presented in this chapter are organized according to the adapted conceptual framework developed from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Two overarching themes were identified during data analysis, namely perceived ease of use and perceived usefulness. These themes are aligned to the study objectives and research questions and provide the basis for understanding science teacher educators' perceptions of LMS use within a South African open distance learning context.

Data presentation will follow, starting with the theme: Perceived ease of use.

5.2 Science teacher educators' perceptions on the ease of use of Learning Management Systems

This initial section presents and analyses the data relevant to the first research question of the study:

What are the factors that influence science teacher educators **perceived ease of use** of LMS in open distance education?

Theme 1, perceived ease of use, relates to participants' perceptions of the effort required to use the LMS. This theme was informed by the conceptual framework constructs of effort expectancy, facilitating conditions, and familiarity with technology. The theme addresses the first research objective, which sought to identify science teacher educators' perceptions of the ease of use of LMSs within a South African ODL environment.

Gaining insight into the teacher educators' perceptions was valuable, as these perceptions directly influenced how they used the LMS and informed the development of the strategy to enhance LMS utilization. To effectively manage the data, the findings have been organized into categories and subcategories as seen in table 5.2.

Table 5.2: Perceived ease of use: Categories and subcategories for data analysis

Perceived ease of use	Category	Sub- Categories
	Effort expectancy	Intuitive Design: How user-friendly and intuitive is the LMS interface?
		Learning Curve: The time and effort required for teacher educators to become proficient in using the LMS
		Complexity: Teacher educators' perceptions of the complexity/simplicity of the LMS
	Facilitating conditions	Technical Support: Availability and quality of technical support for teacher educators.
		Resource Accessibility: Ease of access to necessary resources within the LMS.
		Infrastructure: Adequacy of the technological infrastructure supporting the LMS.
	Familiarity with technology	Prior Experience: Previous experience with similar technologies or LMS platforms.
		Technology Training: Availability, attendance and effectiveness of training programs for the LMS.
		Self-Efficacy: Educators' confidence in their ability to use the LMS effectively.

5.2.1 Dr K: Data Presentation and discussion

This section will present and discuss the data of Case 1: Dr K.

5.2.1.1 Effort Expectancy

Intuitive Design

Dr K's initial reaction to the learning management system was one of apprehension. He described the platform as "*shocking*" and "*difficult*," citing the complexity of its layout and the placement of essential features as major challenges.

Researcher: "*What was your initial reaction to the LMS interface?*"

Dr K: "*I was shocked and afraid of using it because it looked somewhat difficult.*"

Dr K described his initial encounter with the LMS following the institutional migration to the new platform. Having had limited prior exposure to the system, he expressed feelings of uncertainty and apprehension regarding its complexity. This sentiment aligns with Lavidas et al. (2022), who argue that non-intuitive interfaces discourage early adoption, particularly among users who lack confidence with digital tools. Dr K rated his confidence and comfort in using the LMS as six out of ten.

A complex design requires additional effort to navigate and utilize the platform's various features. Such design barriers can hinder user onboarding and reduce the likelihood of deeper engagement beyond basic content delivery.

Observations of Dr K's LMS module site revealed that he primarily used only the announcements and basic assessment tools. While his welcome message was personalized, it included only standard text and a photograph, reflecting limited engagement with the LMS's broader functionalities.

Dr K also noted that he would have liked the option to meet with students through the LMS, similar to his experience using Google Classroom during the COVID-19 pandemic. However, on reviewing his site, it was evident that he did not use any LMS-based live session activities. Despite this functionality being available, he had neither discovered nor utilized it, highlighting a gap in his knowledge and familiarity with the platform's capabilities.

Learning Curve

Dr K reported requiring between two to five months to become proficient with the LMS.

Researcher: *“How long did it take you before you were comfortable with the LMS?”*

Dr K: *“It took me some months like I said it can be 2 – 4 months, even 5 months. It took quite a lot of training attended for one to understand [the LMS], so it took me quite some time.”*

During this period, Dr K relied on trial-and-error exploration, participation in multiple workshops, and consultation with peers. This aligns with the Technology Acceptance Model (TAM) proposed by Davis (1989), which emphasizes that perceived ease of use is directly influenced by the effort required to achieve competence. Legris et al. (2003) further reinforce this perspective, linking longer learning curves to lower initial user satisfaction and slower system adoption. Dr K’s experience highlights the critical need for sustained support and a user-centred design to reduce the adaptation period and facilitate more effective engagement with the LMS.

Complexity

Although Dr K’s confidence with the LMS improved over time, he still rated its complexity as 7 out of 10. He highlighted the multi-step processes required to set up assessments and configure grades as particularly frustrating and inefficient.

Researcher: *“What were the key challenges that you encountered when you were learning to use the LMS?”*

Dr K: *“Setting up and navigating assessments. To navigate through them and also to enable them so that I can access [the LMS] that was my first challenge, I had to be calling people each and every time when I want to upload my assessments to say can you come and assist and they would repeatedly do so. One other thing was uploading the study materials on my site like an online study guide – it took me quite a time to understand how to upload it and also how to navigate through it, and also one other thing was that it took me quite a lot, quite a long time maybe 5 months to understand how to navigate through the study guide and make it easier for students to*

understand how to navigate through such study guides, and then one other thing that was quite challenging in the beginning was to release the marks.”

Dahlstrom et al. (2014) similarly found that complexity in assessment tools discourages instructors from using advanced LMS functionalities, often limiting them to superficial engagement. This aligns with Naveh et al. (2010), who note that when systems lack procedural transparency, users may avoid potentially valuable tools due to fear of errors or system failure.

This pattern is evident in Dr K’s limited personalization and minimal use of LMS tools on his module site. With progressive support to navigate the more complex functionalities-particularly in assessment settings-he may be able to implement more advanced tools and activities, enhancing both engagement and pedagogical effectiveness.

5.2.1.2 Facilitating Conditions

Technical Support

Dr K described the institutional technical support as inconsistent and often delayed. He recounted instances where response times from the support desk did not align with the urgency of his instructional needs, particularly during critical assessment periods.

Researcher: *“Can you recall a time when technical support was particularly problematic?”*

Dr K: *“To be quite honest with you, technical support is always quite problematic to me because when you are having a technical issue, you send them an email saying I need support on this – they take time. Sometimes you will be seeking assistance on an urgent matter, which needs to be resolved instantly and then they take time to respond. I think that's the problematic part of technical support to me. Even though they come and resolve, sometimes they resolve issues when they are no longer necessary, or they are no longer needed. They give you support after 2 or 3 weeks whereas you needed support on something that was due in days. Their replies in terms of assisting us are quite slow in such a way that you need to be very, very patient.”*

Dr K also identified that the support provided is generalized and did not always cater for the specific needs.

Dr K: *“...or it might be a repetition of something that we have done then there are some aspects you find out that you need assistance on this and then because its quite general you'll find that its hard for them to maybe touch the aspects that you do want.”*

Kisanga and Ireson (2015) caution that inadequate and slow support services can undermine users' confidence and contribute to disengagement from digital platforms. This underscores the need for real-time, context-sensitive support mechanisms, particularly in open distance learning environments, such as the university in which this study is situated.

Resource Accessibility

On a more positive note, Dr K praised the LMS's ability to host and organize teaching materials, describing it as *“a phone, a laptop, a tablet away from the students and the internet.”* This ease of access aligns with Ahmed et al. (2021), who highlight the value of LMSs in centralizing educational content and enabling ubiquitous access. Kakasevski et al. (2008) further note that user satisfaction with content accessibility significantly contributes to overall perceptions of ease of use, a pattern evident in Dr K's satisfaction with this aspect of the LMS.

Infrastructure

Despite the strengths of the LMS itself, infrastructural challenges such as a slow laptop and unstable VPN access repeatedly disrupted Dr K's workflow.

Dr K: *“The device I have is slow. I struggle with access, especially when the VPN is down.”*

His experience reflects the findings of Maphalala and Mpofu (2018), who identified poor connectivity and outdated hardware as significant barriers to LMS adoption in South Africa. Even when platforms are well-designed, such technical limitations can impede their effective use, particularly in resource-constrained environments.

5.2.1.3 Familiarity with Technology

Prior Experience

Dr K's prior experience with Google Classroom and Microsoft Teams played a pivotal role in easing his transition to the LMS. His case aligns with Bhalalusesa et al. (2013), who argue that previous exposure to digital platforms fosters the transfer of technological confidence and skills. This familiarity with foundational online teaching principles enabled him to adapt more readily, even when confronted with the LMS's steeper learning curve.

Dr K: *"So then when I started using the LMS, it was not that new to me because I was also teaching before using, or teaching online, so it really influenced the love that I had and also influenced me to want to know more about this LMS. I was using Google classroom and also Microsoft teams to teach."*

Technology Training

However, Dr K's reflections on formal LMS training were less favorable. He criticized institutional workshops for being overly theoretical and lacking practical application, stating, *"They workshop us... but they don't give us that platform wherein we try and do. The first improvement that needs to be done is that training needs to be hands-on."* This perspective aligns with Edeh et al. (2022), who emphasize that effective training must be experiential, interactive, and context-specific to foster meaningful technology adoption.

Self-Efficacy

Although Dr K rated his digital competence as 6 out of 10, he demonstrated a strong willingness to improve and actively experimented with the LMS features.

Dr K: *"... the positive part of it is that I have got that opportunity of going out and learning more. You have got room for improvement each and every time because there is a lot that you don't know about digital tools, digital use of aspects and also there's a lot that you want to know and in order to gain more confidence. So I would say I'm still passionate to learn about the digital use of different aspects that we use and, my confidence is not yet there but I think its also helping me to want to know more because I can feel it I'm not yet there, so I want to know more."*

His case resonates with Martin's (2008) conceptualization of digital literacy as a combination of both skills and disposition. His willingness to explore, "play around," and learn from mistakes was critical in overcoming usability challenges. This attitude aligns with Calvani et al. (2008), who argue that confidence, adaptability, and motivation to learn are essential components of effective digital technology integration.

5.2.1.4 Findings

Dr K's experience with the LMS illustrates that perceived ease of use is not merely a technical outcome but emerges from the dynamic interplay of system complexity, institutional support, prior digital experience, and individual agency. These interrelated factors align with the core constructs of the Technology Acceptance Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), which together form the conceptual framework guiding this study.

Effort Expectancy

The emotional tone of Dr K's first encounter with the LMS is captured in his own words: *"I was shocked and afraid of using it because it looked somewhat difficult."* This response reflects the cognitive load experienced when navigating complex educational platforms, particularly those with non-intuitive interfaces. Lavidas et al. (2022) argue that poorly designed interfaces significantly hinder early engagement, especially for users who are digitally cautious.

Over time, Dr K became more proficient, but the process required substantial effort, informal experimentation, and consultation with colleagues. He explained, *"It took me between two and five months... I had to ask people, I had to go to workshops, I had to try and try again."* His experience exemplifies the self-directed learning necessitated by steep learning curves, which, as Legris et al. (2003) note, can impede full LMS adoption if institutional scaffolding is inadequate.

The high mental effort required to complete even routine tasks-such as creating assessments or configuring grades-underscores that effort expectancy is a decisive factor in perceived ease of use. Dr K rated the LMS's complexity as "seven out of ten," adding that *"some things are hidden and it becomes frustrating,"* highlighting a misalignment

between user needs and system architecture. Dahlstrom et al. (2014) similarly caution that when users struggle with advanced features, they often rely solely on basic functionalities, thereby limiting the LMS's full pedagogical potential.

Facilitating Conditions

Although the LMS provides foundational accessibility, Dr K's ability to use it effectively was significantly constrained by weak support systems and technological limitations. He emphasized, "*The device I have is slow...*" These challenges reflect broader findings that infrastructure gaps remain persistent barriers in developing contexts (Maphalala & Mpofu, 2018; Ssekakubo et al., 2011).

More critically, Dr K's reflections on institutional technical support highlight a misalignment between the timing of need and the provision of assistance. As he noted, "*They get back to you when the problem has passed. It's not helpful when you're in the middle of something urgent.*" This aligns with Kisanga and Ireson (2015), who argue that technical support must be not only available but also timely and pedagogically relevant.

Dr K's experience demonstrates that perceived ease of use depends on more than individual user competence; it requires an enabling ecosystem that includes responsive support, adequate hardware, and institutional responsiveness. Without these, even highly motivated users encounter friction that diminishes their willingness and capacity to engage fully with the LMS.

Familiarity with Technology

A central enabler in Dr K's eventual adaptation to the LMS was his prior use of Google Classroom and Microsoft Teams. This highlights the significance of digital transferability, where familiarity with general LMS principles accelerates mastery of new platforms (Bhalalusesa et al., 2013; Saripudin et al., 2021).

However, his experience also revealed a disconnect between training provision and practical application. He criticized the generalized structure of institutional workshops, noting that they lacked hands-on engagement. This supports Edeh et al. (2022), who emphasize that training must be practical, interactive, and context-specific to meaningfully enhance digital literacy and system usability.

Despite rating his digital competence as “six out of ten,” Dr K demonstrated high self-efficacy and digital resilience. He described his approach as “*playing around with the system, seeing what happens if I click here or there.*” This aligns with Martin’s (2008) conceptualization of digital literacy, which encompasses not only technical knowledge but also mindset, adaptability, and a willingness to learn through experimentation.

5.2.1.5 Synthesis and Interpretation of findings

Dr K’s case exemplifies how perceived ease of use is shaped not solely by the LMS itself, but by the broader learning and institutional ecosystem. The barriers he encountered—interface complexity, delayed technical support, hardware limitations, and abstract training—were not isolated challenges, but interdependent stress points that collectively influenced his engagement. His trajectory from initial confusion to eventual competence reflects the adaptive effort required of educators operating in under-supported digital environments.

Aligned with the Unified Theory of Acceptance and Use of Technology (UTAUT), his experience illustrates how effort expectancy, facilitating conditions, and prior experience collectively shaped both his behavioral intentions and actual use of the LMS. Furthermore, his experience supports Davis’ (1989) assertion in the Technology Acceptance Model (TAM) that ease of use directly influences user acceptance, particularly when contextual barriers are present.

It is also noteworthy that Dr K teaches student teachers, who, in today’s digital age, are expected to integrate digital tools into their own teaching practices. This underscores the importance of ensuring that teacher educators like Dr K feel confident and adequately supported in using the LMS, as their competence directly impacts how their students adopt and apply digital technologies in practice.

In summary, while the LMS platform offers extensive functionalities, its usability depends heavily on institutional support, effective training, intuitive design, and individual adaptability. Dr K’s case demonstrates that perceived ease of use is not an inherent property of technology, but a negotiated experience shaped by multiple interrelated factors. Addressing these dimensions holistically is essential to ensure that LMSs fulfil their intended role in enhancing teaching and learning within open distance education.

5.2.2 Mr L: Data presentation and discussion

This section will present and discuss the data from Case 2: Mr L.

5.2.2.1 Effort Expectancy

Intuitive Design

Mr L described his initial exposure to the LMS as entering “a new environment,” which he found “very, very challenging.” While not completely overwhelming, his difficulties arose from the need to “adapt to the system because of how the system works.” Although the landing page appeared accessible at first glance, the deeper functionalities were not immediately visible, as confirmed during observation. He further commented:

Mr L: *“Most of the options are... hidden or you cannot see them when you are using the LMS for the first time.”*

It was also observed that Mr L attempted to conduct a poll with his students and host live lectures. Interestingly, he relied on Microsoft applications for both activities, posting the corresponding links on his LMS site. Notably, the LMS itself offers built-in functionalities to facilitate polls and live sessions, yet Mr L did not make use of these LMS-based tools. This suggests that he either lacked awareness of these features or was unable to locate them within the platform.

Mr L: *“I just use the normal teams and share the link with the students and that’s where I teach my students. So teaching by creating a teams class is still a challenge to me, I think we as teacher educators need training for that because it is very complicated.”*

This aligns with Lavidas et al. (2022), who argue that non-intuitive interfaces hinder new users’ adaptation, requiring extra exploration to locate essential tools-particularly when menus are collapsed or nested within multiple layers.

Learning Curve

Despite his initial discomfort, Mr L reported becoming proficient with the LMS in less than a week. He attributed this rapid mastery to his prior experience in student support, where he had regular exposure to multiple module sites. He explained:

“During those times when they implemented [the LMS], I was in student support... which gives me an idea on how to play with [the LMS]... if you don't play around with [the LMS] it's not so easy to understand it.”

Complexity

When asked to rate the LMS's complexity, Mr L gave it a 3 out of 10, indicating a relatively low perceived difficulty. However, he did qualify that this ease came after familiarity:

Mr L: *“If you missed a step you are somewhere else.”*

He noted that some functionalities, like editing the welcome message or granting extensions, were not initially intuitive.

5.2.2.2 Facilitating Conditions

Technical Support

Mr L's responses revealed gaps in institutional support structures. While he acknowledged some annual training workshops, particularly on MCQ uploading, he emphasized the lack of ongoing, practical training:

Mr L: *“I don't remember receiving such kind of training on how to play around with [the LMS]... like routing assignments to markers or changing the welcome note.”*

It was observed that Mr L's welcome note was somewhat personalized, meaning he did receive the necessary support in this regard.

Researcher: *“How could you describe the technical support provided by your institution?”*

Mr L: *“I can say that it's not enough, especially to someone who is still new to the department or to the college, because they only offered, I think it's one training in the beginning of the year in terms of marking and uploading the MCQ assignments. I don't remember attending the training on, on how to use the LMS”*

While he found the Multiple Choice Questions (MCQ) training helpful, he criticized the lack of follow-up on broader functionality.

He also described a delayed response from technical support when marker synchronization issues arose, stating:

Mr L: *“It takes around 7–14 days for the markers to appear on the LMS... it was quite challenging because even the response took some time to receive the feedback from the LMS staff”*

Such delays compromise instructional planning, particularly in assessment-heavy modules (Kisanga & Ireson, 2015).

Resource Accessibility

Mr L found the process of adding resources and activities within the LMS to be clear, provided the user knew where to begin:

“It’s very straightforward... you just need to click the edit button on the landing page.”

Infrastructure

Unlike Dr K, Mr L reported satisfaction with the university’s technological infrastructure:

“It provides us with the working gadgets... and data to work from home, which is also very important.”

This positive outcome contrasts with findings from many studies in low-resource settings (e.g., Maphalala & Mpofu, 2018), indicating that infrastructure challenges can vary significantly even within the same institution.

5.2.2.3 Familiarity with Technology

Prior Experience

Mr L had previously used another system but emphasized that the current LMS was *“more advanced.”* He found the previous system restrictive in terms of file formats and moderation options, which positioned the current LMS as an upgrade:

“On [the previous system], you had to convert documents to PDF... [the current LMS] opens them directly and even allows moderation.”

Contrary to literature highlighting the benefits of platform continuity (Bhalalusesa et al., 2013), in this instance, prior experience with the previous system did not appear to meaningfully ease the transition to the current LMS.

Technology Training

Mr L rated the effectiveness of his LMS training as 6 out of 10, stating it was *“not enough, especially to someone new.”* He added that training on specific LMS features such as offline marking needed enhancement:

“We really need training... especially when you cannot mark the script online and have to download it and upload as a feedback file.”

Self-Efficacy

Mr L rated his comfort level with digital tools at 7 out of 10, and described himself as *“extremely open”* to adopting new technologies. He added:

“We need to adapt... the world is evolving every day... it’s our duty as teachers to assist the younger generation to be more advanced.”

He also adds:

“...we really need to adapt and tell ourselves that we really need to learn because if we don’t learn that means we are no longer a lifelong learner or a researcher if I may put it like that.”

This outlook reflects Calvani et al.’s (2008) framework of digital competence, where attitudinal openness and continuous learning form key pillars of long-term digital literacy.

5.2.2.4 Findings

Mr L’s experience with the LMS illustrates a distinct trajectory in perceived ease of use, characterized by initial navigational uncertainty, rapid familiarization, and a current sense of digital confidence. His reflections underscore that ease of use is not a static attribute but evolves with user exposure, prior experience, and the quality of institutional training and infrastructure. These insights align with the constructs of the Technology Acceptance Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), while also echoing recent literature emphasizing user-

centred design, robust support ecosystems, and adaptive competence in digital pedagogy.

Effort Expectancy

Unlike Dr K's slower adoption curve, Mr L reported feeling comfortable with the LMS within a week, largely due to his prior exposure during student support duties. He emphasized that his early success stemmed from exploring multiple sites and "*playing around with the LMS.*" Despite this rapid adaptation, he acknowledged that some features-such as editing welcome notes or granting extensions-were not easily discoverable.

Observations corroborated his reflections, showing that he often used tools from external applications that were available on his LMS site but less accessible through the platform itself. This aligns with Bervell and Umar's (2017) critique that while LMSs offer powerful functionality, poorly surfaced design options can hinder usability, particularly for less confident users. Although Mr L rated the LMS's complexity as 3 out of 10, this relatively low score must be understood in the context of his high prior exposure and comfort with digital platforms.

Facilitating Conditions

Mr L acknowledged that institutional support was available but limited in both scope and frequency. While annual workshops on uploading multiple-choice questions were helpful, other essential tasks-such as script routing and editing site content-were not formally addressed. Consequently, he relied heavily on informal peer support, reflecting Kisanga's (2016) observation that, in the absence of responsive institutional assistance, educators often turn to colleagues to bridge knowledge gaps.

Nonetheless, Mr L viewed the institution's infrastructure provision positively. He did, however, express frustration with delays in marker synchronization and slow responses from support staff, highlighting a disconnect between user needs and institutional responsiveness. As Naqshbandi and Idris (2021) note, technical efficacy depends not only on the availability of support but also on the timeliness and pedagogical alignment of interventions.

Familiarity with Technology

Mr L's comfort with digital tools, which he rated as 7 out of 10, along with his openness to adopting new technologies, underscores the importance of self-efficacy and a positive digital mindset in effective LMS engagement. Although he had prior experience with a different system, he regarded the current LMS as a more advanced and capable platform.

5.2.2.5 Synthesis and Interpretation of findings

Mr L's case illustrates that perceived ease of use is highly context-dependent. His strong self-efficacy, willingness to explore, and prior exposure to institutional systems contributed to a relatively high comfort level with the LMS. However, this confidence was not consistently supported by institutional mechanisms, particularly for new users or for more complex LMS functionalities.

Observations of his site revealed limited use of LMS-native tools, with some functionalities being outsourced to external applications despite being available within the platform. This highlights how rapid onboarding can coexist with structural weaknesses. Even digitally competent users benefit from systematic, modular training and responsive technical support. His experience aligns with the UTAUT framework, which posits that facilitating conditions, prior experience, and user expectations jointly influence behavioral intention and actual system use (Venkatesh et al., 2003).

Furthermore, Mr L's case underscores the importance of interface design. Even confident users may struggle when essential functions are "hidden" or not intuitively located, demonstrating that perceived ease of use is shaped not only by user skills and attitudes but also by platform architecture and tool visibility (Bervell & Umar, 2017).

Overall, Mr L's trajectory reflects the dynamic and multifaceted nature of perceived ease of use. While he adapted quickly to the LMS, early navigation challenges, limited training scope, and inconsistent support revealed vulnerabilities in the broader LMS implementation framework. His experience affirms that effective LMS adoption depends on pairing infrastructure with targeted support and designing systems with user experience in mind. While individual disposition is important, sustained engagement in open distance education contexts ultimately relies on system-level responsiveness.

5.2.3 Dr E: Data presentation and discussion

This section presents and discusses the data from Case 3: Dr E.

5.2.3.1 Effort Expectancy

Intuitive Design

Dr E held a nuanced view of the LMS interface. On one hand, he appreciated the layout and the availability of basic tools, such as announcements and weekly lesson plans, describing it as *“visually organized and easy to follow”* due to the structured left-hand navigation pane. On the other hand, he expressed frustration with accessing deeper functionalities, noting, *“There are settings I can never find unless I go to three or four different places. That slows me down.”*

Learning Curve

Dr E mentioned a prolonged learning curve, indicating that he *“only got used to the system after making many mistakes. I just kept trying.”* The time-consuming nature of this process reflects the TAM’s view that systems perceived as requiring more effort tend to be less readily adopted (Davis, 1989).

Complexity

Although comfortable with the LMS’s basics, Dr E rated the platform’s complexity at *“about a 6 or 7,”* (out of ten) particularly lamenting assessment-related tasks: *“Creating quizzes or assignments takes a lot of clicks, and sometimes you don’t know if you did it right until a student complains.”*

5.2.3.2 Facilitating Conditions

Technical Support

Dr E shared that technical support was accessible but inconsistent: *“Sometimes you log a ticket, and it’s sorted. Other times, you wait a week.”* This sporadic support discouraged him from experimenting with the LMS during tight teaching schedules.

Resource Accessibility

He commended the LMS for its centralized resource repository, stating, *“Everything I need is in one place-notices, videos, discussion forums-it’s all there.”* This highlights the value of consolidated access in enhancing perceived ease of use. As Rambe and Bere (2013) note, a well-organized content structure reduces cognitive load and supports effective time management, particularly in ODL contexts.

However, Dr E’s perception was contradicted by observations of his module site. He mentioned that the LMS lacked functionality for hosting live lessons with students and felt that this feature would be beneficial. Yet, the same resource repository he praised included the tool for live sessions, indicating that the LMS feature existed but was either overlooked or not discovered.

Infrastructure

While Dr E did not face major hardware or connectivity challenges himself, he noted that *“students often complain they can’t access a feature or upload assignments,”* highlighting a gap between educator and student infrastructure. This indicates a secondary barrier that indirectly affects teacher educators’ LMS use, aligning with Ssekakubo et al. (2011), who emphasize the systemic and interconnected nature of LMS challenges in low-resource environments.

5.2.3.3 Familiarity with Technology

Prior Experience

Dr E had prior experience with digital teaching tools such as Blackboard and Zoom, which he described as advantageous: *“I didn’t come to [the LMS] fresh. I already knew the basics of navigating platforms.”* This aligns with Mtebe and Raisamo (2014), who found that previous exposure to digital systems is a strong predictor of positive attitudes and smoother adaptation to new platforms.

Technology Training

He expressed mixed feelings about training: *“I attended the workshops, but they don’t always go deep. It’s very surface-level.”* This critique underscores a persistent gap in professional development for digital teaching. As Ifenthaler and Schweinbenz (2016)

note, many institutional training programs emphasize tool familiarity over pedagogical integration, which limits their long-term effectiveness and impact on teaching practice.

Self-Efficacy

Despite these limitations, Dr E rated his digital competence as “above average” and remarked: *“Once I get the hang of something, I use it fully.”*

5.2.3.4 Findings

Dr E’s experience illustrates that perceived ease of use is influenced by the interplay of interface design, institutional support, and individual digital readiness. His reflections suggest that while the LMS is functionally useful, it becomes labor-intensive when tasks go beyond basic content delivery.

Effort Expectancy

While describing the LMS as generally user-friendly for basic tasks, Dr E highlighted the inefficiencies and frustrations involved in configuring more complex activities. His remark, *“I feel like I need a map just to set an assignment correctly,”* illustrates how excessive procedural steps can deter deeper engagement. His experience indicates that, although extended exposure gradually builds competence, the initial complexity presents a significant barrier to early adoption.

Facilitating Conditions

Dr E’s experience with uneven support and indirect student constraints confirms that facilitating conditions are not limited to the lecturer’s interface with the LMS.

He reported:

“Sometimes I avoid trying new things because I don’t have time to wait a week for support.”

The limited scope of institutional training further illustrates an ongoing gap between technology provision and educator capacity development (Ifenthaler & Schweinbenz, 2016).

Familiarity with technology

Despite challenges, Dr E displayed strong self-efficacy and drew on previous digital experience to ease his transition to the LMS. His approach to technology use is encapsulated in his statement: *“I prefer to learn by doing. Once I understand it, I go all in.”* This mindset is indicative of high digital agency.

5.2.3.5 Synthesis and Interpretation of findings

Dr E’s case underscores that perceived ease of use is dynamic, evolving through familiarity, reflection, and adaptation. However, it remains highly contingent on the extent to which the system and institutional ecosystem support user needs. A misalignment between available features and their practical usability, coupled with inconsistent technical and pedagogical support, limits full engagement.

Consistent with TAM (Davis, 1989) and UTAUT (Venkatesh et al., 2003), Dr E’s perceptions were strongly influenced by effort expectancy and facilitating conditions. His experience demonstrates that even users with prior digital fluency require time, targeted training, and robust institutional support to fully leverage LMS functionalities in an open distance learning context.

5.2.4 Dr M: Data presentation and discussion

This section will present and discuss the data from Case 4: Dr M

5.2.4.1 Effort Expectancy

Intuitive Design

Dr M described the LMS as user-friendly for basic tasks such as accessing announcements and uploading assignments. He stated:

Dr M: *“If you want to get into assignment one, you know it’s there in front of you... announcements, it’s there on the left-hand side.”*

However, he noted that some tools were not immediately visible or were easily forgotten, such as discussion forums or embedded files:

Dr M: *“You might forget about that you’ve got the tool... maybe having those tools also present on the site.”*

When core features are not easily accessible, educators tend to rely on familiar functions only.

Learning Curve

Dr M reported that it took him around four months to become “basically comfortable” using the LMS. He attributed much of his progress to having to address recurring student queries:

Dr M: *“Luckily-or unluckily-the modules that I've been in, the students have got quite a bit of queries, which actually forced one to go into certain... like grade books.”*

Tools such as the gradebook functionality is visible on the landing page of the module site, however, not as frequently used. This tool is also a basic function.

He acknowledged a reluctance to explore advanced features due to fear of making mistakes:

Dr M: *“I'm still uncomfortable, to be honest... not wanting to make a mistake and put something that will give the students incorrect information.”*

This finding reflects the concerns raised by Mlitwa and Van Belle (2011), who argue that unfamiliarity with advanced LMS features contributes to low confidence, especially when initial training does not sufficiently address complex use cases.

Complexity

Dr M rated the LMS as “five out of ten” in terms of complexity. He felt confident using basic tools but expressed uncertainty about managing large live sessions:

“Managing all the things... what happens if you get full attendance at 3700 students?”

This corresponds with Mtebe and Raisamo's (2014) observation that perceived complexity, especially in managing high-enrolment classes online, limits how confidently educators engage with more interactive tools within the LMS.

5.2.4.2 Facilitating Conditions

Technical Support

Dr M had mixed experiences with training workshops. While he appreciated the availability of sessions and recordings, he pointed out that facilitators sometimes lacked in-depth expertise:

“Sometimes in the workshops the facilitators also are not too sure about certain things... which doesn’t garner much confidence.”

This concern echoes insights from Nkonki and Ntlabathi (2016), who found that inconsistent technical training in South African higher education institutions often leaves educators uncertain about applying their knowledge independently.

Resource Accessibility

Dr M used the LMS primarily to post PowerPoint slides and announcements with brief explanations:

“Sometimes I will speak about a submission date... within that announcement, I will explain one or two aspects and then attach a resource.”

This is supported by on-site observations, where it became apparent that the announcement tool was the only tool Dr M used to share resources or information with his students.

Despite knowing other tools were available, he admitted to using only what was familiar:

“Maybe they are there and I don’t know that they’re there... I tend to only stick to what I know.”

Infrastructure

Although institutional infrastructure generally supported his work, Dr M raised concern about LMS maintenance being scheduled over weekends:

“Maintenance could be planned for different days... not on a weekend where [markers] have time to actually do our marking.”

This reflects the misalignment between institutional planning and academic workflows, a concern noted by Makhanya (2020), who advocates for academic-led scheduling of technical interruptions to avoid disruption in ODL settings.

5.2.4.3 Familiarity with Technology

Prior Experience

Dr M reported having minimal prior exposure to LMS platforms before the current LMS. This contributed to initial apprehension:

“Due to the lack of previous exposure... there’s a certain apprehension or fear to make a mistake on the system.”

As supported by Mlitwa and Van Belle (2011), limited exposure to digital teaching platforms often results in slow adoption and high dependence on institutional support, especially among late-adopting educators.

Technology training

Although Dr M rated the training as “six to seven out of ten,” he found it too surface-level and emphasized the need for deeper, more personalised sessions:

“We were getting shown various ways to do it... that can be confusing... It was like information overload.”

He expressed a preference for more interactive, face-to-face sessions where mistakes could be corrected immediately:

“Where the facilitator is there with you... and they review it there and then-it gives you the confidence.”

This aligns with Nkonki and Ntlabathi (2016), who argue that hands-on, context-specific support enables educators to build competence and confidence in using LMS tools.

Self-Efficacy

Dr M rated his digital competence as moderate and viewed himself as someone who “*gets things done*” but does not necessarily explore new features unless required:

“I can use technology to get things done, but not at an expert level.”

Despite this, he displayed a willingness to learn:

“I see the value in technology, definitely. I can take on board and implement.”

This supports the position of Chisango et al. (2021), who argue that digital self-efficacy in ODL environments is less about high proficiency and more about openness to learning.

5.2.4.4 Case 4: Findings

Dr M's reflections illustrate the layered nature of LMS usability. He demonstrated general ease with basic functions, such as uploading documents and posting announcements, but expressed hesitation when faced with more complex tasks, such as managing large online classes or navigating unfamiliar tools. His experience highlights how platform design, personal digital readiness, and institutional support intersect to shape perceptions of ease of use in an open distance learning environment.

Effort Expectancy

Dr M rated the LMS's complexity as “five out of ten,” noting that while basic features were accessible and intuitive, more advanced tools-particularly those not immediately visible-were often overlooked or avoided. He expressed concern about “making a mistake” when managing live sessions or using unfamiliar functionalities. His learning curve was steep, taking approximately four months to gain confidence, largely driven by the necessity of responding to student queries. This aligns with Chaka (2020), who found that LMS usability in South African contexts is influenced not only by system design but also by the frequency of actual engagement with features. Mlitwa and Van Belle (2011) similarly argue that confidence develops over time and through use, rather than being assumed initially. When interfaces do not clearly guide users toward advanced tools, as in Dr M's experience, effort expectancy is shaped more by accumulated familiarity than by inherent simplicity.

Facilitating Conditions

While Dr M acknowledged that workshops and support materials were available, he described the training sessions as inconsistent, with some facilitators lacking sufficient expertise. His experience-being shown multiple, sometimes conflicting methods for the same task-led to confusion and diminished trust in institutional support. These challenges

are consistent with Nkonki and Ntlabathi (2016), who found that in South African universities, training facilitators are sometimes inadequately prepared to address educators' practical classroom needs, particularly regarding digital tools. Dr M also highlighted a misalignment between academic workflows and LMS maintenance schedules, noting that system downtime on weekends-when most marking occurs-hindered productivity. This concern aligns with Makhanya (2020), who advocates for institutional responsiveness that aligns system operations with pedagogical rhythms in ODL environments.

Self-Efficacy

Dr M rated his digital literacy as moderate and acknowledged limited prior experience with LMS platforms. Nonetheless, he demonstrated a strong willingness to learn and adapt, particularly when training was hands-on and immediate. He expressed greater confidence in situations where he could ask questions and receive real-time feedback. This aligns with Chisango et al. (2021), who argue that self-efficacy in digital learning contexts depends less on technical expertise and more on an educator's mindset toward continuous improvement. Similarly, Mlitwa and Van Belle (2011) emphasize that openness to experimentation, coupled with supportive environments, is crucial for developing confidence in LMS use. Dr M's preference for step-by-step, contextually grounded guidance further highlights that digital self-efficacy is socially and institutionally mediated.

5.2.4.5 Synthesis and interpretation of findings

Dr M's case highlights the multifaceted nature of perceived ease of use, which arises not solely from the LMS platform itself but from the interaction between the system, the educator's prior experience and confidence, support structures, and institutional responsiveness. His comfort with basic functions, such as announcements and content uploads, reflects the LMS's intuitive design for routine tasks. However, the underutilization of advanced tools-partly due to their limited visibility-demonstrates that familiarity, rather than simplicity alone, governs user engagement. This supports Chaka (2020), who concludes that LMS features that are not clearly visible or adequately introduced in training are less likely to be adopted in practice.

Dr M's learning journey was heavily shaped by necessity rather than design. Frequent student queries compelled him to explore deeper LMS functionalities, a pattern noted by Mlitwa and Van Belle (2011), who argue that hands-on experience often substitutes for formal training in cultivating proficiency. However, inconsistencies in workshop delivery and facilitator expertise created uncertainty and diminished confidence-issues echoed by Nkonki and Ntlabathi (2016), who found that training in many South African higher education institutions often lacks alignment with pedagogical needs.

Institutional scheduling decisions-such as performing LMS maintenance during peak academic periods-further created practical barriers to effective LMS use. Makhanya (2020) emphasizes that ODL institutions must synchronize administrative processes with teaching demands to avoid undermining staff productivity. In this regard, Dr M's experience reflects broader challenges of institutional misalignment with academic workflows.

Although not highly digitally fluent, Dr M demonstrated openness to learning, particularly when training was context-specific and interactive. His reflections align with Chisango et al. (2021), who argue that digital self-efficacy is shaped not by technical expertise alone but by an educator's willingness to engage, experiment, and learn with digital tools. His case illustrates that, with a supportive environment characterized by responsive training and clear tool visibility, even moderately confident users can progressively integrate technology into their teaching.

In summary, Dr M's experience underscores the critical role of well-structured training, intuitive LMS design, and institutional responsiveness. Together, these factors shape how easily educators adopt and effectively use digital platforms in ODL contexts. Addressing gaps in tool visibility, training quality, and infrastructure coordination can significantly enhance LMS usability for science teacher educators.

5.2.5 Cross-case synthesis: Perceived ease of use

Across all four cases, effort expectancy, facilitating conditions, and familiarity with technology emerged as important influences on perceived ease of use. Although participants differed in their levels of confidence and prior experience, all reported challenges associated with navigating advanced LMS functionalities and identified the need for more practical, hands-on support. Technical support and training quality emerged as recurring concerns, while prior experience with digital technologies generally contributed to greater confidence and faster adaptation. These findings suggest that perceived ease of use is shaped by the interaction between individual capability, institutional support, and system design rather than by any single factor in isolation.

5.3 Science teacher educators' perceptions on the usefulness of Learning Management Systems

This section will present and analyse the data relevant to the second research question of this study:

What are the factors that influence science teacher educators **perceived usefulness** of LMS in open distance education?

In order to manage the data, findings have been arranged into themes, categories and sub-categories as outline in table 5.3:

Table 5.3: Perceived usefulness: Categories and subcategories for data analysis

Perceived usefulness	Category	Sub- Categories
	Performance Expectancy	Teaching Efficiency: How LMS contributes to efficient planning, execution, and assessment of lessons.
		Student Engagement: The impact of LMS on student participation and interaction.
		Content Delivery: The effectiveness of LMS in delivering educational content
	Social Influence	Collegial Endorsement: The extent to which colleagues' recommendations influence the adoption of the LMS.
		Institutional Support: The role of institutional policies and encouragement in the use of the LMS.
		Recognition: What role does the recognition of the use of LMS influence how it is used?
	Familiarity with technology	Digital Literacy: The level of comfort and skill with digital tools and platforms
		Innovativeness: The willingness to adopt new technologies and explore their potential in education.

Theme 2, perceived usefulness, relates to participants' perceptions of the extent to which LMS use contributes to their teaching practices. This theme was informed by the conceptual framework constructs of performance expectancy, social influence, and

familiarity with technology. The theme addresses the second research objective, which sought to identify science teacher educators' perceptions of the usefulness of LMSs within a South African ODL environment.

5.3.1 Dr K: Data presentation and discussion

5.3.1.1 Performance Expectancy

Teaching Efficiency

Dr K reported that the LMS significantly enhanced his planning and assessment processes. He explained, *"The LMS has assessment shells wherein I need to upload my assessments, and it also has this other space for uploading my study guide."* He further elaborated that the platform allowed him to integrate video links and digital resources, providing students with a richer learning experience. Dr K also praised the simplicity of preparing and administering multiple-choice assessments, noting, *"With multiple-choice questions, you just prepare... using Aiken or GIFT format... it becomes easy for students because they just go to that assessment, click, and submit."*

These observations align with Rajhans et al. (2020) and Ahmed et al. (2021), who found that LMSs enhance teaching productivity and reduce administrative burdens. Similarly, Panigrahi et al. (2018) highlight the LMS's value in lesson structuring and instructional design.

Student Engagement

According to Dr K, the LMS has enhanced student engagement, particularly through its discussion forum functionality: *"Students can go under the discussion forum and pose a question... and I can also go there; if I have tutors, they can also assist."* He noted that this feature helped reduce the volume of student emails while promoting peer collaboration. However, he expressed concern that not all students used the forum effectively, suggesting that *"we need to have trainings with our students on how to use these platforms."* These observations align with Swart (2015) and Venter et al. (2012), who emphasize that discussion tools in LMSs foster active engagement. At the same time, Ssekakubo et al. (2011) caution that such tools require adequate user training to achieve their full potential.

Content Delivery

The LMS was praised by Dr K for its ability to centralize educational content, making resources easily accessible across multiple devices. He explained, *“You’ve got your study guides that are always available-it’s just a phone, a laptop, a tablet, or desktop away from the students.”* He also highlighted the advantage of integrating external resources: *“If you find something related to your module, you can just come and insert it there in [the LMS] and tell your students.”* However, he expressed a desire for integrated synchronous capabilities, noting, *“I don’t want to have to leave [the LMS] to go and have my class... I feel like it would be much more helpful if I could do everything within the LMS.”* These reflections align with Henderson et al. (2017) and Cavus and Alhih (2014), who emphasize that LMSs support flexible, multimedia content delivery. At the same time, his concerns about limited interactivity reflect challenges identified by Bhalalusesa et al. (2013).

5.3.1.2 Social Influence

Collegial Endorsement

Dr K emphasized the critical role of peer support in his LMS journey, stating, *“The majority of things I know... it’s from the recommendations and assistance from colleagues... through their guidance, I started to fall in love with using this LMS.”* He credited his departmental peers with helping him overcome the initial barriers to LMS use. This experience aligns with Lavidas et al. (2022) and Kisanga and Ireson (2015), who highlight peer collaboration as a key enabler of technology adoption.

Institutional Support

While institutional policy mandates LMS use, Dr K described the initial support as inadequate, noting, *“Policy says we need to upload study material and also give feedback on the LMS, but then if there’s lack of training, that’s where we encounter challenges.”* He acknowledged that more recently, professional development workshops had improved: *“From the beginning of the year, we have been trained and workshopped... that raises interest and motivates one to learn more.”* These insights align with Dhawan (2020) and

Mtebe and Raisamo (2011), who emphasize the importance of institutionally driven training to complement policy requirements.

Recognition

Institutional recognition of LMS use was initially limited but has improved over time. Dr K reflected, *“Initially I was not using LMS because... I don’t know if it was because they were still piloting it.”* Gradually, structured training and visible recognition fostered motivation: *“Now I think we are moving in the right direction with workshops that encourage us to want to use the LMS.”* This observation aligns with Alshehri et al. (2019), who argue that clear institutional support enhances educators’ perceived value of digital platforms.

5.3.1.3 Familiarity with Technology

Digital Literacy

Dr K rated his general digital proficiency as moderate, stating, *“I will say 6... I’m not that much comfortable.”* Nevertheless, he leveraged prior experience with platforms such as Sakai, Google Classroom, and Microsoft Teams: *“When I started using the LMS, it was not that new... I also used Sakai to mark and give feedback.”* This prior exposure eased his transition into the LMS. As Edeh et al. (2022) and Law et al. (2018) note, familiarity with ICT tools is a critical factor in overcoming digital literacy barriers during LMS adoption.

Innovativeness

Despite rating his digital literacy as 6, Dr K demonstrated a strong commitment to continuous learning and innovation: *“I’m always open to learning... it’s fascinating to know that there are quite a number of online platforms you can use to teach your students.”* This openness aligns with van der Heijden’s (2000) argument that perceived enjoyment and intrinsic motivation encourage system adoption, and supports the TAM and UTAUT frameworks, which emphasize the central role of user attitudes in shaping behavioral intention (Zurinah et al., 2013).

5.3.1.4 Findings

Dr K's reflections highlight not only how the LMS supports teaching and learning activities, but also how institutional dynamics, peer support, and personal attitudes toward technology shape his usage.

Performance Expectancy

The data revealed that Dr K views the LMS as highly useful in terms of enhancing his teaching efficiency. He cited examples such as the ease of uploading study guides and setting up assessments using the Aiken format. He indicated that these features saved time and simplified the process of managing large cohorts of distance students. He remarked:

"With multiple choice questions, you just prepare using Aiken format... it becomes easy for students because they just go to that assessment, click and submit."

The LMS was also perceived to support student engagement, primarily through the discussion forum tool. While acknowledging that not all students make effective use of this tool, Dr K found that it reduced his email load and encouraged peer-to-peer support. He suggested that formal student training on the LMS could increase the effectiveness of this engagement feature.

Content delivery was further improved through the LMSs ability to centralize materials and host multimedia content. Dr K explained that:

"If you find something related to your module, you can just come and insert it there in the LMS and tell your students."

However, he also expressed limitations in the system's synchronous teaching capabilities, wishing for integrated live teaching tools.

Social Influence

Dr K's adoption and continued use of the LMS was strongly influenced by collegial endorsement. He described how informal support and peer guidance played a more significant role than formal training in helping him become familiar with the platform:

“The majority of things... it’s from the recommendations and assistance from colleagues...”

Institutionally, the university mandates the use of LMS for study material uploads and student feedback. However, Dr K noted that initial implementation support was weak. He observed improvements in recent years, with targeted continuous professional development (CPD) workshops encouraging deeper engagement:

“From the beginning of the year, we have been trained and workshopped... that raises interest from one to want to know more.”

Recognition of the LMS usage has also increased over time. Initially, its use was not well publicized, but this has since changed, with CPD initiatives reinforcing the system’s importance.

Familiarity with Technology

Dr K assessed his digital literacy as moderate, rating himself at 6 out of 10. Nonetheless, he reported previous experience with platforms like Sakai and Microsoft Teams, which helped ease the transition to the LMS:

“When I started using the LMS, it was not that new... I also used Sakai to mark and give feedback.”

Despite some uncertainty with digital tools, he expressed an openness to learning and innovating in his teaching practice. He conveyed enthusiasm for exploring new platforms and continuously improving his digital competence:

“I’m always open to learning... it’s fascinating to know that there are quite a number of online platforms you can use to teach your students.”

This attitude demonstrates a forward-looking view of LMS use, driven by a motivation to adapt to evolving educational technologies.

5.3.1.5 Synthesis and interpretation of findings

Overall, the analysis of Dr K’s Phase 1 interview portrays a teacher educator whose LMS adoption was influenced by a combination of perceived usefulness, social influence, and developing technological familiarity, yet constrained by institutional limitations in training

and system functionality. Performance expectancy emerged as a central motivator for his LMS use: he consistently emphasized how the platform streamlined assessment preparation, centralized content delivery, and supported student engagement. These reflections align with prior research highlighting LMSs' potential to enhance instructional efficiency and teaching productivity (Panigrahi et al., 2018; Rajhans et al., 2020; Henderson et al., 2017). At the same time, Dr K identified practical constraints-particularly the absence of integrated synchronous teaching capabilities-which reflects findings by Bhalalusesa et al. (2013) regarding structural limitations that inhibit full LMS integration.

Social influence also played a critical role in shaping his behaviour, with collegial support proving more influential than early institutional training efforts. This is consistent with UTAUT assertions that peer endorsement is a strong motivator for technology adoption (Venkatesh et al., 2003), and with studies showing that informal peer networks often compensate for insufficient formal support (Lavidas et al., 2022; Kisanga & Ireson, 2015). While institutional policy mandated basic LMS use, Dr K's deeper engagement was nurtured through sustained professional development opportunities, reflecting literature emphasizing that policy-driven expectations must be reinforced with ongoing training to effect actual behavioral change (Mtebe & Raisamo, 2011; Dhawan, 2020).

Dr K's technological familiarity further supported his adaptation, though some uncertainties remained. His moderate digital proficiency, combined with prior experience using platforms such as Sakai and Teams, facilitated his LMS uptake, corroborating research that pre-existing ICT competence promotes smoother adoption (Law et al., 2018; Edeh et al., 2022). Crucially, his willingness to experiment and learn from digital tools reflects attitudes linked to higher behavioral intention in both TAM and UTAUT frameworks, where curiosity and motivation directly influence technology acceptance (van der Heijden, 2000; Zurinah et al., 2013). His narrative suggests that while initial adoption was driven by institutional requirement, sustained use was fostered by peer support, growing familiarity, and perceived pedagogical value.

Collectively, Dr K's Phase 1 data illustrate the complex interplay of individual capability, social dynamics, and institutional structures in shaping LMS adoption in open distance learning contexts. His experience underscores the importance of structured, continuous

training, robust peer networks, and fully integrated LMS functionalities to support and deepen educator engagement.

5.3.2 Mr L: Data presentation and discussion

5.3.2.1 Performance Expectancy

Teaching Efficiency

Mr L regarded the LMS as a practical tool for managing his teaching responsibilities efficiently. He found the system's ability to automate administrative tasks particularly useful. For example, he noted the convenience of automated assessment schedules:

"The system will make the closing by itself... I found that very much helpful."

Student Engagement

Mr L reported that the LMSs discussion forums enhanced student interaction and collaborative learning. He regularly posted questions in these forums and observed that students were more likely to respond to one another and reflect on their learning experiences. He stated:

"Students really engage with one another because I usually posted the discussion forums."

These forums were also used to prompt metacognitive reflection, particularly after assignment submissions, to shape future teaching approaches.

Content Delivery

According to Mr L, the LMS served as an effective platform for sharing and storing learning materials. He emphasized that students benefited from the ability to download recorded lectures and access materials at any time:

"It serves as a storage of information... they can access the information and also help them in the preparation of the exams."

He appreciated the platform's flexibility in supporting students' revision and learning at their own pace, particularly in preparation for assessments.

5.3.2.2 Social Influence

Collegial Endorsement

Unlike other participants, Mr L indicated that his use of the LMS was not strongly influenced by colleagues. Instead, institutional expectations and departmental norms played a more significant role in his adoption of the LMS. He clarified:

“This LMS was influenced by the university or the department... not necessarily by colleagues.”

This highlights the limited role of peer support in his specific context, in contrast with other cases where colleagues played a pivotal role in LMS uptake.

Institutional Support

Mr L emphasized that institutional policy requires weekly teaching and submission of evidence of student support, which directly motivates the use of LMS tools. He pointed out that announcements and regular content updates are necessary to show compliance and ensure consistent student contact:

“We really need to teach our students weekly... to show that indeed we are supporting our students.”

The LMS thus becomes a tool not only for instruction but also for accountability within the open distance learning environment.

Recognition

Recognition, in the form of institutional expectations for weekly postings and announcements, encouraged him to maintain active use of the platform. He shared:

“We have to make sure that we have contact with our students by the use of announcements.”

While not explicitly framed as reward-based recognition, the visibility of LMS activity appears to serve as a form of institutional validation.

5.3.2.3 Familiarity with Technology

Digital Literacy

Mr L rated his digital proficiency at a moderate level, estimating it as a 7 out of 10:

“I rate a 7... it’s above average that’s correct.”

He credited his confidence in part to previous experience with digital tools such as the J-router, which helped ease his transition to newer systems like the current LMS. His digital literacy supported independent exploration and more confident engagement with the platform.

Innovativeness

Mr L expressed a proactive and open-minded approach toward adopting educational technologies. He reflected on the necessity for educators to evolve alongside technological advancements:

“We really need to open or to be able to adapt... because the world is evolving every day.”

This sense of responsibility to guide students toward digital competence underscores his view of innovation as integral to effective teaching in a digital era.

5.3.2.4 Findings

Mr L’s reflections indicate that he values the LMS not only for streamlining his teaching tasks but also for meeting institutional reporting requirements, facilitating student interaction, and supporting his personal motivation to engage with new technologies-even when peer influence is minimal.

Performance Expectancy

Mr L expressed strong confidence in the LMS’s ability to enhance his teaching efficiency. He highlighted that administrative automation-such as the system’s capacity to open and close assessments and route scripts to markers-significantly reduced his manual workload, allowing him to devote more time to instructional duties and learner support. This aligns with Panigrahi et al. (2018), who note that LMSs streamline both

administrative and instructional responsibilities, particularly in open distance education contexts.

Regarding student engagement, Mr L reported that the LMS discussion forums promoted peer-to-peer interaction and encouraged deeper reflection. By prompting students to reflect on their assignment experiences, he was able to adjust his teaching strategies accordingly. As Panigrahi et al. (2018) observe, online discussion forums enable learners to construct knowledge collaboratively and maintain engagement throughout the learning process.

Content delivery was another strength he identified. Mr L described the LMS as a reliable repository, providing students with access to pre-recorded videos, slides, and study guides at their convenience, thereby supporting assessment preparation. However, he did not make use of live synchronous teaching within the LMS, reflecting the limitations noted by Bhalalusesa et al. (2013), who argue that while LMS platforms excel in asynchronous content delivery, they often provide less robust support for interactive, real-time engagement.

Social Influence

Interestingly, Mr L's adoption of the LMS was not strongly influenced by peer interactions. He reported that his engagement with the platform was primarily driven by institutional requirements rather than collegial endorsement. This finding contrasts with Lavidas et al. (2022), who argue that peer collaboration and knowledge sharing are key drivers of digital platform adoption. In Mr L's case, institutional policy exerted greater influence on practice than peer persuasion.

Institutional support emerged as a dominant factor in LMS use. Mr L emphasized the importance of meeting weekly teaching and reporting obligations, which are monitored through the LMS. The platform thus functions not only as a pedagogical tool but also as an accountability mechanism, supporting Dhawan's (2020) assertion that robust institutional frameworks are critical for consistent LMS integration in open distance education.

Recognition also played a subtle but meaningful role. Mr L noted that weekly announcements and content uploads were encouraged, reinforcing a culture of consistent digital engagement. While not a formal reward system, these expectations reflect institutional acknowledgment of LMS use. As Alshehri et al. (2019) note, such forms of recognition can positively influence motivation and usage patterns among academic staff.

Familiarity with Technology

Mr L rated his digital literacy as slightly above average, estimating it at 7 out of 10. He attributed this confidence to prior experience with ICT tools, such as the J-router, which facilitated a smoother transition to the LMS. This aligns with Law et al. (2018), who emphasize that digital literacy is a key enabler of effective LMS use, particularly when formal training is limited or informal.

Beyond technical competence, Mr L demonstrated a forward-thinking attitude toward educational technology. He viewed technological adaptation not as optional but as a professional responsibility, noting that the evolving digital landscape requires teachers to continually adjust. His perspective supports van der Heijden (2000), who argues that perceived usefulness and personal innovativeness strongly influence behavioural intentions to adopt new systems.

5.3.2.5 Synthesis and interpretation of findings

Overall, Mr L's Phase 1 reflections reveal a teacher educator whose LMS adoption is primarily shaped by institutional expectations, personal professional values, and a moderate-to-high level of digital familiarity, rather than by peer influence or collaborative support structures. His narrative demonstrates that performance expectancy is a central motivator in his use of the LMS: he consistently emphasized the system's value in reducing administrative workload, automating assessment management, and centralizing module resources—all of which allowed him to focus more effectively on teaching and learner support. This aligns with Panigrahi et al. (2018) and Ahmed et al. (2021), who identify productivity gains and streamlined task execution as major drivers of LMS adoption, particularly in open distance learning environments. Additionally, Mr L's use of discussion forums to foster student reflection underscores the role of digital spaces in

supporting learner metacognition and collaborative meaning-making (Panigrahi et al., 2018; Fearnley & Amora, 2020).

Where Mr L's experience diverges from common patterns is in the influence of social factors. Unlike many educators whose LMS adoption is strongly shaped by peer support (Lavidas et al., 2022; Kisanga & Ireson, 2015), Mr L attributed little of his usage to colleague recommendations. Instead, institutional monitoring mechanisms-such as weekly expectations for announcements, resource uploads, and student feedback-served as the primary motivator. This reflects a more compliance-driven form of adoption, consistent with UTAUT's assertion that social influence can originate from organizational expectations rather than interpersonal persuasion (Venkatesh et al., 2003). Research indicates that in structured academic environments, institutional accountability often functions as a *de facto* motivator for technology use (Dhawan, 2020; Bervell & Arkorful, 2020). Mr L's case illustrates this dynamic: while peer interactions were minimal, institutional requirements embedded within LMS use provided a structured framework that reinforced consistent engagement.

Mr L's reflections also highlight the critical role of digital familiarity in shaping confidence and competence with the LMS. His above-average digital proficiency, combined with prior exposure to ICT tools such as routers and other teaching platforms, facilitated a smoother transition into LMS use, supporting findings by Law et al. (2018) and Edeh et al. (2022) on the foundational importance of baseline digital literacy. Equally important is Mr L's intrinsic motivation and proactive approach to technological adaptation. His forward-looking perspective-that digital proficiency is a professional responsibility-aligns with van der Heijden's (2000) argument that personal innovativeness and perceived usefulness strongly influence behavioral intention. For Mr L, LMS integration is not merely a compliance requirement but a necessary evolution of professional practice in open distance learning contexts.

Taken together, Mr L's data portray a teacher educator who is functionally competent, intrinsically motivated, and aligned with institutional expectations, yet largely independent of peer networks. His adoption of the LMS is driven by perceived usefulness, reinforced by institutional structures, and supported by his digital literacy. These findings underscore

the need for LMS support strategies that recognize variations in social influence: while some educators depend heavily on peer collaboration, others-like Mr L-respond more strongly to structured institutional scaffolding and personal accountability. This insight directly informed the development of the Phase 2 enhancement strategy, emphasizing hands-on, personalized support that does not assume peer collaboration is a universal enabler of LMS adoption.

5.3.3 Dr E: Data presentation and discussion

5.3.3.1 Performance Expectancy

Teaching Efficiency

Dr E described the LMS as a valuable tool for enhancing lesson planning and sequencing. He appreciated its ability to structure weekly lessons and activities in a way that complemented his teaching style, explaining, *“It helps in structuring your work, and it also makes it easy for students to know what is coming each week.”* The platform’s consistency and predictability supported improved organization and time management, particularly in a blended learning context.

Student Engagement

He reported using the LMS’s discussion forums and chat functions to promote student interaction, although he acknowledged that participation was uneven. He explained, *“We use discussion forums, and we sometimes use chat... but you still get some students who are passive.”* While these tools provided opportunities for engagement, their effectiveness was limited by learner responsiveness, highlighting that the LMS alone cannot ensure interaction without sufficient student motivation and support.

Content Delivery

Dr E valued the LMS’s ability to store and retain educational content. He noted that once materials were uploaded, they could be consistently reused, supporting both teaching and student revision. He explained, *“Once you upload something, it is there and can be reused. Students also get used to that layout.”* This continuity was beneficial for both educators and learners, enabling efficient content reuse and providing students with a familiar, navigable learning environment.

5.3.3.2 Social Influence

Collegial Endorsement

Colleagues played a pivotal role in Dr E's adoption and sustained use of the LMS. He emphasized the value of informal peer sharing, which offered practical, hands-on guidance. He explained, "*We do share things as colleagues... like this is how I do it, maybe you can try this approach.*" These exchanges facilitated ongoing learning and experimentation within the department, highlighting the importance of collegial networks in developing digital competence.

Institutional Support

Institutional policies and requirements also shaped Dr E's engagement with the LMS. He noted that the university mandated the uploading of study materials and the monitoring of student activity through the platform, stating, "There are institutional policies and expectations to use [the LMS]... and there are also training workshops." This institutional support provided a structured framework for LMS use, ensuring that its implementation aligned with both administrative and pedagogical objectives.

Recognition

While formal recognition was not always explicit, Dr E suggested that LMS usage was embedded into performance expectations and departmental culture. He explained, "*Although we are not always praised, you can see it's expected... it's become part of how we are measured.*" This subtle recognition encouraged regular LMS engagement, particularly in relation to maintaining visibility and accountability in teaching practice.

5.3.3.3 Familiarity with Technology

Digital Literacy

Dr E developed his digital skills primarily through experiential learning rather than formal training. He described his approach as "*trial and error*", reflecting the self-directed nature of his early engagement with the LMS. Over time, he became more comfortable and confident, particularly through experimentation and feedback from colleagues.

Innovativeness

He also demonstrated a willingness to explore and integrate digital tools to enhance his online teaching. He expressed enthusiasm for incorporating multimedia resources, noting, *“I like using videos and animations... it gets students interested, even if it's online.”* His attitude reflects a proactive approach to maintaining student interest and enhancing content delivery through creative use of available technology.

5.3.3.4 Findings

Dr E's reflections highlight how the LMS supports his teaching practices by enhancing lesson structure, promoting content continuity, and enabling student interaction. His experience also underscores the influence of institutional policy and collegial collaboration on LMS usage, as well as the importance of self-directed learning and a proactive attitude toward educational technology.

Performance Expectancy

Dr E regarded the LMS as a valuable tool for enhancing his instructional planning and delivery. He particularly appreciated its ability to structure content on a weekly basis, which brought consistency to his teaching and clarity for students. He explained, *“It helps in structuring your work, and it also makes it easy for students to know what is coming each week.”* This aligns with Panigrahi et al. (2018), who note that LMS platforms support improved course planning and efficient lesson management.

Regarding student engagement, Dr E reported that the LMS's discussion forums and chat tools provided opportunities for interaction, although participation was often uneven. He observed, *“We use discussion forums, and we sometimes use chat... but you still get some students who are passive.”* This reflects Panigrahi et al. (2018), who emphasize that while LMSs can facilitate collaborative engagement, actual participation is strongly influenced by learner motivation and the strategies used to foster interaction.

In terms of content delivery, Dr E found the LMS effective for storing and organizing learning materials in a reusable, structured format. He explained, *“Once you upload something, it is there and can be reused. Students also get used to that layout.”* This

supports Bhalalusesa et al. (2013), who argue that LMS platforms enhance flexible and accessible content delivery, benefiting both instructors and learners.

Social Influence

Collegial influence played a significant role in Dr. E's LMS usage. He observed that informal peer-sharing within the department facilitated his learning and adoption of the platform: *"We do share things as colleagues... like this is how I do it, maybe you can try this approach."* This aligns with Lavidas et al. (2022), who argue that collaboration among educators fosters effective LMS integration through peer modelling and the exchange of practices.

Institutional policy also shaped his engagement with the LMS. Dr. E noted that the university required educators to upload materials and monitor student activity via the platform: *"There are institutional policies and expectations to use the LMS... and there are also training workshops."* His experience echoes Dhawan's (2020) assertion that clear institutional guidelines and ongoing support are essential for promoting technology adoption in open distance education.

Although formal recognition for LMS use was limited, Dr. E indicated that its use was implicitly expected and embedded within departmental practice. This reflects Alshehri et al.'s (2019) finding that institutional acknowledgment-whether formal or informal-can motivate sustained engagement with educational technologies.

Familiarity with Technology

Dr. E's digital literacy developed primarily through hands-on experience rather than formal training. He described his learning process as experimental and iterative: *"I learnt by doing... at first, it was just trial and error."* This learning-by-doing approach aligns with Law et al. (2018), who argue that digital competence often emerges through experiential engagement, particularly in resource-constrained environments.

Moreover, Dr. E demonstrated a strong inclination toward innovation in his teaching practice. He expressed enthusiasm for incorporating multimedia content to maintain student interest, reflecting van der Heijden's (2000) assertion that educators' willingness

to experiment and derive enjoyment from using new technologies is critical for successful adoption.

5.3.3.5 Synthesis and interpretation of findings

Dr. E's reflections reveal a teacher educator whose LMS adoption is shaped by the interplay of performance expectations, collegial influence, institutional policy, and an intrinsically motivated, self-directed approach to digital learning. His experiences demonstrate a steady progression toward deeper LMS integration, underpinned by an awareness of its pedagogical value and a willingness to experiment with technological tools even in the absence of extensive formal training.

From a performance expectancy perspective, Dr. E consistently framed the LMS as a platform that enhances teaching structure, clarity, and continuity. He praised its ability to organize content weekly, aligning with Panigrahi et al. (2018), who emphasize that LMS environments improve instructional planning and pacing-critical aspects in large open distance learning modules. His observation that "students also get used to that layout" suggests that LMS use contributed not only to teaching efficiency but also to learners' cognitive predictability, a key factor in successful online learning (Henderson et al., 2017). At the same time, Dr. E's concern about inconsistent student participation in forums highlights a challenge noted in the literature: while LMS tools can facilitate interaction, actual engagement depends heavily on learner motivation, scaffolding, and digital competence (Cavus & Alhih, 2014; Swart, 2015). This reinforces the Technology Acceptance Model (TAM) argument that perceived usefulness must translate into clear behavioral benefits for both educators and learners to maximize effectiveness.

In terms of social influence, Dr. E's experiences support the UTAUT proposition that both collegial and institutional cues shape technology adoption. His account of departmental knowledge-sharing reflects Lavidas et al. (2022), who argue that peer modeling helps educators internalize digital practices through observational learning. Unlike Mr. L-whose adoption was primarily institutionally driven-Dr. E benefited from a blend of informal collegial mentorship and formal policy-driven expectations. The university's requirements to upload teaching materials and track student participation provided a structured framework, consistent with Dhawan (2020) and Bervell & Arkorful (2020), who describe

LMS policy mandates as critical scaffolds in open distance learning. Although he noted limited explicit recognition, the implicit normalization of LMS use within the department acted as a form of institutional reinforcement, aligning with Alshehri et al. (2019). For Dr. E, social influence was multidimensional, involving peer support, institutional expectations, and a departmental culture that positioned LMS usage as both routine and necessary.

Regarding familiarity with technology, Dr. E's narrative mirrors patterns observed in developing-country contexts, where educators often build competence through experiential, trial-and-error approaches due to insufficient formal ICT training (Law et al., 2018; Edeh et al., 2022). His statement that "I learnt by doing" reflects a self-regulated learning orientation that compensates for gaps in training while fostering autonomy and resilience in navigating new systems. This type of experiential familiarization is common in environments where digital infrastructure and formal support may be inconsistent, reinforcing findings by Maphalala & Mpofu (2018) and Mtebe & Raisamo (2011). Importantly, his eagerness to experiment with multimedia tools demonstrates a high degree of technological innovativeness—a predictor of positive behavioral intention according to both TAM and UTAUT (van der Heijden, 2000; Venkatesh et al., 2003). His willingness to embrace digital tools to sustain student engagement positions him as an educator focused on continuous improvement rather than mere compliance.

Collectively, these findings suggest that Dr. E's LMS usage is shaped by a combination of structured pedagogical needs, institutional expectations, peer collaboration, and intrinsic motivation. Unlike Dr. K-whose adoption was strongly peer-driven-or Mr. L-whose engagement was primarily institutional-Dr. E represents a hybrid case in which social influence and self-directed learning intersect to foster LMS uptake. His experience underscores the importance of providing both collaborative spaces and structured policy guidance, as different educators draw on different motivational sources. Insights from his narrative contributed directly to the refinement of the LMS enhancement strategy, particularly in reinforcing hands-on demonstration, promoting peer-sharing spaces, and ensuring that LMS design supports self-paced exploration while offering institutional scaffolding.

5.3.4 Dr M: Data presentation and discussion

5.3.4.1 Performance Expectancy

Teaching Efficiency

Dr M reported that the LMS improved his ability to plan and deliver content in a more organized and time-efficient manner. He explained how uploading weekly content helped him maintain pacing and manage student expectations:

“I upload content weekly... it helps with pacing the course and lets students know what to expect.”

This structured approach enabled him to streamline module delivery and reduced the likelihood of content overload or learner confusion.

Student Engagement

While he made active use of the LMS discussion forums and messaging tools to foster learner interaction, Dr M observed varying levels of student participation. He commented:

“Some students are very active in the forums, others need a bit more encouragement.”

This suggests that while the LMS provides the infrastructure for engagement, individual learner motivation remains a determining factor in its effectiveness.

Content Delivery

Dr M valued the LMS for its ability to centralize educational content. He noted that students benefitted from having all resources in one place, including readings, videos, and announcements:

“Everything is in one place-notes, videos, announcements-it makes it easier for the students.”

This centralization supported ease of access and continuity, especially important in an asynchronous, remote learning environment.

5.3.4.2 Social Influence

Collegial Endorsement

Dr M emphasized the importance of collegial support in his LMS adoption journey. He mentioned that informal exchanges with colleagues allowed him to develop practical teaching strategies using the LMS:

“We have a culture of sharing tips... I learnt a lot from what others were already doing.”

These collaborative efforts created a positive learning environment that encouraged experimentation and shared growth.

Institutional Support

Institutional expectations were a significant driver of LMS use for Dr M. He acknowledged that his use of the LMS was initially shaped by policy requirements and formal training provided by the institution:

“We are expected to use [the LMS], and the training helped a lot at the beginning.”

This structured support helped him gain early familiarity with the platform and laid a foundation for sustained use.

Recognition

Although he did not receive explicit recognition for his LMS engagement, Dr M described a sense of professional accountability that came with his digital responsibilities:

“It’s not about rewards, but you feel responsible to keep your module active and updated.”

This internalized expectation suggests that recognition is embedded in institutional norms and educator identity rather than formal praise.

5.3.4.3 Familiarity with Technology

Digital Literacy

Dr M admitted to feeling uncertain when first introduced to the LMS but became more confident through regular use and training. He shared:

“I was not confident at first... but the more I used it, the more I understood how it works.”

This progression reflects an experiential learning process common among educators who develop digital literacy through practice rather than formal instruction alone.

Innovativeness

His growing confidence was accompanied by a willingness to explore the LMSs features and adopt new tools to enhance learner engagement. He described his current approach as exploratory and enthusiastic:

“Now I like exploring things-adding quizzes, uploading videos... it keeps things dynamic.”

This indicates a proactive attitude toward innovation, highlighting his commitment to adapting digital tools to enrich online teaching.

5.3.4.4 Findings

Dr. M's reflections highlight not only how LMS supports teaching and learning activities, but also how institutional dynamics, peer support, and his growing digital confidence influence his use of the platform. His experience underscores that perceived usefulness is shaped not only by the tool's functionality, but also by the broader academic and professional context in which the LMS is implemented.

Performance Expectancy

Dr. M found the LMS to be an effective tool for enhancing teaching efficiency, particularly in pacing and structuring course delivery. By uploading content on a weekly basis, he was able to maintain clear expectations and a consistent workflow for students. This aligns with Panigrahi et al. (2018), who note that LMS platforms help educators organize learning materials and manage instructional time more effectively.

In terms of student engagement, Dr. M used forums and messaging tools to encourage participation. While some students were highly responsive, others required ongoing prompting. This supports Panigrahi et al.'s (2018) observation that LMS platforms provide opportunities for interaction, but their effectiveness depends on both platform design and learner motivation.

Regarding content delivery, Dr. M valued the ability to centralize resources-lecture notes, videos, and announcements-making access more convenient for students. This reflects Bhalalusesa et al. (2013), who argue that centralizing content on LMS platforms enhances flexibility and accessibility in open distance education.

Social Influence

Dr. M's LMS usage was positively influenced by his colleagues, who shared tips and strategies for using the platform effectively. This collegial support was instrumental in shaping his early LMS practices, aligning with Lavidas et al. (2022), who highlight the importance of peer collaboration and informal learning in promoting LMS adoption, particularly in higher education contexts.

Institutional support also played a key role. Dr. M acknowledged that LMS use was embedded in the university's teaching policy and that initial training sessions were provided to facilitate adoption. These observations are consistent with Dhawan (2020), who emphasizes that institutional policies, together with professional development opportunities, are critical for successful LMS integration.

Although he did not receive explicit praise for his LMS use, Dr. M described a strong sense of professional accountability tied to digital engagement. This internalized expectation reflects Alshehri et al. (2019), who note that subtle forms of recognition can nonetheless influence educator motivation and consistency in LMS use.

Familiarity with Technology

Initially unfamiliar with the LMS, Dr. M developed his digital literacy through hands-on practice and repeated use. He described how his confidence grew over time as he explored different features. This self-directed learning pathway aligns with Law et al. (2018), who emphasize experiential engagement as a key mechanism for building digital competence in higher education.

Over time, Dr. M demonstrated increasing innovativeness, actively incorporating videos, quizzes, and other interactive tools to keep his modules dynamic and engaging. His willingness to experiment with new digital methods supports van der Heijden's (2000)

assertion that educators' openness to innovation reinforces the perceived usefulness of technology.

5.3.4.5 Synthesis and interpretation of findings

Dr. M's reflections illustrate how his LMS usage is shaped by the combined effects of perceived usefulness, social influence, institutional conditions, and growing digital confidence. His experiences show that LMS adoption is not merely a technical process, but also a pedagogical and relational one, influenced by institutional culture and his evolving comfort with digital tools.

From a performance expectancy perspective, Dr. M consistently framed the LMS as a system that enhances teaching efficiency, particularly in structuring weekly content and ensuring predictable learning pathways. His emphasis on pacing aligns with Panigrahi et al. (2018), who highlight that LMS platforms support systematic instructional planning, especially in open distance education contexts where consistency is critical. The LMS allowed him to create structured, repeatable learning routines that provided students with clarity regarding expectations and weekly activities. His reflections underscore that perceived usefulness is heightened when LMS tools not only simplify educator tasks but also deliver visible benefits for learners.

Dr. M's experiences with student engagement reveal a nuanced picture. He leveraged forums and internal messaging tools to encourage participation but noted variability in responsiveness. This reflects Panigrahi et al.'s (2018) observation that while LMS tools provide the infrastructure for interaction, sustained engagement depends on learner motivation and educator strategies that foster participation. His need to repeatedly prompt students highlights the challenge identified by Bhalalusesa et al. (2013): the LMS alone cannot guarantee engagement without supporting student digital literacy and motivation.

In terms of content delivery, Dr. M valued the LMS as a centralized hub for resources. Uploading lecture notes, videos, and announcements in one accessible space enhanced flexibility and accessibility for distance learners, echoing findings by Bhalalusesa et al. (2013) and Swart (2015). His practice of enriching modules with multimedia demonstrates alignment with contemporary digital pedagogies that emphasize multimodal learning.

From a social influence standpoint, Dr. M's adoption trajectory underscores the importance of collegial collaboration. He frequently drew on peers for guidance, modeling the informal professional learning communities described by Lavidas et al. (2022), where educators share tips and demonstrations to improve digital practices. This collegial support helped bridge gaps in formal LMS training and aligns with Kisanga & Ireson's (2015) argument that peer interactions strengthen technology acceptance in resource-constrained environments.

Institutional influence was also significant. Dr. M acknowledged policy requirements and initial training opportunities, illustrating how institutional expectations shape perceived normative pressure toward LMS use. This aligns with the UTAUT framework and Dhawan's (2020) claim that institutional policy and training are essential to successful LMS adoption in open distance learning. Although explicit recognition for LMS use was limited, Dr. M internalized digital engagement as part of his professional responsibility, reflecting Alshehri et al.'s (2019) notion of implicit recognition, where institutional norms influence educator behavior even without formal rewards.

Regarding technological familiarity, Dr. M's experience reflects patterns seen in developing-country contexts, where educators often develop digital skills through self-directed experimentation due to limited formal ICT training (Law et al., 2018; Edeh et al., 2022). His statement, "*I learnt by doing*," illustrates an experiential learning pathway common in higher education, where educators must navigate complex LMS systems despite uneven digital readiness. Over time, his growing confidence enabled him to adopt more advanced tools, such as videos and quizzes, demonstrating what van der Heijden (2000) terms technological innovativeness—a factor closely associated with positive behavioural intention toward digital systems.

Overall, Dr. M's case demonstrates the interplay between pedagogical needs, institutional expectations, peer influence, and personal digital growth. His trajectory, from cautious beginner to emerging innovator, reflects the dynamic nature of LMS adoption in open distance learning. His experiences reinforce the need for strategies that support hands-on practice, peer collaboration, and gradual skill development—elements that were directly integrated into the LMS enhancement strategy

5.3.5 Cross-case synthesis: Perceived usefulness

Across the four cases, participants consistently perceived the LMS as useful for content delivery, assessment management, and communication with students. However, differences emerged regarding the factors that encouraged sustained LMS use. While some participants were strongly influenced by collegial support and collaboration, others were motivated primarily by institutional expectations and accountability requirements. Familiarity with technology and willingness to experiment with digital tools further shaped perceptions of usefulness. Collectively, the findings indicate that perceived usefulness extends beyond the technical capabilities of the LMS and is influenced by organizational, social, and individual factors.

5.4 Summary of findings

Table 5.4 summarizes the findings for each theme across each category and sub-category.

Table 5.4: Summary of findings across both themes

Theme	Category	Sub-Category	Case A: Dr K	Case B: Mr L	Case C: Dr E	Case D: Dr M
Perceived Ease of Use	Effort Expectancy	Intuitive Design	Found interface “shocking” and difficult; only used basics.	Hidden options; relied on external tools.	Layout simple but settings confusing; non-standardised tasks.	Basics visible; advanced tools overlooked/forgotten.
		Learning Curve	Took 2-5 months; relied on workshops/colleagues.	Less than a week (prior exposure).	More than 4 months; self-learning and colleague support.	~4 months; learning triggered by student queries.
		Complexity	Rated 7/10 (frustrating, esp. assessments).	Rated 3/10 (easy once familiar).	Rated 6-7/10 (assignments complex).	Rated 5/10; confident with basics only.
	Facilitating Conditions	Technical Support	Delayed, unhelpful.	Limited training; slow support (7-14 days).	Mixed: immediate to one week.	Workshops inconsistent; facilitators not confident.
		Resource Accessibility	Praised easy access to resources.	Straightforward after learning edit mode.	Valued central repository; misused live features.	Used mainly for announcements/slides; underutilised.
		Infrastructure	VPN issues; slow laptop.	Institution provided devices/data.	Stable; but students struggled.	Institutional maintenance misaligned with teaching.

Perceived Usefulness	Familiarity with Technology	Prior Experience	Google Classroom, Teams, Sakai.	ICT tools (J-router); smoother transition.	Blackboard, Zoom; eased entry.	Minimal prior exposure.
		Training	Theoretical, not hands-on.	One-off, insufficient.	Surface-level; lacked depth.	Rated 6-7/10; "overload"; prefers step-by-step.
		Self-Efficacy	6/10; self-directed learner.	7/10; proactive.	Above average; fully uses once understood.	Moderate; willing to learn basics first.
	Performance Expectancy	Teaching Efficiency	Automation aided efficiency; study guides easy to upload.	Automation reduced workload, freeing time for support.	Improved organisation of lessons/assessments.	Routine tasks efficient but advanced underused.
		Student Engagement	Forums reduced emails; encouraged peer learning.	Forums fostered reflection, improved strategies.	Used assignments and forums to stimulate interaction.	Limited-mainly announcements.
		Content Delivery	Central repository valued; lacked synchronous teaching.	Effective for video/slide access; no synchronous tools.	Strong for documents/videos; limited interactivity.	Primarily announcements/resources.
	Social Influence	Collegial Endorsement	Relied on colleagues for help.	Minimal peer influence; policy-driven use.	Strong peer influence in uptake.	Some peer influence, but uneven.

		Institutional Support	Training, workshops, expectations increased.	Institutional reporting drove usage.	Policy frameworks promoted adoption.	Institutional scheduling undermined productivity.
		Recognition	Initially low, later improved.	Recognition via weekly announcements.	Valued when LMS work was visible.	Little explicit recognition.
	Familiarity with Technology	Digital Literacy	6/10; average.	7/10; confident.	Stronger than average.	Moderate; prefers contextual help.
		Innovativeness	Open to experimenting, motivated.	Felt innovation was professional duty.	Highly innovative; adopted new tools readily.	Willing but cautious.

5.5 Conclusion

Across the four cases, it became evident that perceived ease of use of the LMS was shaped by a combination of system design, prior digital experience, and institutional support. While participants such as Dr. K and Dr. M described the LMS as initially “shocking” or intimidating, Mr. L and Dr. E adapted more quickly due to earlier exposure to digital platforms and prior support roles. Nevertheless, all four participants encountered challenges with hidden features, multi-step assessment processes, and a steep learning curve, which limited their confidence in using more advanced tools. Complexity ratings ranged from 3/10 to 7/10, highlighting differences in individual experiences, but a common theme emerged: basic functions, such as posting announcements and uploading resources, were far more readily adopted than interactive or pedagogically rich tools. This pattern underscores that ease of use is influenced not only by interface design but also by familiarity, training, and user confidence.

Regarding facilitating conditions, institutional training and support were critical yet inconsistent. Participants described workshops as overly general, theoretical, or lacking depth, leaving them reliant on peer support or trial-and-error learning to build competence. Technical support was sometimes slow or delayed, particularly during urgent teaching or assessment periods. While infrastructure provision—such as laptops and data—was acknowledged in some cases, challenges like VPN failures, misaligned LMS maintenance schedules, and students’ limited access constrained both educator and learner engagement. These findings suggest that perceived ease of use is best understood as an ecosystem outcome, dependent not only on the system itself but also on the timeliness, quality, and responsiveness of institutional scaffolding.

In terms of perceived usefulness, all participants agreed that the LMS positively supported teaching efficiency, content delivery, and, in some instances, student engagement. Tools such as assessment shells, discussion forums, and centralized resource repositories were praised for reducing administrative workload, streamlining access, and facilitating peer-to-peer learning. However, the effectiveness of these tools varied: some educators relied on external platforms for live teaching or polling despite LMS availability, while others avoided advanced features due to fear of mistakes. Social influence also shaped

usage patterns, with colleagues often providing more immediate and practical guidance than formal training structures. Recognition of LMS use was initially limited but reportedly increasing as workshops and institutional emphasis grew. Importantly, all participants demonstrated openness to innovation and continuous learning, suggesting that with appropriate institutional support and hands-on training, educators are likely to deepen their LMS engagement.

Furthermore, participants demonstrated limited awareness and use of integrated communication and virtual teaching tools available within the LMS. This finding informed the inclusion of BigBlueButton as a component of the LMS enhancement strategy developed in Chapter 6.

Taken together, the cross-case findings highlight both the potential and the limitations of LMS integration in an ODL environment. Educators value the LMS as a tool that enhances efficiency and access, yet their engagement with its full capabilities is constrained by complexity, insufficiently intuitive design, limited training, and uneven support systems. At the same time, their shared motivation to adapt and improve indicates a clear opportunity: targeted, user-centred interventions that are context-specific and responsive to the realities of open distance education can significantly enhance both perceived ease of use and usefulness.

The findings presented in this chapter highlight both the opportunities and challenges associated with LMS use among science teacher educators. These findings directly informed the development of the LMS enhancement strategy presented in Chapter 6. Specifically, the identified challenges relating to effort expectancy, facilitating conditions, familiarity with technology, performance expectancy, and social influence provided the basis for the design of targeted strategy components aimed at improving LMS adoption and pedagogical use.

Chapter 6: A strategy for LMS usage

6.1 Introduction

In this chapter, the developed strategy for LMS use among science teacher educators at an open distance learning university is presented and discussed. The development and implementation of this strategy are guided by a conceptual framework that integrates the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), with the additional facilitating condition of familiarity with technology. The strategy was designed in response to challenges identified in the first phase of data collection, including the limited use of LMS tools beyond basic functionalities, perceptions of LMS complexity, insufficient structured support, and generally low digital confidence among participants.

Chapter 5 identified several challenges affecting LMS use among science teacher educators, including issues related to effort expectancy, facilitating conditions, familiarity with technology, performance expectancy, and social influence. Drawing on these findings, together with the conceptual framework and relevant literature, this chapter presents the development and implementation of a strategy designed to enhance LMS use within the ODL context

The findings from phase one align with existing literature, which highlights the underutilization of LMS platforms due to insufficient training and usability concerns among educators (Kakasevski et al., 2008; Dahlstrom et al., 2014; Lavidas et al., 2022). As Legris et al. (2003) note, sustained engagement with educational technologies-and the perceived usefulness of these systems-depends not only on their availability, but also on supportive strategies that reduce effort and enhance user confidence.

6.2 Strategic aim

The strategic aim of the intervention was to guide science teacher educators through a process designed to progressively build both awareness of LMS functionalities and confidence in their use. By providing structured support that addressed individual needs while also introducing educators to previously unfamiliar features, the strategy sought to enhance their competence and comfort with the platform. Ultimately, the goal was to

improve LMS usage by upskilling teacher educators through a hands-on, practical approach that demonstrated ways to make the LMS both easier to use and more pedagogically effective.

6.3 Strategy Design

The strategy was implemented through four hands-on, practical steps, during which the researcher met individually with each participant to guide them through different LMS functionalities. Each step included a short tutorial, delivered either as a recorded video or a synchronous session, where the researcher provided training on specific LMS features. For this training, an LMS sandpit site was created for each participant, allowing them to practice and experiment with the various functionalities while the researcher monitored progress and understanding during the sessions.

During each session, participants engaged in hands-on tasks with the researcher present to provide guidance, answer questions, and ensure completeness. Following the practical tasks, participants completed a self-reflection activity, using a checklist and written responses. This process not only confirmed that the teacher educators had acquired the intended skills but also encouraged them to identify challenges and benefits associated with each step.

The strategy was structured to be completed in six sessions, each lasting no more than one hour, as outlined in Section 6.4. The sessions were conducted over eight weeks, scheduled according to participants' availability. This approach addressed the TAM constructs of perceived usefulness and perceived ease of use by clearly demonstrating the benefits and relevance of LMS tools. It also aligned with the UTAUT constructs of performance expectancy and facilitating conditions, particularly by increasing digital familiarity and reducing anxiety associated with LMS use.

The design of the strategy was also informed by principles of adult learning and professional development. Adult learners benefit from learning experiences that are relevant to their professional contexts, build on prior experience, and provide opportunities for immediate application of newly acquired knowledge and skills (Knowles et al., 2020). The hands-on nature of the strategy, the use of authentic LMS tasks, individualized support, and opportunities for reflection were intended to promote active

engagement and meaningful learning. Furthermore, the strategy aligns with professional development literature that emphasizes sustained, practice-based support rather than one-off training interventions as a means of promoting lasting changes in teaching practice (Desimone & Garet, 2015).

6.4 The implementation of the strategy

This section outlines the stages of the strategy. Prior to implementation, an orientation meeting was held with each participant, the purpose of which is detailed in Section 6.4.1. Following the orientation, the four practical steps of the strategy were carried out during the implementation phase, as described in Section 6.4.2. The structured design of the strategy was intended to ensure both ease of use and alignment with pedagogical goals. An overview of the strategy is illustrated in figure 6.1.

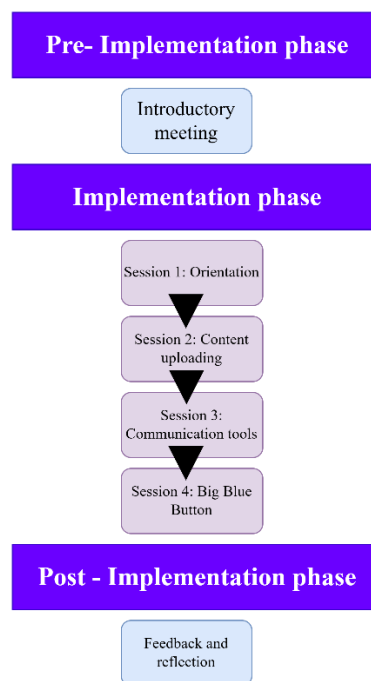


Figure 6.1: Strategy outline

6.4.1 Pre-Implementation Phase

Prior to the initiation of the LMS enhancement strategy, an introductory meeting was held with the four participating science teacher educators.

The purpose of this orientation meeting was as follows:

- To clearly outline the purpose of the strategy.
- To clarify expectations, roles, and responsibilities of both the researcher and the participants.
- To explain the structure of the implementation process (four guided sessions followed by reflection).
- To ensure each participant was linked, had access to and managed to navigate towards their *LMS-Sandpit* site.

6.4.2 Implementation Phase

Each teacher educator participated in four sequential sessions in the format of a Microsoft Teams meeting. Each session focused on various LMS functionalities and took approximately 1 hour. Thereafter, each participant was sent and completed a checklist confirming their newly acquired skills and reflecting on any challenges or benefits of the session. The sessions will be described below.

6.4.2.1 Session 1: Orientation session

The primary objective of this session was to familiarize the participants with the LMS's interface, course layout, and basic navigation features.

The following skills were covered:

- Logging in and accessing course shells.
- Activating Edit mode and navigating to various parts of the basic LMS interface
- Identifying where resources, activities, and tools are located.

The activities completed:

- Watch an orientation video.
- Guided navigation of a practice course shell.
- Exploration of announcements, gradebook, and participant tools.

The expected outcome was an enhanced level of comfort with the navigation and terminology used for the LMS interface.

6.4.2.2 Session 2: Uploading and Organizing Learning Content

The primary objective of this session was to develop skills for uploading, organizing, and managing various materials within the LMS, within sections, that assisted teacher educators with personalization and organizing of their sites.

The following skills were covered:

- Creating sections and renaming or editing them.
- Uploading individual files and folders.
- Adding pages, labels, and media.
- Organising resources logically and previewing in Student View.

The activities completed:

- Watch a tutorial video on content uploading, where the researcher paused at intervals, checked in with the participant and at the same time monitored the *LMS Sandpit site*
- The upload of content in various forms, within folders and populating of a page.

The expected outcome was an enhanced level of performance expectancy linked to the improvement of teacher educator efficiency and confidence in the upload and management of content.

6.4.2.3 Session 3: Using various communication tools

The primary objective of this session was to encourage and enable the use of communication tools within the LMS to enhance teacher educator- students communication and engagement.

The following skills were covered:

- Posting announcements (with embedded audio, images and tables, beyond the basic use of announcements, as observed in phase one)
- Creating , managing and communicating with the forum activity.
- Using the *participants* resources to send private, direct messages

- Using Quickmail as a tool to send emails to the users of the module site.
- Creating chat sessions.
- Using polls (choice) activity to allow students the opportunity to vote on a response.

The activities completed:

- Watch the tutorial video on various communication tools.
- Practice posting announcements including embedded media and setting up forums.
- The sending of direct messages.
- Sending out of Quickmails.
- Creating a chat room.
- Conduct quick poll to test interactive features.
- Switch to Student View to verify visibility.

The expected outcome relates to an enhanced ability to interact and communicate with students using the LMS.

6.4.2.4 Session 4: Using BigBlueButton

The objective of this session was to familiarize teacher educators with BigBlueButton, a tool that enables hosting synchronous sessions and recording of asynchronous sessions for students. The need for such a tool emerged during Phase 1 of data collection, which revealed that none of the four participants were using the LMS to host synchronous sessions, as they were unaware this functionality existed. Additionally, participants reported difficulties in uploading external recordings of sessions onto the LMS site.

The following skills were covered:

- Creating and joining live sessions.
- Screen-sharing and chat management.
- Recording sessions and downloading attendance reports.
- Accessing and reviewing recorded materials.

The activities completed:

- Set up BigBlueButton and navigate through the various options

- Host a live session, upload content, manage chat and shared notes along with all the various optionalities available within the BigBlueButton interface
- Practice recording and retrieving session data.
- Reflect on observed benefits and challenges.

The expected outcome was to enhance teacher educators' abilities to teach in a synchronous manner, increasing their perceptions of usefulness as well as ease of use of the platform.

6.4.3 Post-Implementation Phase

After completing all four sessions, individual feedback and reflection interviews were conducted with each teacher educator. These sessions aimed to capture participants' reflections on the LMS's ease of use, perceived usefulness, and their overall experience of the strategy. The interviews also sought to identify enablers and barriers within the strategy, providing recommendations for future iterations. Collectively, these reflections offered qualitative evidence of changes in adoption behavior, skill development, and pedagogical attitudes.

6.5 Conclusion

The LMS strategy for science teacher educators presented in this chapter was a contextually responsive intervention, developed based on findings from Phase 1 of this study. Its primary aim was to enhance LMS use at a South African open distance learning university. Grounded in the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), with the added facilitating condition of familiarity with technology, the strategy specifically addressed the barriers identified in Phase 1: limited awareness of LMS functionalities, low digital confidence, perceived complexity, and insufficient structured support.

The strategy progressed from orientation and basic navigation to more advanced functionalities. Each step was designed in direct response to needs expressed during the Phase 1 interviews and observations, incrementally strengthening teacher educators' perceived usefulness of the LMS while enhancing their confidence and skills. The use of individual LMS sandpit sites allowed participants to practice skills safely and authentically,

while real-time guidance from the researcher provided a safety net that reduced anxiety, clarified procedures, and promoted deeper understanding of previously underutilized or unknown LMS features.

The strategy also modelled effective professional development for open distance learning contexts by combining video-based demonstrations, synchronous coaching, self-paced checklists, and reflective prompts. This multimodal approach aligns closely with the UTAUT constructs of performance expectancy and facilitating conditions, as participants were not only shown how to use LMS tools, but also supported in understanding why these tools enhance teaching and learning in their modules. The design further advanced familiarity with technology, a critical factor in environments where educators' digital readiness varies widely.

Collectively, the phases of the strategy created a cohesive developmental pathway that extended beyond technical skill acquisition to influence pedagogical confidence, intentionality, and readiness for integrating LMS tools into science education. The strategy laid the groundwork for meaningful shifts in LMS usage and adoption, which are examined in Chapter 7 through post-implementation reflection interviews. These findings will illustrate the extent to which the strategy contributed to changes in perceptions, behaviours, and future intentions regarding LMS-based teaching and learning, thereby completing the final phase of the research design.

Chapter 7: Science teacher educator experiences of the LMS strategy

7.1 Introduction

This chapter presents the findings from the post-implementation interviews with the four participants. The aim is to evaluate how the teacher educators perceived the strategy, the influence it had on their perceptions of LMS usefulness and ease of use, and their confidence and familiarity with the LMS. Additionally, the chapter explores how participants envisioned sustaining their LMS usage because of the strategy.

The conceptual framework guiding this study integrates the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the added construct of familiarity with technology. The structure of the implemented strategy, as detailed in Chapter 6, is also referenced in the presentation of the data, allowing the findings to be interpreted in relation to each session of the strategy. Organizing the findings according to the conceptual framework provides insight into perceived ease of use and perceived usefulness, which is particularly relevant to addressing the first two research questions:

- What are the factors that influence science teacher educators perceived ease of use of LMS in open distance education?
- What are the factors that influence science teacher educators perceived usefulness of LMS in open distance education?

Subsequently, integrating the structure of the strategy provides insight into the teacher educators' experiences with the intervention, as well as their reflections on using the LMS in open distance education. This analysis addresses the final research question:

- What are the science teacher educator experiences of the implementation of the strategy for using LMS in open distance education?

7.2 Presentation of data

The analysis of the post-implementation interviews is structured according to the integrated conceptual framework guiding this study, which combines the Technology

Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), with an additional construct-Familiarity with Technology-added to address the unique digital readiness needs of science teacher educators in an open distance learning environment.

From TAM, two constructs inform the analysis:

- **Perceived Ease of Use**, which relates to the level of effort teacher educators believe is required to engage with the LMS and its functionalities.
- **Perceived Usefulness**, which reflects the extent to which educators perceive the LMS as improving teaching efficiency, effectiveness, and overall module delivery.

The UTAUT framework contributes four additional constructs central to understanding teacher educators' acceptance and continued use of LMS tools:

- **Performance Expectancy**, capturing the anticipated benefits and value educators associate with the LMS in enhancing teaching and learning processes.
- **Effort Expectancy**, referring to the perceived simplicity or difficulty of using the LMS. While closely aligned with TAM's Perceived Ease of Use, this construct is analyzed where participants explicitly mention reduced effort, ease, or streamlined tasks resulting from the strategy.
- **Social Influence**, examining the extent to which institutional expectations, colleague encouragement, or broader professional norms shape educators' willingness to use the LMS.
- **Facilitating Conditions**, encompassing the contextual, structural, and technical supports-such as access to training, institutional resources, and technical assistance-that enable or constrain effective LMS adoption.

The final construct, **Behavioural Intention**, reflects teacher educators' willingness, motivation, and commitment to continue using the LMS and its advanced functionalities in future teaching.

Given the distance learning environment, an additional construct-**Familiarity with Technology**-was included. This acknowledges the varying levels of prior digital exposure

and comfort that influence how easily educators navigate and adopt LMS tools. This construct was particularly significant given Phase 1 findings, where limited exposure and low digital confidence emerged as key barriers to advanced LMS use.

Together, these constructs form the analytical lens through which the post-implementation data are interpreted and presented. They guide the organization of the chapter, ensuring that each participant's reflections are examined systematically in relation to the conceptual framework. A visual representation of this framework and its relationship to the data structure is provided in Figure 7.1.

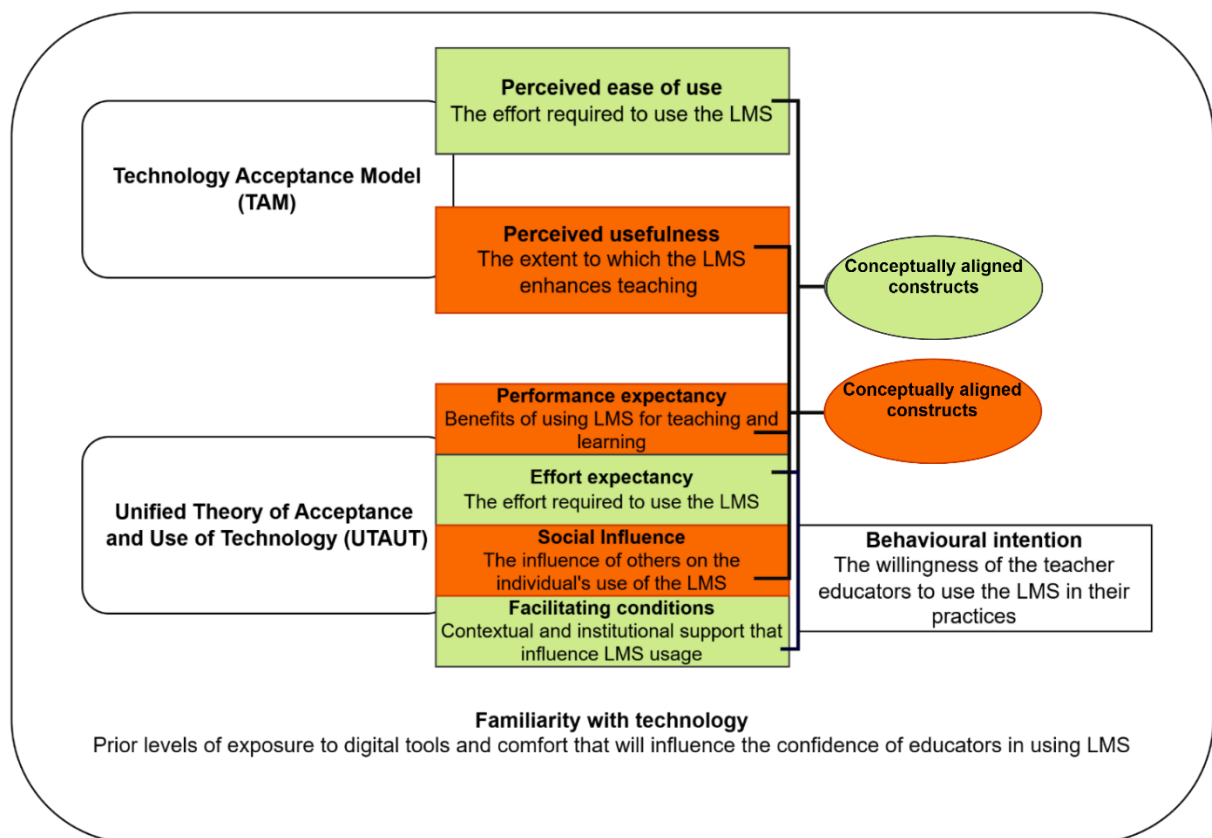


Figure 7.1: Adapted conceptual framework illustrating the conceptual relationships between TAM, UTAUT and behavioural intention following implementation of the LMS strategy

Figure 7.1 illustrates the adapted conceptual framework used to interpret participants' post-implementation experiences following implementation of the LMS strategy. The

framework demonstrates the conceptual alignment between the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The conceptually aligned constructs indicate that perceived ease of use is closely related to effort expectancy, while perceived usefulness aligns with performance expectancy. These constructs were interpreted together during data analysis because they represent complementary dimensions of technology acceptance. Social influence and facilitating conditions extend the explanatory scope of TAM by recognizing the influence of organizational support, collegial interactions, and institutional factors on LMS adoption. Collectively, these constructs contribute to behavioral intention, representing participants' willingness to continue integrating LMS functionalities into their teaching practice following implementation of the strategy.

Although the conceptual framework integrates constructs from TAM and UTAUT, its application within this study was guided by an interpretivist paradigm informed by social constructivist principles. Consequently, the framework was not used to measure or predict technology adoption, but rather as an analytical lens through which participants' perceptions, experiences, and meanings associated with LMS use were explored and interpreted within their institutional context

7.2.1 Perceived ease of use, effort expectancy and facilitating conditions

7.2.1.1 Dr K

Perceived ease of use and effort expectancy

Upon reflection, Dr. K reported a significant shift in his perceived ease of use of the LMS. Although he had been using the platform for two to three years, he acknowledged that his familiarity was largely limited to basic functionalities-announcements, checking grades, viewing participants, and uploading simple resources. His observation that “*you think you know something and then find out that you know little*” reflects a common phenomenon described in the literature, where educators develop routine familiarity with surface-level LMS functions while remaining unaware of the system's broader capabilities (Naveh et al., 2010). This aligns with Davis's (1989) definition of perceived ease of use as the belief that using a system requires minimal effort. For Dr. K, unfamiliarity with deeper LMS

functionalities initially created a perception of difficulty when navigating more complex tools.

Through the hands-on, step-by-step nature of the strategy, Dr. K experienced a notable improvement in his perceived ease of use. He described some sessions as “*an eye opener*,” particularly when he realized he could independently add sections, create folders, upload new content areas, and personalize his LMS site-tasks he had previously believed required administrative intervention. This mirrors findings in the literature showing that practical, step-by-step modelling reduces perceived complexity and builds user confidence (Bhalalusesa et al., 2013; Lavidas et al., 2022). Dr. K reflected: “I thought I need to send an email to someone to add a section for me, but I discovered I could do it myself,” demonstrating a reduction in perceived effort.

Dr. K also highlighted specific LMS areas that initially felt confusing. He recalled uncertainty about adding certain resources and described tools such as quick messaging, chat, and BigBlueButton as completely unfamiliar. This aligns with Al-Nuaimi and Al-Emran (2021), who note that unfamiliar tools are often perceived as difficult until users receive adequate support. He admitted, “*I used to tell myself I can’t use this thing*,” referring to BigBlueButton, reflecting internalized barriers associated with low digital confidence. However, through the implementation sessions, he reported that guided, step-by-step instruction “arose my interest” and revealed that these tools were far simpler than he had assumed.

Dr. K emphasized that a major factor enhancing his ease of use was the combination of video demonstrations and real-time guidance. While video tutorials alone initially maintained his hesitance, pausing the tutorials for live, guided walkthroughs allowed him to practice, ask questions, and observe tools in action. This confirms Martin’s (2008) assertion that digital ease develops through both modelling and active practice. Dr. K noted that this live guidance “changed the mindset,” reflecting a shift from perceived effort to perceived simplicity—a core principle of TAM.

He also reflected that he previously completed tasks in more cumbersome ways. For instance, he had been recording lessons externally in Microsoft Teams, downloading the recordings, and then re-uploading them to the LMS. Discovering that BigBlueButton

allowed him to perform all these functions within the LMS reduced the steps required, thereby lowering perceived effort. This aligns with Walker's (2015) finding that tools perceived to streamline workflow significantly improve ease of use.

Importantly, Dr. K acknowledged that his self-perception as a digital user shifted alongside his increased ease of use. While some tools initially felt confusing, repeated exposure and hands-on experimentation enabled him to use functionalities independently. This reflects Calvani et al.'s (2008) conceptualization of digital competence, which combines operational skill with a willingness to engage with technology-both of which improved during the strategy.

Overall, Dr. K's reflections reveal a meaningful transformation in his perceived ease of use and effort expectancy of the LMS. Phase 1 characterized him as having assumptions of complexity, limited familiarity, and dependence on others. Post-strategy, his experience evolved into one of confidence, independence, and reduced cognitive effort. His perspective now aligns with the TAM proposition that ease of use significantly enhances willingness to adopt and explore technology (Davis, 1989). The hands-on, supportive delivery of the LMS strategy directly facilitated this shift, helping him recognize the LMS as an easy-to-navigate and manageable platform.

Facilitating conditions

Dr. K's reflections highlight the important role of facilitating conditions in shaping his ability and willingness to use the LMS effectively. In the UTAUT model, facilitating conditions refer to the organizational, technical, and infrastructural supports that enable technology use. As noted in the literature, these conditions-such as training, resources, support structures, and system reliability-strongly influence educators' actual system use (Venkatesh et al., 2003; Alshehri et al., 2019). Dr. K's experience illustrates this relationship, as he acknowledged both supportive and limiting conditions within his teaching environment.

A key facilitator identified by Dr. K was the existence of structured assessment shells and resource spaces within the LMS. These built-in tools provided a ready-made organizational structure, reducing the administrative burden associated with resource management and assessment delivery. He noted, "The LMS has assessment shells

wherein I need to upload my assessments... [and] space wherein I need to upload my study guide,” demonstrating his reliance on the system’s infrastructure to support essential teaching tasks. This aligns with literature emphasizing that stable LMS structures for assessment and content enhance educators’ efficiency and confidence (Lin & Wang, 2012; Lavidas et al., 2022).

However, Dr. K also identified gaps in institutional and pedagogical support, particularly regarding student training and synchronous teaching tools. He observed that many students “do not know that they can go [to the forum] and pose a question,” indicating that the absence of structured student orientation limits the LMS’s effectiveness as a communication and engagement platform. This mirrors findings that LMS adoption is hindered when institutions overlook student digital readiness, which in turn affects educators’ perceptions of system support (Walker, 2015; Maphalala & Mpofu, 2018). Dr. K reinforced this point, stating that students “need to have trainings... on how to use these platforms,” highlighting that facilitating conditions must support both educators and learners.

Dr. K also pointed out limitations due to the lack of integrated synchronous teaching tools. He expressed frustration at having to leave the LMS to conduct live classes, stating, “I don’t want to have to leave the LMS to go and have my class... it would be much more helpful if I can do everything within the LMS.” This reflects a gap in the technological ecosystem supporting his work—a common challenge noted in the literature, where insufficient integration of tools leads to fragmented systems and reduces educators’ sense of support (Al-Sharhan et al., 2020). His desire for an all-in-one environment demonstrates how facilitating conditions influence both perceived usefulness and performance expectancy.

Despite these challenges, the LMS strategy addressed a crucial facilitating condition: lack of awareness of available tools. Dr. K had not known that BigBlueButton existed or was accessible within the LMS. Limited system awareness is a well-documented barrier, where insufficient orientation prevents educators from fully leveraging available technologies (Bhalalusesa et al., 2013). The strategy’s personalized, hands-on support

aligns with Alshehri et al. (2019), who argue that detailed, user-focused training significantly improves perceptions of institutional support.

Technology infrastructure also emerged as a facilitator. Dr. K did not report issues with devices, connectivity, or access, suggesting that the institution provides a reasonably enabling technological environment. While systemic infrastructure challenges are reported elsewhere in South African open distance education, this baseline support enabled Dr. K to adopt new digital practices more readily (Maphalala & Mpofu, 2018).

Overall, Dr. K's reflections indicate that facilitating conditions strongly influenced his LMS use. The LMS's built-in structures and institutional provision of assessment spaces supported his teaching, while gaps in training, limited tool awareness, and the lack of integrated synchronous capabilities initially constrained adoption. The LMS strategy strengthened these facilitating conditions by offering personalized, practice-based guidance that expanded his functional awareness of the platform. This aligns with UTAUT's proposition that strong facilitating conditions directly enable actual technology use. Dr. K's experience confirms that targeted, hands-on support, combined with visibility and accessibility of LMS tools, significantly enhances educators' capacity to meaningfully adopt and use LMS functionalities.

7.2.1.2 Mr L

Perceived ease of use and effort expectancy

Through Mr. L's reflections, a substantial shift in his perceived ease of use of the LMS was evident. In phase one of data collection, prior to the strategy, he described himself as only "50% comfortable" with the platform, relying almost exclusively on announcements because many features felt "hidden" or unfamiliar. This initial uncertainty aligns with Naveh et al. (2010), who argue that educators frequently perceive LMSs as "complex" and "multifaceted," resulting in confusion and limited exploration of advanced functionalities. Mr. L's narrative confirms this, as he reported that although numerous tools were visible within the interface, he "did not know how to use them," a pattern consistent with Davis's (1989) definition of perceived ease of use as the degree to which a user believes a system is simple to use and understand.

In his post-strategy reflection, Mr. L quantified his comfort level, noting that he had gained “another 50%” in terms of familiarity with the LMS. This indicates that the strategy effectively addressed the high effort expectancy commonly associated with LMS adoption. Venkatesh (2000) notes that beliefs about the effort required to use a system significantly shape attitudes toward adoption, and this was evident in Mr. L’s repeated emphasis on feeling more empowered and less intimidated by the interface. The hands-on, personalized guidance he received mirrors literature emphasizing the importance of contextualized, demonstration-based training for improving ease of use. As Bhalalusesa et al. (2013) and Lavidas et al. (2022) note, generic workshops rarely build deep competence; LMS users benefit most from scaffolded, practice-oriented support—the very approach employed in the strategy.

Several previously underutilized or unknown tools became more familiar through the strategy. Mr. L noted that he had never used or even known where to find the block drawer, which contains Quickmail for communicating with students. He was also unaware that announcements could be scheduled and had no knowledge of the tool for synchronous lessons, BigBlueButton. Literature supports the notion that unfamiliarity amplifies perceived effort and discourages exploration (Walker, 2015). After guided practice, however, he expressed a sense of freedom to “play with the outline” and explore tools independently, reflecting Martin’s (2008) view that digital literacy encompasses both technical skill and a confident, proactive disposition toward technology. His growing confidence also aligns with Calvani et al. (2008), who argue that adaptability and motivation are essential in overcoming usability challenges.

The progression from dependency on announcements to using a broader range of tools—such as forums, chat, Quickmail, and BigBlueButton—indicates a reduction in perceived effort. Literature warns that when advanced features are perceived as difficult, users revert to basic tools (Dahlstrom et al., 2014). Mr. L acknowledged this pattern, noting that before the strategy he used announcements for everything because it was the only tool he understood. Following the LMS strategy, he expressed enthusiasm for applying more sophisticated tools and reported feeling comfortable exploring additional features independently.

TAM's principle-that users are more likely to adopt technologies perceived as requiring minimal effort-is evident throughout Mr. L's engagement with the strategy. Prior to the intervention, limited exposure to LMS functionalities and lack of targeted support contributed to a high effort expectancy. After the strategy, he demonstrated increased familiarity, confidence, and readiness to integrate new tools. His experience supports Legris, Ingham, and Collette's (2003) argument that perceived ease of use strongly influences intention to use technology, underscoring the importance of structured, personalized training in promoting LMS adoption among science teacher educators.

Facilitating conditions

Mr. L's reflections reveal that facilitating conditions played a crucial role in shaping both his ability and motivation to use the LMS effectively. Although he did not initially perceive major structural barriers, he later highlighted the importance of functional hardware-such as a reliable laptop-which, when malfunctioning, could temporarily hinder LMS use (e.g., "my laptop is no longer functioning properly"). This aligns with UTAUT's emphasis on adequate infrastructure as a prerequisite for technology adoption, particularly in digital teaching environments where basic hardware reliability determines educators' capacity to engage with tools (Venkatesh et al., 2003; Mtebe & Raisamo, 2014). Mr. L's perspective that such obstacles are "not forever," but rather bound to specific moments, reflects an adaptive mindset that mitigates the psychological impact of infrastructural challenges.

A key institutional condition he identified was the need for regular, targeted, and tool-specific training. He emphasised that monthly sessions-not generic digital literacy workshops, but focused demonstrations on specific LMS tools such as BigBlueButton-would "make us much better" and enhance teaching quality (e.g., "if we can receive training... monthly... that will be appreciated"). This aligns with literature showing that inadequate training is one of the most frequently cited barriers to LMS adoption in developing countries (Bervell & Arkorful, 2020; Ssekakubo et al., 2011), whereas structured, ongoing support increases confidence, reduces anxiety, and encourages meaningful integration of LMS functionalities (Eachempati & Ramnarayan, 2020; Tarus & Gichoya, 2015).

Mr. L also reflected on the value of exposure to previously hidden or underutilized features, such as the block drawer and advanced announcement options, which he had never fully explored. This highlights the impact of detailed, personalised guidance in enhancing educators' digital competence. His endorsement of the hands-on strategy-which allowed him to discover hidden features and understand settings in context-mirrors Legris et al.'s (2003) argument that supportive conditions directly reduce perceived complexity.

Moreover, Mr. L's expressed interest in continuing to use tools like BigBlueButton, Quickmail, chats, and forums indicates that when facilitating conditions are present-reliable infrastructure, ongoing targeted training, and contextualised support-educators not only adopt LMS tools but also develop sustained intentions to integrate them into future teaching. His experience reaffirms the theoretical position that robust facilitating conditions are foundational for meaningful, confident, and ongoing LMS use in open distance education contexts.

7.2.1.3 Dr E

Perceived ease of use and effort expectancy

At the beginning of the strategy, Dr. E had moderate operational familiarity with the LMS, primarily with tools he used routinely, such as announcements. He explicitly stated that announcements were "easy" and something he had "been using the whole time," indicating baseline familiarity with surface-level LMS functions. Phase one observations of his module site revealed a heavy reliance on announcements, which Dr. E used not only for communication with students but also for uploading content. He acknowledged that many of the LMS's deeper functionalities were unknown to him, reflecting a common phenomenon in the literature where educators engage with LMSs in narrow, habitual ways-resulting in overconfidence in basic features but underuse of more complex tools (Kakasevski et al., 2008; Naveh et al., 2010).

A major barrier to ease of use for Dr. E prior to the strategy was his struggle with LMS terminology. He explained that he often encountered challenges but was unable to articulate them sufficiently to receive support. The strategy addressed this challenge directly by standardising terminology from the very first session. Dr. E described this as

“necessary” and “help[ing] quite a lot in terms of following... because I could hear the terms that are being used.” He was the first participant to highlight the benefit of the strategy’s initial orientation session, which familiarised participants with the LMS interface. Literature shows that unfamiliar digital vocabulary increases the mental effort required to navigate LMS spaces (Bhalalusesa et al., 2013; Walker, 2015). By repeatedly reinforcing core terms such as course index, content area, dashboard, and activities, the strategy reduced cognitive load and strengthened Dr. E’s perception that the LMS was easier to use than he had previously believed.

Dr. E also highlighted that functionalities he had once perceived as complex became noticeably easier once demonstrated. He emphasised the value of “seeing where you (the researcher) are clicking, are you right-clicking... which option do you take,” illustrating the importance of visual modelling and the hands-on nature of the strategy. Practice-based training has been shown to improve system usability by reducing anxiety and clarifying procedural steps (Lin & Wang, 2012; Dahlstrom et al., 2014). Dr. E’s reflections indicate that the combination of video demonstrations and real-time guidance transformed tools he once found overwhelming-such as BigBlueButton, Pages, Quickmail, polls, and content reorganisation-into manageable, intuitive tasks. He reported that several tools he previously avoided were now navigable and even appealing.

The strategy also revealed the “surface-level” use of announcements. While the basic functions felt intuitive initially, Dr. E realised he had been underutilising the tool. The sessions demonstrated features such as incorporating audio, images, hyperlinks, and interactive elements-capabilities he had seen on other LMS sites but “did not know how people did it.” Once modelled, he understood both how to perform these tasks and why they were important for accessibility and inclusion. For instance, adding an audio recording to an announcement was quick, easy, and supported visually impaired students. This reflects Davis’s (1989) argument that ease of use improves when task steps are visible and meaningful, and that discovering hidden affordances within familiar tools enhances overall system usability (Lavidas et al., 2022).

Dr. E also described a reduction of unnecessary effort in synchronous teaching. He valued teaching students synchronously but previously relied on multiple extra steps: creating a

Microsoft Teams meeting, copying the link, posting it in announcements, and managing permissions manually. He labelled this process as “a lot of work” and noted that students often missed sessions. Exposure to BigBlueButton dramatically shifted his perception of ease of use, as everything was already integrated within the LMS. This aligns with literature emphasising that system integration reduces effort expectancy, increasing perceived usability (Venkatesh et al., 2003).

Importantly, Dr. E reported that deeper understanding of LMS tools enhanced his confidence to navigate independently. Even though he had not yet implemented all functionalities, he felt able to “go and try the others that you see,” signalling an increase in digital self-efficacy—a core predictor of LMS adoption (Calvani et al., 2008). He attributed improved confidence, clearer procedural understanding, and simplified workflows to the strategy. His reflections mirror patterns in the literature, reinforcing the argument that targeted, guided, and context-specific training enhances educators’ perceptions of LMS ease of use.

Facilitating conditions

Dr. E’s reflections highlight several facilitating conditions that shaped his ability to use the LMS effectively, many of which became clearer through the strategy. In UTAUT, facilitating conditions refer to the organisational, technical, and infrastructural supports that enable system use (Venkatesh et al., 2003). As discussed in the literature review, supports such as training, system integration, peer assistance, and intuitive infrastructure play a critical role in determining teacher educators’ actual engagement with LMS platforms. Dr. E’s responses illustrate how both enabling and constraining conditions influenced his LMS adoption prior to and during the intervention.

A consistent barrier for Dr. E was insufficient institutional training, particularly regarding the depth, variety, and purpose of LMS functionalities. He noted that before the strategy, he did not know how many communication tools existed beyond announcements, admitting that “there are different tools that we can use” only after the guided sessions introduced forums, private messages, polls, and chats. Lack of structured orientation contributes to superficial LMS use, reinforcing surface-level engagement and limiting the development of digital confidence (Bhalalusesa et al., 2013; Ifenthaler & Schweinbenz,

2016). Dr. E's earlier reliance on announcements was therefore not due to disinterest, but rather to limited facilitating conditions.

Another significant facilitating condition that influenced Dr. E's LMS use was the absence of integrated synchronous teaching tools. Before the intervention, hosting live sessions required multiple steps: creating a separate Microsoft Teams meeting, posting the link on the LMS, managing permissions manually, and uploading recordings afterward. He described this process as laborious, with students frequently missing links or failing to attend. Fragmented systems increase cognitive load and reduce perceived institutional support (Lin & Wang, 2012; Mtebe & Raisamo, 2014). Through the strategy, however, Dr. E discovered BigBlueButton, an integrated synchronous tool embedded in the LMS, which he described as "the best" part of the training because everything was "joined as a unit" and far easier to manage. This illustrates how effective facilitating conditions can transform expectations and reduce procedural barriers.

Terminology also functioned as an important facilitating (and previously inhibiting) condition. Dr. E acknowledged that he often did not know the correct words to describe LMS locations or functions, which made communication with ICT support difficult. He stated that learning terminology "helped quite a lot... because I could hear the terms that are being used" and could finally follow instructions accurately. Digital vocabulary is a foundational facilitating condition: without shared terminology, even basic support becomes inaccessible (Walker, 2015). By standardising language early in the strategy, the cognitive and linguistic barrier was reduced.

Peer support emerged as another facilitating condition, although it had previously played a minimal role. Dr. E noted that colleagues sometimes showed him features he had never used, but this support was sporadic and informal, insufficient for building deep competence. While peer support is valuable, it must be complemented by structured training to meaningfully enhance perceived institutional support (Lavidas et al., 2022). The strategy addressed this gap by providing systematic, guided, and personalised assistance, transforming incidental support into a purposeful learning pathway.

Importantly, Dr. E repeatedly emphasised that the strategy itself functioned as a facilitating condition. He described the guided demonstrations, the visibility of each click,

and the ability to ask questions as crucial aids to his learning. This aligns with Alshehri et al. (2019), who argue that practical, hands-on scaffolding significantly enhances educators' sense of support and system mastery. For Dr. E, the sessions not only clarified complex tasks but also provided the reassurance and structure needed to explore tools he had previously avoided.

7.2.1.4 Dr M

Perceived ease of use and effort expectancy

Dr. M reflected on a complex and nuanced understanding of LMS ease of use, shaped not only by his technical familiarity but also by psychological and contextual factors. His reflections highlight how identity, self-confidence, fear of failure, and prior exposure influence perceived ease of use (Bhalalusesa et al., 2013; Calvani et al., 2008). He described his fear of “fumbling” in front of students on his module sites when unsure how to use a tool efficiently, which made the LMS feel more difficult to navigate. This illustrates that, as TAM (Davis, 1989) suggests, ease of use is not solely about the effort required to operate a system, but also about the confidence and comfort of the user.

A unique contribution to perceived ease of use in Dr. M's reflections is his articulation of how professional identity shapes comfort with technology. He explained that teacher educators often avoid unfamiliar LMS tools because “students are looking at us as the experts,” and making mistakes in a live environment threatens credibility. This fear creates reluctance and avoidance, echoing literature on digital anxiety, fear of error, and perceived threats to professional competence (Walker, 2015; Ifenthaler & Schweinbenz, 2016). Dr. M's reflections therefore highlight an additional dimension of ease of use: educators may perceive the LMS as difficult not only because of its inherent complexity but because using it is publicly visible and feels risky.

Dr. M also emphasised the structural component of exposure. He argued that ease of use is often a function of prior opportunities to practise: “for some individuals, it's second nature because they have been exposed to it, while others are reluctant... because they just have not been exposed to it.” This aligns with the literature on digital inequality (Calvani et al., 2008; Maphalala & Mpofu, 2018) and demonstrates that LMS ease of use is mediated by prior access, training, and socio-economic background. Dr. M openly

linked his own challenges to his upbringing, noting that he did not grow up with computers and only began using them “in the latter part” of his studies. This insight underscores that ease of use cannot be divorced from broader issues of digital equity and prior opportunity.

Despite these barriers, the strategy significantly improved Dr. M’s ease of use by providing a safe, low-stakes environment for practice. Pre-recorded videos, structured support, and, most importantly, an LMS Sandpit site allowed him to explore activities privately and without scrutiny. He likened the Sandpit to a school teacher learning to use a projector: a task that feels daunting in front of students becomes manageable when practised independently. TAM literature supports this, showing that perceived ease of use increases when users can practise without fear of consequences (Lin & Wang, 2012), and aligns with constructivist arguments that hands-on exploration reduces cognitive load and anxiety.

Dr. M noted that Session 1: Orientation felt like revision, but he provided a critical insight: orientation must be tailored to the user’s level. He argued that ease of use is hindered in group training because some participants “switch off” if content does not match their competency level. Currently, institutional training is only offered in group settings. This aligns with critiques of generic professional development, which often fails to meet users at their point of need (Bhalalusesa et al., 2013; Ifenthaler & Schweinbenz, 2016). Dr. M adds a novel perspective: ease of use is enhanced not only by content but also by differentiation-training must adapt to individual readiness rather than assume homogeneity.

Dr. M’s reaction to BigBlueButton was especially notable. He described the session as “music to my ears,” as live sessions had previously felt intimidating due to limited exposure and fear of failure. The strategy reframed synchronous teaching from a daunting task to one that was feasible and manageable. This aligns with literature showing that guided practice and modelling reduce perceived complexity and increase self-efficacy (Dahlstrom et al., 2014; Lavidas et al., 2022). Unlike other participants, Dr. M had not hosted synchronous sessions at all prior to the strategy, highlighting the emotional barrier he faced rather than a lack of willingness to learn.

Dr. M also provided a pedagogical insight rarely articulated in LMS research: ease of use is enhanced when training mirrors effective teaching practice. He argued that just as students benefit from step-by-step scaffolding, so too do educators. He emphasised that the strategy supported ease of use because it aligned with learning theory-breaking tasks into steps, demonstrating them, and providing guided followed by independent practice. This reflects Vygotskian principles of scaffolding.

Dr. M acknowledged that while the strategy improved his ease of use, mastery of the skills would require ongoing time and repetition: “more time is needed to engage fully.” This highlights that perceived ease of use is an ongoing developmental process, dependent on sustained exposure, repeated practice, and continuous scaffolding to prevent regression into avoidance (Rambe & Bere, 2013).

Ultimately, Dr. M expands the understanding of ease of use beyond technical skill to include identity, confidence, socio-economic background, exposure, emotional safety, and training design. His reflections support the conceptual framework’s position that ease of use is multidimensional, shaped by both system design and human factors. He also suggests that careful, scaffolded strategies like the one implemented have the power to shift educators from avoidance to engagement.

Facilitating conditions

Dr M’s reflections reveal that the facilitating conditions provided during the strategy played a significant role in enabling his enhanced engagement with the LMS. One of the strongest indicators of this was his consistent emphasis on the value of structured, personalised support throughout the implementation process. He repeatedly highlighted that having “*someone to guide me through the steps*” reduced the sense of intimidation he previously associated with the LMS. This is particularly noteworthy given that Phase 1 data showed he seldom explored functionalities beyond file uploads due to uncertainty and lack of confidence. His experience aligns with Mtebe and Raisamo’s (2011) argument that the absence of adequate support structures significantly constrains educators’ ability to use LMS tools effectively, as well as Bhalalusesa et al’s., (2013) findings that digital hesitation is frequently rooted in a lack of accessible training and technical backing.

The presence of the *LMS-Sandpit site* served as another crucial facilitating condition for Dr M. He described it as “*a safe space to try things out,*” indicating that the opportunity to engage experimentally without fear of disrupting a real module site allowed him to practise advanced functionalities more freely. This reinforces the argument by Sife et al., (2007) that meaningful technology adoption is strongly supported when institutions provide environments where educators can explore digital tools without pressure. The scaffolded nature of the sessions-each focusing on a distinct set of tools-also helped Dr M organise his learning, demonstrating the importance of structured, progressive training highlighted by Tarus and Gichoya (2015). Dr M explicitly mentioned that the step-by-step flow “*made it all feel possible,*” signalling that the pacing and clarity of the support reduced cognitive overload, a challenge frequently associated with LMS complexity (Kakasevski et al., 2008).

Institutionally, Dr M also acknowledged that prior to the strategy, he did not perceive the LMS as something the university expected him to use beyond the basics. This lack of institutional signalling often inhibits LMS adoption, as noted by Bervell and Arkorful (2020), who argue that clear institutional expectations and aligned support structures are essential facilitating conditions for consistent and advanced use of educational technologies. The strategy acted as an indirect institutional cue-demonstrating to Dr M that deeper engagement with the LMS was both supported and pedagogically meaningful. His recognition that “*this is something I must now start using properly*” suggests that the combination of training, guided practice, and explicit encouragement functioned as a holistic package of facilitating conditions that shifted his perception of the LMS from an optional tool to an integral part of his teaching.

Finally, the immediate availability of feedback during each session emerged as another enabling factor for Dr M. The opportunity to troubleshoot in real-time-rather than relying on asynchronous, often delayed institutional support-appears to have significantly helped him overcome the frustrations he previously experienced when navigating the LMS independently. This reflects Dahlstrom et al’s (2014) assertion that user satisfaction and adoption are closely linked to the responsiveness and accessibility of technical support. For Dr M, the combination of real-time guidance, hands-on practice, structured materials, and a non-threatening learning environment formed a robust set of facilitating conditions

that allowed him not only to acquire new skills but to develop greater confidence and willingness to continue experimenting beyond the training sessions.

7.2.1.5 Synthesis and interpretation of findings

Perceived ease of use and effort expectancy

The construct of Perceived Ease of Use-or Effort Expectancy within the UTAUT framework-emerged strongly across all four participants, reflecting a consistent shift in how science teacher educators experienced the LMS after participating in the structured support strategy. Davis's (1989) seminal definition of perceived ease of use emphasises that users are more likely to adopt a system when they believe it requires minimal effort, a notion reaffirmed in later analyses showing that ease of use is one of the strongest predictors of technology acceptance (Legris, Ingham, & Collette, 2003). In the context of this study, participants' reflections demonstrated a clear reduction in the cognitive and technical effort required to engage with LMS functionalities, indicating that the strategy directly influenced this TAM construct.

Across participants, the hands-on, scaffolded approach significantly reduced the perceived complexity of the LMS-an important outcome considering that LMS complexity is widely cited in literature as a barrier to optimal use, particularly in resource-constrained developing-country contexts (Naveh et al., 2010; Dahlstrom, Brooks, & Bichsel, 2014). Prior to the intervention, educators mainly used the LMS for basic administrative tasks, echoing international studies showing that users tend to remain within the simplest functions when systems feel overwhelming or unintuitive (Azlim et al., 2014; Al-Sharhan et al., 2020). After implementation, however, participants reported that previously unfamiliar tools-such as the gradebook, forums, Quickmail, embedded media, and BigBlueButton-became more approachable as the step-by-step demonstrations demystified their operation.

The LMS-sandbox environment played a pivotal role in strengthening perceived ease of use. Literature shows that opportunities for low-stakes experimentation build digital confidence, especially for educators with uneven digital literacy backgrounds (Martin, 2008; Law et al., 2018). This resonates with the experiences of the participants, many of whom expressed that practising in a "safe" space allowed them to develop procedural

fluency without fear of making errors on live module sites. This aligns with digital literacy research suggesting that technological skill acquisition is accelerated when users can repeatedly test tools in supported environments (Calvani et al., 2008) and with UTAUT's assertion that effort expectancy is closely linked to users' early learning experiences with a system.

The synchronous guidance provided during each session further enhanced ease of use by reducing the cognitive load associated with navigating multiple menus and layered LMS interfaces. Studies in developing-country contexts highlight that a lack of real-time support is a major contributor to frustration and confusion when navigating LMS platforms (Tarus et al., 2015; Bhalalusesa et al., 2013). The intervention countered this barrier by allowing participants to receive immediate clarification, personalised explanations, and tailored pacing-conditions shown to significantly influence perceptions of system simplicity (Venkatesh et al., 2003). Participants' reflections demonstrated that the presence of support transformed tasks that had previously felt "difficult," "time-consuming," or "confusing" into manageable routines they felt capable of repeating on their own.

Another factor contributing to improved ease of use was the exposure to structured checklists. These checklists acted as cognitive organisers, aligning with literature identifying task clarity and stepwise guidance as essential components of reducing user effort in digital environments (Moore et al., 2011). The checklists also encouraged reflection, which supports deeper learning and internalisation of new processes, further reinforcing the sense of ease.

Collectively, the findings illustrate that perceived ease of use improved not through system redesign but through strategic support-confirming that, as Ssekakubo et al. (2011) note, LMS challenges in developing contexts stem less from the technology itself and more from how institutions implement and support these systems. The intervention addressed these systemic gaps by providing personalised training, immediate reinforcement, and structured opportunities for practice. As a result, by the end of the strategy, participants expressed significantly lower effort expectancy and greater

confidence, aligning strongly with TAM predictions and with UTAUT's emphasis on the centrality of effort expectancy in technology adoption.

This shift is particularly meaningful in a open distance learning institution, where LMS use is fundamental to teaching, and where improving ease of use not only enhances individual confidence but also creates the conditions necessary for deeper engagement with LMS pedagogical tools. In this way, the findings reaffirm that strengthening perceived ease of use is not merely a technical outcome but a pedagogical enabler that directly influences how science teacher educators conceptualise and enact digital teaching.

Facilitating conditions

Facilitating conditions-defined in the UTAUT model as the degree to which individuals believe that organisational and technical infrastructures exist to support system use-emerged as a central determinant of the participants' ability to adopt and sustain LMS practices after the implementation strategy. Venkatesh et al. (2003) position facilitating conditions as a direct predictor of technology use, particularly when users may not yet feel fully confident or autonomous in their digital capabilities. This was strongly reflected in the experiences of the science teacher educators, who consistently emphasised that their ability to use the LMS was shaped not only by personal perceptions but also by the availability-or absence-of supportive structures.

Across all participants, the structured nature of the intervention itself functioned as a significant facilitating condition. The one-on-one guided sessions, the use of personalised LMS-Sandpit sites, and the immediate troubleshooting provided during training reduced the cognitive load typically associated with navigating complex LMS environments. This aligns with the literature, which consistently identifies the lack of targeted training, insufficient support, and overwhelming complexity of LMS interfaces as major barriers to adoption in developing-country contexts (Ssekakubo et al., 2011; Bhalalusesa, Lukwaro & Clemence, 2013; Dahlstrom, Brooks & Bichsel, 2014). By offering responsive support and step-by-step scaffolding, the strategy addressed these barriers directly, enabling participants to engage with LMS functionalities that previously felt inaccessible.

Technical support-or historically, the lack thereof-featured prominently in the participants' reflections on why LMS use had been limited before the intervention. Several echoed

findings from earlier studies showing that inadequate institutional support systems often leave educators uncertain, hesitant, or dependent on ad-hoc solutions (Sife, Lwoga & Sanga, 2007; Kisanga & Ireson, 2015). The post-strategy reflections revealed that having immediate access to troubleshooting and clear demonstrations built confidence and reduced the anxiety associated with “breaking the system,” a fear widely documented in LMS literature (Al-Sharhan et al., 2020). Participants also noted how the strategy clarified features and workflows that had been available for years but were not intuitively discoverable, emphasising the importance of guided exposure and user-centred training. Infrastructure challenges, often identified in literature related to African and distance-education contexts-such as internet reliability, access to devices, and the impact of load shedding (Andersson & Grönlund, 2009; Malik et al., 2022)-remained relevant for participants. However, the intervention mitigated the effects of some of these constraints by offering flexible session times, short modular tutorials, and a supportive environment where connectivity fluctuations did not penalise learning. This responsiveness aligns with recommendations by Edeh et al. (2022), who emphasise that sustained and adaptive support-rather than one-off workshops-is essential for improving technological competency and digital confidence among educators.

Institutional culture also featured subtly within facilitating conditions. Participants frequently referenced the broader expectations of the university, such as the need to structure module sites professionally, communicate effectively with students, and ensure compliance with ODeL teaching requirements. Literature on LMS adoption in developing nations highlights that institutional expectations, when clear and consistently reinforced, serve as enabling conditions that shape user behaviour (Tarus et al., 2015; Kant et al., 2021). Several participants expressed that the strategy helped them understand not only *how* to use the LMS tools, but *why* these tools were important for meeting institutional standards and supporting student success-thus increasing the alignment between individual practice and organisational priorities.

Finally, the LMS-Sandpit itself functioned as one of the strongest facilitating conditions. Participants repeatedly reported that having a risk-free space to test tools, experiment with content, and make mistakes without affecting live modules significantly enhanced

their willingness to explore the platform. This aligns with the growing body of literature advocating sandbox environments as essential for improving digital self-efficacy (Lavidas et al., 2022; Ramadhani et al., 2019). For many, the Sandpit shifted LMS use from a high-stakes task to a learn-by-doing experience, allowing them to internalise skills that may not have been acquired through theoretical training alone.

In summary, facilitating conditions played a pivotal role in shaping the participants' post-implementation experiences. Technical guidance, responsive support, a safe practice environment, and clearer institutional expectations all contributed to a context where LMS adoption became less burdensome and more feasible. These findings reinforce the argument that effective technology integration in open distance learning settings cannot rely solely on individual motivation; rather, it must be underpinned by robust support systems that reduce complexity and promote sustainable digital practice. The intervention demonstrated how targeted, contextually responsive scaffolding can transform digital hesitation into confident, purposeful LMS use-aligning closely with both TAM and UTAUT's conceptualisation of the conditions necessary for successful adoption.

7.2.2 Perceived usefulness, performance expectancy and social influence

7.2.2.1 Dr K

Perceived usefulness and performance expectancy

Following his participation in the LMS strategy, Dr K's perceptions of the LMS's usefulness appeared to increase significantly. According to TAM, perceived usefulness refers to the extent to which an individual believes that using a system will improve their teaching performance (Davis, 1989). Prior to the strategy, Dr K's LMS use was limited to announcements, assessment shells, and basic content uploads. He acknowledged being unaware of functionalities that could streamline his teaching and enhance student engagement. His reflections indicate that the strategy fundamentally shifted his understanding of the LMS's value in supporting effective, interactive, and efficient teaching.

A clear expression of this improved perceived usefulness emerged when Dr K noted that some LMS features "can make life easier," specifically citing Quickmail for email

communication, live interaction with students, and BigBlueButton, which he “didn’t know...exists” until the strategy introduced it. Before the intervention, he duplicated efforts by conducting synchronous sessions on Microsoft Teams and then uploading materials to the LMS-a practice also observed in Dr E and Mr L. He explained that the strategy revealed “a simpler way of doing things altogether,” reflecting a recognition that the LMS could reduce unnecessary effort and consolidate teaching processes. This aligns with Lavidas et al. (2022), who found that educators perceive LMS platforms as more useful when they integrate multiple teaching tasks within a single environment.

Dr K further described how learning to create folders, add resources, and structure course content aligns directly with the requirements of an open distance learning environment, emphasising that “these are key elements of teaching and learning.” Literature suggests that LMS tools are most useful when they enhance pedagogical visibility and provide students with a consistent learning pathway (Dahlstrom et al., 2014; Al-Sharhan et al., 2020). For Dr K, the ability to be “more visible” is central to his identity as a teacher educator, highlighting that the LMS is both technically and pedagogically valuable.

He also referenced the LMS’s role in “bridging the distance” inherent in open distance learning, allowing students to experience a live-class environment “even though they are online.” Dr K emphasised that the LMS facilitates immediate communication, in contrast to delayed emails. This aligns with research indicating that tools enabling immediacy, presence, and real-time feedback increase educators’ perceptions of teaching quality (Al-Gahtani, 2016; Ahmed et al., 2021). Importantly, he anticipates that the LMS will now “shape the way that I approach teaching and learning and also support students moving forward.”

Dr K’s reflections also demonstrate a clear enhancement in his performance expectancy-the UTAUT construct referring to the degree to which an individual believes that using a system will improve job performance. Performance expectancy is identified as one of the strongest predictors of LMS adoption among educators (Venkatesh et al., 2003; Legris et al., 2003). He expressed that the LMS supports core teaching functions such as managing assessments and disseminating resources. He described the LMS as having “assessment shells where I upload my assessments” and “spaces where I upload my

study guide,” recognising the platform as a centralised organisational tool that enhances teaching efficiency. This aligns with Lin and Wang (2012), who note that educators perceive LMS platforms as more performance-enhancing when they streamline and structure teaching processes.

Within the strategy, Session 2 provided detailed guidance on content uploading and organisation, directly supporting assessment management and resource dissemination. Al-Sharhan et al. (2020) found that educators value LMS systems that simplify repetitive tasks and automate assessment processes. Dr K highlighted that the LMS facilitates quicker, more efficient assessment, particularly for multiple-choice tests.

Regarding student engagement, Dr K recognised the discussion forum as a tool that enhances academic interaction and reduces fragmented communication. He explained, “students can go under discussion forum and pose a question... I can also go there, if I have tutors they can also assist,” demonstrating how the LMS centralises communication and promotes collaborative learning among students and teaching assistants. This expands the communication options available to educators beyond announcements, aligning with Dahlstrom et al. (2014), who assert that LMS tools supporting interaction and dialogue improve teaching performance by enabling responsive and inclusive learning environments. However, Dr K acknowledged that student unfamiliarity with the platform can limit the effectiveness of these tools, echoing Walker (2015), who found that insufficient student digital literacy influences educators’ perceptions of system performance.

Dr K also emphasised the LMS’s value for content delivery, noting its ability to provide flexible, always-available learning materials. Study guides and resources are accessible across devices, “just a phone, a laptop, a tablet, or desktop away from the students,” highlighting the platform’s support for accessibility and continuity of learning. Lavidas et al. (2022) similarly found that educators perceive LMS platforms as performance-enhancing when they increase resource accessibility and support student autonomy.

Overall, Dr K recognised the strengths and opportunities afforded by the LMS, particularly in communication and content uploading. Despite these strengths, he initially expressed frustration at relying on external platforms for synchronous teaching, stating, “I don’t want

to have to leave the LMS to go and have my class... it would be much helpful if I can do everything within the LMS.” This desire for integration supports Venkatesh’s (2003) assertion that technology is perceived as more performance-enhancing when it consolidates multiple tasks into a single system. Importantly, the strategy addressed this gap by introducing him to BigBlueButton, which he had not previously known existed, demonstrating that exposure to integrated tools directly increases performance expectancy.

Social influence

For Dr K, social influence played a subtle yet meaningful role in shaping his perceptions of the LMS’s usefulness. Although he did not report explicit pressure from colleagues or management, his reflections indicate that broader professional expectations within the institution, combined with the structured support provided through the strategy, acted as indirect social cues encouraging deeper engagement with the LMS. He repeatedly noted that, prior to the intervention, his LMS use was limited partly because “no one really shows you how to use these things,” suggesting that the absence of institutional modelling or peer demonstrations contributed to his perception that advanced LMS use was neither expected nor normatively reinforced. This aligns with UTAUT literature, which posits that when educators perceive LMS use as peripheral or unsupported by colleagues, their perceptions of its usefulness remain limited (Venkatesh et al., 2003; Buabeng-Andoh & Baah, 2020).

However, the personalised, hands-on nature of the strategy shifted this dynamic considerably. Dr K described the sessions as something he “really appreciated,” and his reflections suggest that having an instructor actively engage with him-demonstrating features and affirming his progress-created a sense of guided expectation. This represents an important form of social influence that helped him recognise the LMS as more valuable and relevant to his teaching.

The strategy also functioned as a tacit institutional signal that LMS use should extend beyond basic content uploads and announcements. Dr K’s realisation that he could meaningfully structure content, embed media, communicate more efficiently with students, and organise his module reflects a shift in perceived usefulness that was

socially mediated through instructional modelling. This echoes Dahlstrom et al. (2014), who argue that when skilled users demonstrate effective LMS practices, colleagues are more likely to internalise the value of the system. Similarly, research on technology adoption in developing contexts highlights that professional norms-whether explicit or implicit-strongly influence educators' motivation to engage with LMS tools (Ssekakubo et al., 2011; Bervell & Arkorful, 2020). For Dr K, the strategy created a supportive social environment that validated the LMS as a meaningful pedagogical tool and normalised its expanded use. His reflections that he now feels "more confident" and "able to do more" suggest that the intervention not only developed skills but also repositioned LMS engagement as something a competent educator is expected to undertake.

In this sense, social influence for Dr K operated not through peer pressure or managerial directives, but through relational modelling, targeted support, and the implicit message that enhanced LMS use is both valued and professionally appropriate. This social reinforcement strengthened his perception that the LMS is useful for improving teaching quality, illustrating how social factors shape perceived usefulness within the TAM and UTAUT frameworks.

7.2.2.2 Mr L

Perceived usefulness and performance expectancy

Following the implementation of the strategy, Mr L indicated a substantial shift in how useful he perceives the LMS to be. Perceived usefulness refers to the belief that using a system will improve one's teaching performance or assist in achieving instructional goals (Davis, 1989; Zurinah et al., 2013). Prior to the strategy, Mr L's LMS use was limited, with announcements functioning as his primary-and often sole-tool. This restricted use, which he attributed to not knowing how to apply other tools, contributed to an overall perception that the LMS offered little pedagogical value beyond basic communication. He admitted that he would use announcements for nearly every activity on his LMS site. This experience aligns with the broader literature, which observes that educators who lack exposure to advanced LMS features often fail to recognise the platform's instructional benefits (Islam, 2011; Al-Nuaimi & Al-Emran, 2021).

The strategy helped Mr L recognise the LMS's potential to enhance efficiency, organisation, and student engagement. He highlighted BigBlueButton as particularly transformative, noting that its integration within the LMS "minimises effort" by eliminating the need to create external meeting links, upload recordings elsewhere, or switch between multiple platforms-tasks he had previously completed manually. This aligns with findings for Dr E and Dr K, and supports Walker's (2015) assertion that perceived usefulness increases when users realise that technology streamlines existing practices and reduces workload. Mr L also emphasised that using the LMS as a fully integrated system, rather than a collection of disjointed tools, requires "less effort," demonstrating a clear shift in his appreciation for its practical value.

Beyond efficiency, Mr L identified several pedagogical benefits that emerged once he understood how to organise his module site effectively. He explained that structuring content into meaningful sections-such as dedicated areas for live lessons, due dates, or announcements-helps students navigate the site more intuitively, reducing confusion and missed information. This mirrors literature highlighting that well-designed LMS environments improve student engagement and learning effectiveness (Lin & Wang, 2012; Lavidas et al., 2022). He also recognised that students had previously missed information due to his overreliance on the announcements tool, which he felt most comfortable using. After the strategy, he appreciated that employing a wider range of tools could enhance clarity, support better communication, and ultimately improve his teaching practice.

Mr L expressed appreciation for forums, Quickmail, polls, and chat, recognising that each tool serves practical pedagogical functions aligned with his teaching needs. This supports Legris et al.'s (2003) argument that perceived usefulness increases as individuals discover ways in which technology can enhance job performance. He also valued the LMS's ability to improve the student experience: when a module site is well-structured, students are less likely to miss information, become overwhelmed, or require repeated clarification-issues he had frequently encountered before. This aligns with Zurinah et al. (2013), who note that perceived usefulness is linked to a system's ability to help users achieve educational goals, particularly in contexts where communication and access to learning materials are central to success. Collectively, Mr L's reflections indicate that the

strategy helped him shift from viewing the LMS as a basic tool to recognising it as an integrated, pedagogically valuable system.

Mr L's reflections also demonstrate a marked increase in performance expectancy-the UTAUT construct referring to the degree to which an individual believes that using a system will improve job performance. Before the strategy, his expectations of the LMS's contribution to teaching were limited, mirroring findings that limited exposure to full LMS functionality reduces perceptions of its pedagogical value (Islam, 2011; Zurinah et al., 2013). The strategy expanded his awareness, shifting his expectations regarding how the LMS could enhance day-to-day teaching tasks.

A clear indication of this shift came from his recognition that the LMS could improve organisation and delivery of content. He stated that the training "helps us to be organised," particularly in ensuring that students can easily access lessons, announcements, and recorded sessions. This reflects UTAUT's premise that performance expectancy increases when users perceive a system as enabling them to complete tasks more effectively (Venkatesh, 2000). Organising content into structured sections, using communication tools appropriately, and hosting synchronous lessons directly within the LMS reduced administrative burden and enhanced coherence in his teaching.

BigBlueButton emerged as the tool most strongly associated with performance expectancy. Mr L emphasised that it improves teaching efficiency by removing the need to use Microsoft Teams and by making recordings instantly available to students. Previously, lengthy videos created on external platforms could not be uploaded due to size limitations-a barrier eliminated with BigBlueButton. This aligns with Walker (2015), who observes that educators perceive technology as useful when it reduces workload. For Mr L, BigBlueButton fundamentally changed his expectations regarding how seamlessly teaching could be delivered.

Improved performance expectancy also related to student engagement. Mr L expressed confidence that forums, chat, and Quickmail would facilitate more interaction, deeper discussion, and responsive student support. This is consistent with research showing that LMS tools enhance meaningful interaction and dialogue-based learning in open distance education contexts (Lavidas et al., 2022; Al-Sharhan et al., 2020).

Additionally, the strategy highlighted design features such as scheduling announcements and structuring module layouts, which reduce student confusion and streamline administrative tasks. This aligns with literature suggesting that educators perceive LMS platforms as more useful when they allow better control, customisation, and automation of teaching processes (Zurinah et al., 2013; Lin & Wang, 2012). Mr L now expects the LMS to improve academic communication, clarify expectations for students, and support management of assessments and learning resources. Thus, the LMS is seen as useful not only for students but also for teacher educators themselves.

In summary, Mr L's performance expectancy increased significantly because of the strategy. The shift from viewing the LMS as a basic communication tool to recognising it as a comprehensive teaching platform demonstrates that the intervention effectively strengthened this core component of technology acceptance.

Social influence

Social influence emerged as a significant factor shaping Mr L's growing confidence and willingness to adopt more advanced LMS functionalities, even though he did not report direct pressure from colleagues or institutional leadership. Instead, the influence he experienced was subtle, relational, and embedded within the professional expectations of his teaching context. Mr L repeatedly emphasised the value of being shown how to use LMS tools, noting that many features "were there all along, but no one had ever really explained them before." This suggests that his earlier limited use of the LMS was partly due to weak modelling within his academic environment. This aligns with broader literature indicating that educators' perceptions of technology usefulness are strongly influenced by the expectations, behaviours, and competencies of those around them (Venkatesh et al., 2003; Buabeng-Andoh & Baah, 2020). When colleagues do not visibly engage with LMS tools or institutional guidance is minimal, educators may interpret this as an indication that such tools are neither essential nor valued. Mr L's reflections imply that he previously perceived advanced LMS use as optional because there were no strong social cues signalling its professional importance.

The strategy introduced a form of positive social influence that shifted these perceptions. One-on-one interaction, personalised demonstrations, and affirming guidance functioned

as powerful social cues, signalling that effective LMS use is both expected and beneficial. Mr L's enthusiasm for newly discovered functionalities-particularly BigBlueButton, Quickmail, chat, and polls-was accompanied by comments suggesting a desire to teach "like others who use these things," indicating that he was beginning to align himself with perceived best practices. This resonates with Dahlstrom et al. (2014), who argue that educators' perceptions of usefulness increase when they observe, or experience, enhanced teaching possibilities modelled through supportive engagement. Similarly, UTAUT literature emphasises that guidance and support from credible others strengthen educators' belief in the value of technology, shaping both perceived usefulness and intention to adopt (Bervell & Arkorful, 2020).

Institutionally, Mr L's request for ongoing, monthly training further illustrates the role of social influence in sustaining adoption. His desire to continue learning alongside colleagues ("for us as teacher educators") reflects a recognition that shared professional development fosters collective norms around technology use. This aligns with Ssekakubo et al. (2011), who found that communal ICT support structures enhance educators' motivation to integrate LMS tools into their teaching. Mr L's reflections suggest that being part of an environment where LMS use is encouraged, supported, and modelled-through both the researcher's guidance and potential future peer engagement-has meaningfully influenced his perceptions of what is pedagogically expected and professionally valuable.

Overall, social influence for Mr L operated not through overt pressure, but through supportive modelling, guided exposure, and emerging professional norms, all of which increased his sense that using the LMS fully is both beneficial and aligned with the practices of competent educators in an open distance learning environment.

7.2.2.3 Dr E

Perceived usefulness and performance expectancy

In reflecting on the strategy, Dr E recognised that the LMS offers meaningful benefits for teaching, communication, and course management, which became increasingly visible and relevant as the strategy progressed. Consistent with the literature reviewed, his interview responses illustrate that his sense of the LMS's usefulness expanded as he encountered functionalities he had previously overlooked, misunderstood, or used only

superficially. Like other participants, Dr E had relied almost exclusively on announcements for communication and on Microsoft Teams for synchronous sessions. He had not realised that the LMS already offered integrated tools capable of streamlining these tasks, such as BigBlueButton. After the intervention, he repeatedly emphasised that the strategy “opened my mind” to possibilities he “did not know how people carried out” and that many tools were easier and more powerful than he had believed prior to the training. This aligns with TAM literature, which suggests that perceived usefulness increases when users gain insight into how systems directly support their work (Legris et al., 2003; Venkatesh & Davis, 2000).

A prominent indicator of usefulness for Dr E was the LMS’s ability to improve the efficiency and quality of communication. He explained that before the strategy, he believed announcements were the only available channel for engaging students. Through the strategy, he discovered other tools, including forums, private messaging, polls, and channels, quickly realising that “announcements are not the only communication tool we have; there are different tools that we can use.” This represented a clear shift in his evaluation of LMS usefulness, highlighting its potential to support richer and more interactive student engagement. This finding aligns with literature emphasising communication diversity as a key determinant of LMS usefulness, particularly in open distance learning contexts where multimodal interaction compensates for limited contact (Dahlstrom et al., 2014; Rambe & Bere, 2013).

Dr E also highlighted the usefulness of content structuring tools, such as sections, pages, folders, and student-view previews. The strategy helped him recognise that the LMS could support more organised, visually coherent course sites. He repeatedly noted that these features were “going to help me in teaching one of my modules,” indicating that he saw their value for future use. This is consistent with Aldiab et al. (2019) and Al-Fraihat et al. (2020), who argue that well-structured LMS environments enhance student navigation, reduce confusion, and improve teaching efficiency.

The discovery of BigBlueButton marked a profound shift in Dr E’s perceived usefulness. He explained that he and “most teacher educators” were unaware that the LMS supported synchronous teaching. Learning this changed his perspective dramatically, as he realised

he no longer needed to use external platforms such as Microsoft Teams for live classes. Like Dr K, he saw benefits in hosting synchronous teaching within the LMS, where recordings, chat, slides, and attendance reports are automatically stored and accessible to students. Dr E described BigBlueButton as the “base component” of the strategy and a functionality he would transform and integrate into his future teaching practice. This perception strongly supports UTAUT’s performance expectancy construct, which suggests that educators adopt systems they believe will improve teaching efficiency, reduce administrative duplication, and create seamless workflows (Venkatesh et al., 2003). It also echoes findings from Mtebe and Raisamo (2014), who note that integrating synchronous tools into LMS platforms enhances perceived usefulness by reducing fragmentation across systems.

The strategy also revealed previously hidden or underutilised functionalities. For example, Dr E had frequently used announcements but had not known about options to adjust availability settings, embed multimedia, or control visibility until these were demonstrated. He described these as “hidden options” that improved both his efficiency and the potential for student engagement. This reinforces the literature critique of surface-level training and highlights the importance of detailed demonstrations for educators to understand the pedagogical value of LMS tools (Ifenthaler & Schweinbenz, 2016).

Finally, Dr E emphasised that the strategy made the LMS feel directly relevant to his day-to-day teaching. He repeatedly linked his new knowledge to future intentions, stating that what he had learned was “very important to our everyday teaching experience” and “going to influence what I use in my module” next year.

Dr E’s reflections illustrate how the LMS strategy reshaped his expectations of what the LMS can achieve. At the start of the intervention, his use centred primarily on announcements and basic content uploading. Although helpful, he had not associated the LMS with improving his job performance. After the strategy, however, he recognised that the LMS contains functionalities capable of enhancing productivity, reducing workload duplication, and improving student access-reflecting patterns identified in the literature, where perceived improvements to teaching performance significantly elevate motivation to adopt LMS tools (Lavidas et al., 2022; Legris et al., 2003).

A key shift in Dr E's performance expectancy emerged as he recognised that the LMS's integrated tools reduce effort and enhance efficiency. Before the strategy, running synchronous lessons required posting Microsoft Teams links, managing permissions manually, and uploading recordings afterward-a time-consuming and cumbersome process. Discovering BigBlueButton immediately revealed its potential to transform his workflow, as he described it as "the best" feature because everything was finally "joined together" within the LMS. This eliminated repetitive external steps and created a more accessible and cohesive learning experience for students. Perceived usefulness and performance expectancy increase when systems consolidate teaching tasks into a unified environment (Mtebe & Raisamo, 2014; Lin & Wang, 2012). Experiencing this integration firsthand allowed Dr E to revise his expectations of what the LMS could help him accomplish.

Performance expectancy also grew as Dr E discovered how LMS tools could improve communication and learner engagement-two areas he considered essential to effective teaching. He noted that relying solely on announcements limited student interaction, whereas the LMS provided "different tools we can use," including forums, chat, polls, and private messaging. He remarked that these tools were "important to our everyday teaching experience," enabling richer, more immediate forms of engagement and reducing the administrative burden of responding to repetitive emails. This echoes Dahlstrom et al. (2014), who argue that LMS communication tools enhance teaching performance by facilitating student-centred interaction. Dr E's recognition that these tools will make future teaching "much easier" illustrates a strengthened sense that the LMS supports his teaching effectiveness.

Content structuring and learner navigation further contributed to his improved performance expectancy. Learning to organise content into sections, use pages and folders, embed multimedia, and preview the site from the student's view "help[ed] me in one of my modules," signalling his understanding that good LMS design improves student access and reduces confusion. Educators perceive LMS systems as performance-enhancing when they support structured pathways, predictable navigation, and improved instructor presence (Al-Fraihat et al., 2020; Aldiab et al., 2019). Dr E's reflections show

that the strategy helped him see the LMS not merely as a storage repository, but as a platform capable of shaping the student learning experience more effectively.

Importantly, the strategy broadened Dr E's expectations for long-term LMS use. While he had not yet implemented all tools in live modules due to the timing of the strategy, he emphasised that he intended to make use of these functionalities going forward. He described the tools as "very important" and explicitly stated that they would influence "what I use in my module" next year. This aligns with TAM and UTAUT research, which asserts that when educators perceive technology as improving their ability to perform job-related tasks, their intention to use it increases correspondingly (Legris et al., 2003; Venkatesh et al., 2003).

Social influence

For Dr E, social influence played an indirect yet meaningful role in shaping his perceptions of the LMS and his willingness to extend his use of its functionalities. Although he did not describe explicit pressure from colleagues or institutional mandates, his reflections suggest that the broader academic environment-and his sense of professional responsibility within it-subtly encouraged him to reconsider how the LMS should be used. He noted that he had previously relied heavily on email for student communication and used the LMS primarily for uploading content. However, observing colleagues in other disciplines using more advanced LMS features prompted him to aspire to "do things properly on the LMS" and to provide communication "where students can find it in the module" rather than scattered across external platforms. This indicates that peers' practices acted as an informal benchmark for "good digital pedagogy," aligning with UTAUT's view that social norms-whether explicit or implied-shape educators' technology-related behaviour (Venkatesh et al., 2003).

The strategy itself also served as a direct source of social influence, particularly through the relational modelling provided during the sessions. Dr E repeatedly emphasised the value of seeing LMS tools in action, describing the demonstrations as "eye-opening" and noting that he "did not realise the LMS could do all this." This type of guided modelling mirrors Dahlstrom et al. (2014), who argue that educators develop stronger perceptions of system usefulness when they observe competent users demonstrating meaningful

pedagogical applications. The step-by-step guidance signalled to Dr E not only how the LMS works, but also that fully utilising its features is a professionally valued practice. This modelling reduced ambiguity around appropriate LMS use—a factor the literature identifies as central to adoption in developing-country contexts, where educators often lack peers who demonstrate advanced functionalities (Ssekakubo et al., 2011; Bervell & Arkorful, 2020).

Social influence also emerged indirectly through student expectations. Dr E recognised that students often experience confusion when communication is fragmented across platforms, and their need for clarity and consistency encouraged him to make fuller use of LMS announcements, forums, and messaging tools. In UTAUT terms, this reflects the broader notion that social influence includes the expectations of those who rely on the system. By acknowledging students' needs, Dr E implicitly recognised a professional obligation to provide a coherent and accessible learning experience, supporting Buabeng-Andoh and Baah's (2020) assertion that perceived usefulness increases when technology enhances social or professional expectations.

Finally, the encouragement embedded within the strategy strengthened Dr E's confidence that deeper LMS engagement is both feasible and expected of a competent educator. His closing remarks—expressing gratitude for being “shown things I never knew existed” and his commitment to continue practising—demonstrate that the social dimension of the support played a crucial role in reshaping his perceptions. Rather than viewing LMS competence as an individual struggle, he began to perceive it as part of a shared professional trajectory, supported institutionally and guided through structured interaction.

7.2.2.4 Dr M

Perceived usefulness and performance expectancy

Dr M acknowledged that the strategy introduced him to LMS tools he had previously not used. However, his perception of the LMS's usefulness was primarily shaped by how these tools aligned with the teaching goals of the institute rather than their mere availability. This perspective aligns with TAM's definition of perceived usefulness as the extent to which a system enhances job performance (Davis, 1989) and extends it to encompass professional identity and teaching philosophy.

A central dimension of Dr M's understanding of usefulness was the LMS's ability to enhance student engagement and interaction. He emphasised that "those tools are designed to engage more with students," highlighting that usefulness is measured by the extent to which a tool enables meaningful pedagogical communication. This aligns with literature noting that LMSs are particularly valuable when they support rich interaction and improve learner participation (Holmes & Prieto-Rodriguez, 2018; Henderson et al., 2017). For Dr M, tools such as forums, direct messaging, announcements, and chat are not merely convenient; they are purposeful, enabling deeper academic engagement while maintaining contact with a large and diverse student body.

Dr M also viewed the LMS as useful for structuring and pacing learning. He explained that locating tools, arranging content, and organising module sites provided a sense of order that translated into clearer expectations for students. He further emphasized that when teacher educators possess the correct information, they can apply it, supporting improved planning for the upcoming academic year. This aligns with research indicating that LMS usefulness is enhanced when it helps educators plan lessons and maintain coherence in course delivery (Panigrahi et al., 2018; Ahmed et al., 2021). For Dr M, usefulness lies not only in technical functionality but also in how the LMS supports the intellectual work of organising instruction.

Synchronous tools, particularly BigBlueButton, played a significant role in Dr M's perception of usefulness. He highlighted that it mitigated the fear and uncertainty he had experienced in live teaching contexts. Previously, he had been reluctant to conduct sessions due to concerns about making mistakes in front of students and its potential impact on his professional credibility. The LMS strategy reframed synchronous teaching as both manageable and pedagogically valid, reflecting literature that shows perceived usefulness is strongly influenced by educators' sense of pedagogical control and emotional safety when using digital tools (Bhalalusesa et al., 2013; Ifenthaler & Schweinbenz, 2016).

Another distinctive aspect of Dr M's perception of usefulness relates to contextual equity. He critiqued LMS-based expectations that assume all students have consistent access to technology. Reflecting on teaching practice assessments, he noted that evaluating

student teachers on technology integration could disadvantage those in under-resourced schools. For Dr M, a tool is only truly useful if all learners can benefit from it, not just those with access. This perspective resonates with African ODeL literature, which highlights how structural inequalities mediate LMS usefulness (Hoosen & Butcher, 2012; Chaka, 2020).

Dr M also linked usefulness to personalised, needs-based training. He described the strategy as “tailor-made” because it responded to his actual module usage and teaching needs. As a result, not only were the LMS tools more useful to him, but the strategy itself became a valuable resource. Literature supports this view, noting that perceived usefulness rises sharply when training is contextualised and relevant (Hussein, 2016; Swart, 2015). Because the strategy addressed his real teaching gaps rather than offering generic demonstrations, Dr M perceived LMS tools as more directly valuable.

At the same time, Dr M maintained a balanced perspective. While recognising the value of LMS tools, he cautioned against overuse, noting that excessive integration could overshadow other pedagogical elements or create unrealistic expectations for educators and learners. For him, usefulness is maximised when technology complements, rather than replaces, sound teaching practice (Henderson et al., 2017; Jerolmack & Tavory, 2014).

Dr M's reflections also demonstrated strong performance expectancy, shaped by his conviction that the LMS can significantly improve student engagement, teaching effectiveness, assessment, and course organisation. The strategy expanded his awareness of how the LMS could support more effective teaching, even for tools he was previously familiar with. He emphasised that better navigation and structured module design improve course organisation and teaching efficiency, stating that if instructors “possess the right information, they can apply it.” This aligns with research showing that LMS usefulness increases when it facilitates efficient workflow and transparent course organisation (Panigrahi et al., 2018; Al-Fraihat et al., 2020).

Synchronous teaching was another critical aspect of performance expectancy. BigBlueButton not only provided functionality but transformed Dr M's perception of live teaching, making it more manageable and reducing his anxiety about making mistakes.

This shift illustrates how confidence in technology-mediated teaching contributes to improved performance expectancy (Bhalalusesa et al., 2013).

Furthermore, Dr M emphasised that LMS tools enhance performance only when applied strategically. He cautioned that not all tools are appropriate for every teaching situation and that their use must be balanced with pedagogical coherence. Performance improvements, he argued, come from thoughtful integration rather than blanket adoption (Henderson et al., 2017).

Finally, his awareness of contextual limitations-particularly equity issues affecting students' access to technology-adds a unique dimension. He stressed that LMS tools only improve performance when they align with students' circumstances, highlighting that performance expectancy is mediated by socio-economic context (Hoosen & Butcher, 2012; Chaka, 2020). Dr M also reinforced the importance of contextualised training, noting that the "tailor-made" strategy allowed him to immediately apply new knowledge, consistent with literature showing that relevant, practical training strengthens performance expectancy (Hussein, 2016; Lin & Wang, 2012).

Social influence

One strong indicator of social influence is Dr M's repeated emphasis on appearing competent and confident in front of students, noting that *"students are looking at us as the experts... it does not enhance confidence... when they see us fumbling"*. This illustrates a performance-based form of social pressure, where the expectations of students influence his willingness to engage with new digital tools. As highlighted previously, educator attitudes toward technology adoption are shaped by perceived expectations from the teaching environment and learners (Webster & Hackley, 1997). Dr M's responses show that his motivation to improve his digital competence is partly driven by the desire to maintain credibility in the eyes of his students.

Social influence also appears in his comments about professional identity and peer comparison, especially when he expresses concern that some individuals "shy away... because they do not want to come across as not being the expert" in large online spaces. This sentiment aligns with findings in literature showing that educators' reluctance to use LMS tools is often tied to fears of exposing shortcomings in public, highly visible teaching

environments (Dahlstrom et al., 2014). The pressure to “measure up” to peers who are more technologically fluent thus contributes to his engagement with the strategy.

Institutional culture also shapes Dr M’s perceptions. He acknowledges that the institution’s flexibility, remote work structure, and access to technology create a broader social and professional expectation that the teacher educators *should* be using LMS tools meaningfully. Even his reflections on professional development practices-such as the need for “*tailor-made*” training and baseline assessments-implicitly reference institutional norms around continuous digital upskilling, echoing the literature’s emphasis on the role of organizational expectations in driving technology adoption (Kisanga & Ireson, 2015).

Overall, Dr M’s reflections reveal that social influence plays a significant role in his engagement with LMS tools, not through explicit pressure from colleagues or management, but through subtler expectations embedded in student perceptions, professional identity, and institutional culture.

7.2.2.5 Synthesis and interpretation of findings

Perceived usefulness and performance expectancy

Perceived usefulness-the degree to which an individual believes that using a system will enhance job performance-is a central determinant of technology acceptance in both the TAM and UTAUT frameworks. The post-implementation findings show that all four science teacher educators experienced a marked shift in their perceptions of the LMS as a tool that could meaningfully improve their teaching practice, communication processes, and organisation of learning materials. This aligns strongly with Davis’s (1989) assertion that perceived usefulness is often the most powerful predictor of actual system use and confirms the literature that positions LMS as a pedagogically enabling technology when educators understand its functional value (Coskuncay & Ozkan, 2013; Dahlstrom et al., 2014).

Prior to the intervention, participants viewed the LMS primarily as an administrative repository-useful for uploading documents but offering little additional value. This perception is widely documented in developing-country contexts, where LMS platforms are underutilised due to low digital literacy, limited exposure, and a lack of clarity about

pedagogical affordances (Ssekakubo et al., 2011; Bhalalusesa et al., 2013). The strategy directly countered this by demonstrating not only the existence of various tools but also how these tools directly support teaching and learning. As participants worked through guided sessions on announcements, communication tools, BigBlueButton, and resource organisation, they reported realisations about how these functionalities could enhance student engagement, streamline instructional workflows, and improve module structure. Such developments resonate with Al-Emran and Teo's (2020) argument that LMS effectiveness hinges on educators recognising its utility for supporting learning processes. This expanded understanding of usefulness was particularly evident in participants' discussions of communication tools. Teachers noted that embedded announcements, forums, and direct messaging allowed for clearer, more centralised communication compared to previously used external platforms such as WhatsApp. This aligns with literature highlighting that LMS platforms facilitate improved communication channels, better documentation of interactions, and enhanced student tracking (Bacow et al., 2012; Emelyanova & Voronina, 2014). By observing how communication through the LMS could reach all students in a structured and traceable manner, participants began to see the LMS as a tool that adds pedagogical and administrative value, rather than simply replicating tasks they completed elsewhere.

Participants also expressed that BigBlueButton significantly enhanced their perceptions of usefulness by enabling real-time teaching and recorded sessions within the LMS environment-capabilities they had previously believed were impossible or dependent on external software. Literature on synchronous and asynchronous LMS features confirms that these tools support interactive teaching, promote student engagement, and expand opportunities for learner support in open distance education (Dahlstrom et al., 2014; Swart, 2015). Realising that these functions were built into the LMS shifted educators' views of the platform from a static content site to a dynamic teaching space, thereby increasing their sense of its pedagogical usefulness.

Another dimension of increased perceived usefulness emerged from the improvements participants observed in course organisation. The ability to structure content clearly, create folders, embed pages, and use labels to guide students was repeatedly described

as enhancing the clarity and navigability of modules. This matches findings from the literature showing that LMS environments support self-paced learning, resource accessibility, and improved course management when content is well organised (Perraton, 2012; Henderson et al., 2017). For participants, these realisations translated into a belief that the LMS could improve students' learning experiences, aligning with UTAUT's conceptualisation of performance expectancy as the perceived improvement in task outcomes.

Importantly, perceived usefulness was not limited to immediate functionality; participants also reported an increased understanding of the long-term instructional benefits of integrating LMS tools into their teaching routines. Many expressed that the LMS would make their teaching more efficient, allow for clearer documentation of student engagement, and reduce reliance on fragmented external tools. This perspective aligns with literature describing LMS platforms as improving institutional efficiency, enhancing feedback processes, and supporting flexible, student-centred learning (Rajhans et al., 2020; Alshammari, 2020).

Overall, the findings demonstrate that the strategy significantly strengthened perceived usefulness across all participants by linking LMS functionalities to tangible teaching benefits. This shift is particularly noteworthy in an open distance learning context, where LMS constitutes the primary site of instructional interaction. As the literature suggests, when educators recognise the pedagogical and operational value of LMS tools, their likelihood of sustained adoption increases (Legris et al., 2003; Venkatesh et al., 2003). The post-implementation reflections thus affirm that perceived usefulness-enhanced through guided exposure, practical demonstrations, and contextualised application-played a pivotal role in transforming educators' overall perceptions of the LMS and their willingness to integrate it meaningfully into their teaching practice.

Social influence

Social influence-defined within UTAUT as the extent to which individuals perceive that important others believe they should use a particular technology-is a significant predictor of technology adoption, especially in professional contexts where institutional norms and peer expectations shape behaviour (Venkatesh et al., 2003). In this study, social influence

emerged subtly but consistently across participants' reflections. While none of the teacher educators explicitly framed their LMS use as a response to peer pressure, their narratives suggested that perceptions of what colleagues, students, and the institution expected played a meaningful role in shaping post-implementation attitudes.

A prominent theme was heightened awareness of professional expectations. Several participants noted that improved LMS use aligned with what they perceived as the broader direction of the university and the expectations of their departments. This aligns with literature from developing-country contexts, which highlights how institutional culture and perceived managerial expectations strongly influence LMS integration (Kisanga & Ireson, 2015; Ssekakubo et al., 2011). Participants referenced an emerging belief that "we should be using these tools properly," indicating that the intervention not only enhanced technical skill but also reshaped their understanding of what constitutes acceptable and contemporary teaching practice in an open distance learning context.

Peer influence also played a subtle yet meaningful role. Participants frequently commented on colleagues' practices, particularly regarding communication and module organisation. For instance, some noted that WhatsApp had become the default platform for student communication-not because it was formally endorsed, but because peers widely used it. Literature suggests that when informal practices dominate, they can overshadow institutional systems, creating misalignment between organisational expectations and educator behaviour (Maphalala & Mpofu, 2018). The strategy disrupted this trend by demonstrating the LMS as a centralised, formalised, and pedagogically grounded alternative. As participants observed the value of announcements, direct messaging, and forums, they began to articulate how such practices "made more sense" within professional teaching norms.

Student expectations constituted another dimension of social influence. Participants acknowledged that students increasingly expect structured module sites, accessible materials, and consistent communication. This mirrors findings that students' perceptions of LMS usefulness can encourage educators to adopt more effective practices (Lonn & Teasley, 2009; Emelyanova & Voronina, 2014). By recognising how LMS features could improve clarity and reduce queries, participants expressed greater commitment to

adopting the tools-not only for their own workflow but also to meet students' expectations as distance learners.

The strategy itself further reinforced social influence. One-on-one engagement with the researcher created interpersonal influence akin to mentorship or peer-modelling described in literature on digital professional development (Kordrostami & Seitz, 2022). Participants valued being guided and encouraged, suggesting that the relational nature of the intervention increased their willingness to explore unfamiliar tools. This aligns with research indicating that supportive social environments-where individuals feel guided rather than judged-enhance technology acceptance (Tarus & Gichoya, 2015; Bervell & Arkorful, 2020).

Importantly, post-implementation data show that social influence operated not through explicit pressure, but through shifts in perceived norms. As participants became more familiar with LMS functionalities, they began to reinterpret what was expected by colleagues, the institution, and students. This reflects a key UTAUT principle: social influence is strongest when tasks are mandatory or when individuals feel accountable within professional communities (Venkatesh et al., 2003). Although LMS use at UNISA is not strictly enforced, participants increasingly viewed effective LMS use as an integral part of responsible academic practice.

In summary, social influence emerged as a subtle yet powerful construct, shaped by institutional expectations, peer behaviour, student needs, and the relational context of the strategy. The intervention amplified these influences by providing clarity, modelling best practice, and reinforcing that effective LMS use is not merely optional but central to high-quality distance teaching. Consistent with the literature, when educators perceive that competent LMS use aligns with respected professional norms, their motivation to adopt and sustain such practices is substantially strengthened (Buabeng-Andoh & Baah, 2020; Alshammari, 2020).

7.2.3 Behavioural intention

7.2.3.1 Dr K

Dr K's reflections indicate a strong and growing behavioural intention to continue using the LMS, shaped by the strategy's impact on his confidence, familiarity, and perceived value of its tools. His intention to sustain use is evident in statements highlighting that newly acquired LMS skills had not only improved his immediate teaching capacity but would also be "definitely" incorporated into future module preparation and online teaching practices. This aligns with the Technology Acceptance Model (TAM), which posits that perceived usefulness and perceived ease of use strongly drive behavioural intention (Davis, 1989). Because Dr K experienced both constructs positively through the strategy, his intention to continue engaging with the LMS was naturally reinforced.

This intention is further influenced by UTAUT constructs, particularly performance expectancy and facilitating conditions, which are known to significantly affect system adoption (Venkatesh et al., 2003). Dr K consistently highlighted that the LMS supports his assessment processes, content distribution, and forum-based communication, identifying these features as beneficial for both teaching efficiency and student access. Literature suggests that when educators recognise that technology enhances their job performance, they are more likely to continue using it (Alshehri et al., 2019; Legris et al., 2003). His reflections echo this pattern, particularly when he noted that structured shells, MCQ automation, and discussion spaces reduce administrative burdens while increasing student engagement.

Peer encouragement also played a significant role in shaping his behavioural intention. Dr K explicitly credited colleagues for introducing him to new tools and motivating his LMS engagement, explaining, "The majority of things I know... it's from recommendations and assistance from colleagues... through their recommendation I started to fall in love with using this LMS." This mirrors UTAUT's social influence construct, which suggests that endorsement from significant peers positively shapes behavioural intention (Venkatesh et al., 2003). Previous research similarly identifies collegial collaboration as a critical motivator for sustained technology use (Lavidas et al., 2022; Kisanga & Ireson, 2015). Dr

K's enthusiasm and commitment to the LMS are therefore partially driven by peer-supported reinforcement.

Institutional support also strengthened his intention to continue using the LMS. Although Dr K initially felt unsupported due to insufficient training, he acknowledged recent improvements in workshops and structured sessions, noting that these interventions "raise interest... to want to know more." Literature confirms that visible institutional commitment, ongoing training, and user-centred support environments are strong predictors of sustained technology adoption (Alshehri et al., 2019). Dr K's reflections illustrate this clearly: as training quality improved and he gained concrete, hands-on exposure through the strategy, his intention to maintain and expand LMS use increased.

Overall, Dr K's behavioural intention is anchored in the core TAM and UTAUT mechanisms-perceived usefulness, ease of use, performance expectancy, social influence, and facilitating conditions. Participation in the LMS strategy strengthened each of these constructs, creating optimal conditions for the formation of positive behavioural intention. Consistent with the literature (Legris et al., 2003; Venter et al., 2012), intention is not merely a product of tool exposure but emerges from enhanced digital self-efficacy, supportive institutional structures, and visible pedagogical benefits. Dr K's interview strongly suggests that he intends to continue using the LMS more deeply and purposefully, integrating the newly learned tools into his future teaching and sustaining the momentum generated by the strategy.

7.2.3.2 Mr L

Mr L's reflections indicate a strong and positive behavioural intention to continue using the LMS tools introduced during the strategy. Within the UTAUT framework, behavioural intention refers to a user's motivation and likelihood to adopt or continue using a technology in the future (Venkatesh et al., 2003). This intention is shaped by perceived usefulness, ease of use, performance expectancy, and facilitating conditions-all of which showed noticeable improvement for Mr L following the implementation of the LMS enhancement strategy.

A key indicator of his behavioural intention was his commitment to integrating the tools he learned into his teaching practice in the next academic year. Although he had not yet

implemented them due to the timing of the sessions-“We started late... I was done with teaching. I will use this next year”-he clearly articulated which tools he intended to adopt first and why. His immediate plan focused on orientation and site organisation, explaining that the first step would be “to orientate my LMS site so that it can be easily accessible for students.” This demonstrates both readiness and a clear intention to apply the strategy as part of his routine teaching design.

Mr L also expressed strong enthusiasm for using BigBlueButton, announcements, forums, chats, and Quickmail-the tools he found most beneficial for communication. He stated unequivocally that these were the tools he would rely on most: “Yes, 100%.” This confident articulation of future behaviour aligns with literature indicating that when educators recognise tangible instructional benefits, they develop stronger intentions to integrate technology into their practice (Legris et al., 2003).

His behavioural intention was further reinforced by his expressed desire for ongoing, regular LMS training, which he viewed as essential for continuing and expanding tool use. He explained, “If we can receive training about LMS more regularly... it will make us much better,” highlighting monthly LMS-focused training as especially valuable. This supports Alshehri et al. (2019), who argue that continuous professional development and system-specific training strongly influence long-term engagement with LMS technologies. For Mr L, sustained use is contingent not merely on willingness, but on continued institutional support that enables deeper mastery.

Importantly, his motivation extends beyond individual tools. Mr L’s reflections reveal a broader transformation in his teaching approach, driven by a deeper understanding of the LMS’s overall value. He expressed confidence that the LMS would enhance communication, reduce administrative burden, improve lesson delivery, and involve students more meaningfully in their learning. These insights align with TAM and UTAUT propositions, which suggest that behavioural intention strengthens when users perceive that a system improves teaching performance and reduces effort (Davis, 1989; Venkatesh et al., 2003).

Overall, Mr L’s behavioural intention is strong and forward-looking. His commitment to reorganising his LMS site, adopting multiple communication and teaching tools, and

seeking ongoing support indicates a high likelihood of sustained and expanded LMS use in future academic cycles. His reflections confirm that the strategy successfully influenced not only immediate perceptions but also long-term adoption behaviours-an essential outcome in technology acceptance and digital pedagogical transformation.

7.2.3.3 Dr E

Dr E's reflections reveal a clear and growing behavioural intention to use the LMS more meaningfully in future modules-an intention strengthened by the structured exposure and hands-on support provided by the strategy. In both the TAM and UTAUT models, behavioural intention represents the psychological commitment that predicts actual technology use (Davis, 1989; Venkatesh et al., 2003). This intention is influenced primarily by perceived usefulness, ease of use, social influence, and facilitating conditions. Dr E's interview responses demonstrate strong alignment with this relationship: as his understanding of the LMS deepened and he experienced tangible improvements in usability and teaching efficiency, his intention to adopt additional LMS tools increased substantially.

A central driver of Dr E's behavioural intention was the enhanced usefulness and functionality he perceived in the LMS. He repeatedly emphasised that the new tools he discovered-particularly BigBlueButton, pages, polls, chat, and enhanced announcements-were "very important to our everyday teaching experience" and would directly shape "what I use in my module" going forward. This aligns with TAM literature, which identifies perceived usefulness as the strongest predictor of intention (Davis, 1989; Venkatesh & Davis, 2000). Once Dr E recognised that the LMS could streamline communication, improve engagement, reduce duplication of work, and centralise synchronous teaching, his motivation to integrate these tools into future practice strengthened.

Perceived ease of use also played a critical role. Prior to the strategy, he had little intention to expand his LMS usage because many functionalities seemed complex and intimidating. However, the hands-on demonstrations, clear instructions, and guided practice sessions enabled him to state repeatedly that he now felt confident to explore tools independently and "try the others that you see." Research confirms that ease of use

reduces anxiety, encourages exploration, and significantly increases educators' willingness to adopt additional tools (Lin & Wang, 2012; Bhalalusesa et al., 2013). Dr E's reflections echo this pattern: once procedural barriers were removed, his intention to engage more deeply with the LMS expanded naturally.

Social influence further strengthened his behavioural intention. He noted that he had previously adopted some LMS tools after "seeing how people use them" or observing peers' module designs, though he did not know how to implement such features himself. The strategy formalised and modelled effective LMS practices, transforming passive admiration of peers' work into actionable skills. As a result, Dr E expressed a desire not only to use the tools but to use them as effectively as the colleagues he had been observing.

Improvements in facilitating conditions also reinforced his intention. Before the strategy, the absence of consistent terminology, integrated tools, and structured training undermined his confidence. After the intervention, he described the sessions as "useful," "helpful," and "eye-opening," noting that he intended to incorporate the newly learned functionalities into next year's teaching. Literature supports this: when educators perceive institutional support as strong-especially through guided, contextual training-their intention to adopt technology increases significantly (Alshehri et al., 2019; Ifenthaler & Schweinbenz, 2016). Dr E's reflections mirror this pattern: as soon as he felt supported, his intention to engage more fully with the LMS deepened.

Overall, Dr E's behavioural intention reflects a combination of heightened perceived usefulness, increased ease of use, strengthened institutional support, and reinforced social influence-all constructs identified by TAM and UTAUT as critical for technology adoption. His interview demonstrates a clear transition from minimal, habitual LMS use to purposeful, informed, and forward-looking engagement. The strategy played a central role in this shift by enabling him to experience the LMS's benefits directly and equipping him with the confidence and competence to sustain meaningful use in future module offerings.

7.2.3.4 Dr M

Dr M's reflections demonstrate a clear and strengthened behavioural intention to continue using the LMS more fully following the implementation of the strategy. A key indication of this is his repeated commitment to practising the tools he was shown, noting that the sessions "opened [his] eyes" to features he had previously overlooked. This shift from minimal, cautious use toward deliberate, future-oriented engagement aligns with UTAUT's proposition that behavioural intention increases when perceived usefulness and effort expectancy improve together (Venkatesh et al., 2003). Dr M's recognition that the LMS can streamline his teaching-particularly through tools such as BigBlueButton for recorded sessions, announcements for structured communication, and folders/pages for organised content delivery-created a sense of future value that is central to the development of stable intention. This supports TAM's emphasis on perceived usefulness as a key driver of behavioural change (Davis, 1989).

The strategy also appeared to reduce the psychological barriers that previously inhibited his adoption of new functionalities. He noted that he now feels "more comfortable to try things," suggesting that the guided, hands-on approach not only increased his competence but also alleviated the anxiety associated with making errors-an element repeatedly identified in the literature as essential for sustained technology adoption (Legris et al., 2003; Bhalalusesa et al., 2013). This combination of confidence and perceived ease directly supports the formation of intention, as educators are more willing to use a system when they believe they can do so successfully and without undue frustration. Dr M's intention was further reinforced by his recognition that improved LMS use would benefit his students, particularly by enhancing the clarity, accessibility, and interactivity of his module sites. Literature shows that when educators perceive that technology positively impacts learner engagement or academic outcomes, they are more inclined to integrate it consistently (Sulaiman, 2023; Rajhans et al., 2020).

Moreover, Dr M explicitly acknowledged his desire to continue practising beyond the strategy, indicating that the sessions fostered curiosity rather than reliance. This is a key indicator of the transition from externally supported use toward self-directed adoption, reflecting UTAUT's view that behavioural intention strengthens when users begin to see

technology as a normalised and integral part of their professional identity (Venkatesh et al., 2003). His comments suggest that he now views LMS engagement not as an optional add-on, but as a necessary component of effective science teaching in an open distance learning environment-an interpretation strongly supported in the literature on digital transformation in higher education (Dahlstrom et al., 2014; Maphalala & Mpofu, 2018).

Dr M's reflections reveal a solidified intention to maintain and expand his use of the LMS. The strategy enhanced not only his immediate confidence but also his long-term outlook, positioning LMS use as both manageable and professionally beneficial.

7.2.3.5 Synthesis and interpretation of findings

Behavioural Intention-defined in UTAUT as the degree to which an individual plans or intends to use a technology in future practice-emerged strongly across all participants following the implementation of the LMS strategy. According to Venkatesh et al. (2003), behavioural intention is a central predictor of actual system use and is influenced by perceptions of usefulness, ease of use, social influence, and facilitating conditions. Post-implementation reflections revealed a clear shift from hesitation and limited engagement toward a future-oriented commitment to deeper LMS use.

For all four teacher educators, the strategy fostered a renewed willingness to integrate LMS tools deliberately into their modules. This aligns with Davis's (1989) Technology Acceptance Model, which posits that when users perceive a system as useful and easy to use, their intention to continue using it increases. Tasks that had previously felt intimidating-such as embedding media in announcements, structuring sites, organising content, setting up forums, or hosting synchronous sessions-were now viewed as manageable. Consequently, participants' intention to adopt these tools in real modules strengthened, supporting Dahlstrom et al.'s (2014) assertion that increased confidence and reduced perceived complexity encourage LMS adoption.

A notable trend was that behavioural intention was shaped not only by individual perceptions but also by a growing recognition of the pedagogical value of LMS functionalities. Participants repeatedly noted that the tools would improve communication, enhance student engagement, and streamline module organisation. This aligns with Al-Emran and Teo (2020), who argue that educators' intention increases when they see

technology as enhancing instructional efficiency and learner performance. Hands-on exposure during the sessions enabled participants to envision concrete ways in which LMS could support teaching rather than serve merely as an administrative burden.

Social and institutional expectations also contributed to shaping behavioural intention. As UTAUT emphasizes, social influence strengthens intention when users perceive that colleagues or the institution value or expect LMS adoption (Venkatesh et al., 2003). Participants acknowledged the need to improve the structure of their module sites, enhance communication with students, and align with evolving expectations within the open distance learning environment. This mirrors Tarus et al. (2015), who note that institutional cultures emphasizing digital pedagogies increase educators' openness to sustained LMS use.

Behavioural intention was further reinforced by enhanced facilitating conditions created through the strategy. Responsive guidance, access to a Sandpit practice site, and ongoing support reduced anxiety and strengthened participants' sense of empowerment. This observation aligns with Bervell and Arkorful (2020), who highlight that intention improves when educators perceive organisational structures effectively support technology use. For many participants, the strategy addressed a longstanding gap in structured LMS training, making future use not only feasible but desirable.

Importantly, participants' intention extended beyond basic tools they had previously relied on. Several reported plans to integrate communication tools more actively, utilise announcements more effectively, explore interactive activities such as chats, polls, and forums, and adopt BigBlueButton for synchronous teaching-features they had previously overlooked. This expansion aligns with research showing that behavioural intention strengthens when users are introduced progressively to features and supported in contextually relevant ways (Lavidas et al., 2022; Ramadhani et al., 2019).

Finally, the reflections demonstrated that the strategy increased not only participants' intention to use the LMS but also their sense of agency and ownership over digital teaching spaces. This deepened intention mirrors Buabeng-Andoh and Baah (2020), who note that educators are more committed to LMS adoption when they feel confident, supported, and familiar with the technology.

In summary, behavioural intention emerged as a strong outcome of the strategy, reflected in participants' commitment to integrating LMS tools more comprehensively into future modules. Their willingness was shaped by increased confidence, enhanced perceptions of usefulness, stronger facilitating conditions, and a clearer understanding of the pedagogical value of LMS functionalities. These findings highlight the transformative potential of targeted, scaffolded professional development, which not only builds skills but cultivates lasting intention to adopt digital pedagogies-an essential element for sustainable technology integration in an open distance learning context.

7.2.4 Familiarity with technology

7.2.4.1 Dr K

Dr K's reflections indicate a marked improvement in his familiarity with technology, particularly with respect to navigating the LMS's broader functionalities. Prior to the strategy, his familiarity was limited to basic features such as checking participants, uploading study guides, and administering assessments. This partial familiarity is consistent with literature, which explains that surface-level engagement often creates an *illusion of competence*-educators believe they understand the LMS because they can perform routine tasks, yet remain unaware of the system's deeper pedagogical capabilities (Naveh et al., 2010; Kakasevski et al., 2008). Dr K articulated this directly when he reflected that the training made him realise that "*you think you know something and then find out that you know little,*" clearly illustrating this gap in prior familiarity. His experience aligns with Martin's (2008) assertion that digital competence is not merely operational ability but awareness, adaptability, and a willingness to explore beyond familiar tools.

His unfamiliarity with several LMS tools was evident throughout his interview responses. Dr K admitted that he was unaware of BigBlueButton, quick messaging, chat functions, and some content structuring features until the strategy exposed them. Before the intervention, he believed that adding new sections or modifying the course shell required administrative involvement, revealing a lack of awareness of the system's built-in editing capabilities. This reflects findings from Walker (2015), cited in Chapter 2, who argues that unfamiliarity often leads to unnecessary dependence on others and reinforces the

perception that LMS platforms are complex or rigid. Dr K's case demonstrates this clearly; he previously sent requests for actions he later discovered he could perform himself.

As the strategy progressed, his familiarity with technology grew substantially through hands-on, personalised exposure. He noted that guided walkthroughs "*arose my interest*" and changed his mindset from reluctance to curiosity, which mirrors literature emphasising that familiarity increases when users can practise tasks in a low-pressure environment supported by immediate feedback (Bhalalusesa et al., 2013). The strategy's use of a *LMS Sandpit site* and real-time demonstration aligns with this approach, enabling Dr K to develop both procedural and conceptual familiarity. This is significant, as familiarity is recognised as a key facilitating condition influencing all other acceptance constructs, including ease of use and behavioural intention.

A notable aspect of Dr K's improved familiarity is his increased confidence to experiment independently. He stated that after the session he felt able to "*go there and add them*" when referring to adding new blocks or sections-something he previously avoided. This willingness to explore aligns with Calvani et al.'s (2008) conceptualisation of digital competence as involving autonomy, flexibility, and motivation, not just technical skill. As his familiarity expanded, Dr K transitioned from being a passive user of familiar tools to an active navigator of new functionalities, reflecting the gradual internalisation of digital fluency.

Peer support also played a role in shaping his familiarity. Dr K explained that "*the majority of things I know... it's from recommendations and assistance from colleagues,*" demonstrating how informal learning networks contribute to familiarity development. Such peer-driven engagement aligns with UTAUT's social influence construct and supports findings from Lavidas et al. (2022) that collaboration among educators enhances confidence and exploratory behaviour. The strategy complemented this by formalising the exposure that colleagues had initiated, strengthening his familiarity through structured, sustained learning.

Dr K's familiarity with technology improved significantly as a result of the LMS strategy. His reflections reveal a shift from limited awareness and dependence on others to confident, autonomous navigation of tools he previously perceived as inaccessible. The

strategy provided the exposure, practice, and guidance necessary for Dr K to internalise new functionalities, reinforcing the value of familiarity as the additional construct in your hybrid TAM–UTAUT framework.

7.2.4.2 Mr L

Mr L's reflections reveal a meaningful shift in his familiarity with technology, a construct deliberately incorporated into the conceptual framework to account for the diverse digital readiness levels of science teacher educators in an open distance learning environment. Prior to participating in the LMS strategy, Mr L described himself as only "50% comfortable" with the LMS, noting that he routinely used a limited set of tools-primarily announcements-and had little awareness of many embedded functionalities. This reflects the broader pattern identified in the literature, where educators often enter technology-enhanced environments with uneven digital foundations, making unfamiliarity a key barrier to meaningful LMS adoption (Law et al., 2018; Martin, 2008). Despite regularly teaching within the LMS, Mr L's limited exposure to its broader capabilities exemplifies this challenge.

The strategy played a pivotal role in expanding his familiarity with the platform, particularly by introducing tools he had previously overlooked. He acknowledged that certain functions "were hidden" and that he "did not know they existed" until the training. Examples include scheduled announcements, the block drawer, Quickmail, polls, the chat function, and BigBlueButton. This progression aligns with Walker's (2015) assertion that familiarity develops through active exposure and exploration, and that users are more willing to adopt technologies once uncertainty about unfamiliar features is reduced. As Mr L engaged with these previously unknown tools, his comfort increased, demonstrating how guided, hands-on practice strengthens digital awareness and reduces the cognitive barriers associated with low familiarity.

Importantly, Mr L's earlier unfamiliarity did not stem from resistance, but from a lack of structured opportunities to explore the system. He noted that prior training sessions "were not detailed enough" to improve familiarity. This observation aligns with literature indicating that "surface-level" or generic training does little to develop digital competence, particularly when educators lack opportunities to apply new skills in authentic teaching

contexts (Bhalalusesa et al., 2013; Edeh et al., 2022). In contrast, the strategy's design-featuring personalised LMS Sandpit practice, immediate feedback, and step-by-step demonstrations-created the conditions for familiarity to develop meaningfully. His statement that the strategy "opened my mind" to the LMS's possibilities reflects the value of such pedagogically aligned professional development.

The shift in familiarity is further evident in his newfound ability to "play with the outline" of the LMS. This phrasing is significant: confidence to explore, adjust, and experiment is a hallmark of increased digital familiarity and a precursor to autonomous LMS use. Calvani et al. (2008), cited in the literature review, emphasise that familiarity encompasses not only operational skill but also cognitive readiness and willingness to engage dynamically with technology. Mr L's transformation illustrates this shift, as he expressed readiness to integrate multiple tools-forums, chats, Quickmail, and BigBlueButton-because he now understands both their functionality and how they fit within his teaching workflow.

Finally, Mr L's increased familiarity with technology directly influenced his broader perceptions of ease of use, usefulness, and performance expectancy, demonstrating the conceptual validity of including this construct. He repeatedly noted that he now knows where tools are located, how they function, and how they support his pedagogical goals. This mirrors findings by Al Shehri et al. (2019), who argue that digital familiarity enhances not only current competence but also future adoption intentions, as users who understand a system's structure are better positioned to integrate it meaningfully into their teaching practice.

Overall, Mr L's reflections illustrate a substantial improvement in LMS familiarity. The strategy successfully moved him from partial awareness to confident and informed use, reducing uncertainty and broadening his capacity to implement diverse functionalities. His experience confirms the importance of familiarity within the conceptual framework, demonstrating that structured, personalised, and practice-based opportunities enable teacher educators to develop the digital fluency necessary for sustainable LMS adoption.

7.2.4.3 Dr E

Dr E's reflections reveal a significant transformation in his familiarity with the LMS, moving from fragmented, surface-level awareness to a coherent understanding of its structure, terminology, and functionalities. Within the conceptual framework, familiarity with technology functions as an additional facilitating condition that influences other acceptance constructs, and Dr E's experience aligns closely with this conceptualisation. Prior to the strategy, his operational familiarity was limited: he could use announcements and upload basic materials but lacked awareness of deeper functionalities, navigational logic, and integrated tools. This reflects a common phenomenon in which educators overestimate their digital competence by relying on familiar, repetitive tasks (Naveh et al., 2010; Kakasevski et al., 2008). Dr E's case exemplifies this, as he realised during the strategy that many tools he had assumed were "not available" were in fact simply unfamiliar to him.

A major aspect of his unfamiliarity was terminology. He admitted that he often knew "where to find things" but could not describe them or understand the technical language used in institutional communications. He stated that learning standard terms "helped quite a lot... because I could hear the terms that are being used" and finally follow instructions correctly. This aligns with literature discussed in Chapter 2 (Walker, 2015; Bhalalusesa et al., 2013), which highlights that unfamiliar digital vocabulary creates cognitive barriers, limits help-seeking, and inhibits exploration. By focusing on terminology in the first session, the strategy provided a critical foundation for developing genuine familiarity.

Dr E also acknowledged that prior to the strategy, he had no familiarity with tools such as polls, chat, Quickmail, pages, student-view preview, or content structuring. Even within frequently used tools like announcements, he admitted to only using "surface-level" features, unaware of multimedia embedding, availability settings, or formatting functions. He referred to these deeper functionalities as "hidden options," noting that he often observed colleagues using advanced features without understanding how they did so. This type of unfamiliarity contributes to shallow LMS engagement and reinforces the perception that technology is limited or rigid (Ifenthaler & Schweinbenz, 2016).

A pivotal moment in Dr E's familiarity development occurred when he discovered BigBlueButton. He acknowledged that he-and "most of our teacher educators"-were unaware that the LMS included a built-in synchronous teaching tool. Previously, he had relied on Microsoft Teams for live sessions, requiring multiple, inefficient steps. Learning about BigBlueButton not only filled a knowledge gap but reshaped his understanding of the LMS's potential, illustrating Mtebe and Raisamo's (2014) argument that underutilisation often stems from unfamiliarity rather than system inadequacy. The strategy effectively bridged this gap, showing how increased familiarity can unlock functionalities previously assumed absent.

The strategy strengthened Dr E's familiarity through demonstration-based learning, allowing him to see "where you are clicking" and understand each action visually. This approach reflects how experiential, guided practice develops digital fluency while reducing cognitive overload (Lin & Wang, 2012; Calvani et al., 2008). Through these sessions, he became more aware of the LMS's internal logic, including how sections relate to resources, how to preview sites from a student's perspective, and how integrated tools function within a unified platform.

Dr E's increased familiarity also enhanced his self-efficacy-the belief in his ability to explore and use tools independently. Following the sessions, he expressed confidence that he could "go and try the others" without guidance, indicating a shift from dependence to autonomy. Familiarity is closely linked to self-efficacy (Calvani et al., 2008); as educators' familiarity grows, they are more likely to experiment, adopt new tools, and sustain long-term LMS engagement.

Overall, Dr E's familiarity with technology expanded substantially through the structured, contextualised, and hands-on nature of the strategy. His experience illustrates the conceptual argument that familiarity encompasses not only operational skill but also language, conceptual understanding, system awareness, and the confidence to explore new functionalities. By addressing all these dimensions, the strategy positioned familiarity as a catalyst for improved ease of use, perceived usefulness, performance expectancy, and ultimately, a stronger behavioural intention to integrate LMS tools more fully into future teaching.

7.2.4.4 Dr M

Dr M's reflections indicate that his familiarity with technology prior to the strategy was relatively limited, primarily shaped by routine digital practices rather than purposeful exploration of advanced LMS functionalities. He described himself as someone who "used only the basics" and did not feel confident venturing beyond uploading resources or navigating the most elementary aspects of the platform. This aligns with literature showing that many educators in developing-country contexts possess basic digital skills—such as using email, accessing the internet, or handling simple administrative tasks—while lacking deeper exposure to pedagogically rich digital tools (Nawaz & Kundi, 2010; Edeh et al., 2022). Dr M's comment that he "did not know some of these things exist" mirrors Bhalalusesa, Lukwaro, and Clemence's (2013) observation that unfamiliarity with LMS functionalities often results not from inability, but from a historical absence of structured, hands-on professional development.

The strategy significantly broadened Dr M's technological familiarity by providing guided exposure to LMS elements he had never previously encountered. As he worked through tools such as BigBlueButton, embedded media announcements, structured resource organisation, forum settings, and messaging options, he gained clearer insight into the platform's capabilities. This reflects Calvani et al.'s (2008) model of digital literacy, which emphasises that familiarity grows through active exploration, cognitive engagement, and opportunities to try out tools in authentic contexts. Dr M explicitly valued being able to see the tools demonstrated and then practice them immediately, emphasising that this experiential approach helped "make sense" of features that had previously seemed overwhelming or invisible.

The LMS sandpit environment further deepened his familiarity by offering a protected, low-risk space to experiment. He could explore features, make mistakes, reattempt tasks, and test his understanding without fear of disrupting a live module or confusing students. This aligns with Sife et al.'s (2007) argument that low-risk digital environments are essential for developing confidence and fluency with new technologies. For Dr M, this safe space was pivotal in bridging the gap between previously limited familiarity and the more expansive digital competence he demonstrated following the strategy.

Another important aspect of Dr M's growing familiarity was his recognition of how LMS functionalities relate to broader pedagogical intentions. He emphasised that certain tools-particularly BigBlueButton for hosting and uploading sessions, and the communication tools for structured interaction-aligned directly with the teaching practices he wished to adopt. This shift from simple awareness to pedagogical application reflects the deeper stage of technological familiarity described by Edeh et al. (2022), where educators begin not only to use tools but to integrate them meaningfully into instructional design. Dr M's understanding evolved from "I didn't know this exists" to "this is helpful for my students," demonstrating a conceptual shift that supports long-term adoption.

Finally, Dr M noted that as he became increasingly familiar with the LMS, his confidence grew correspondingly, making him "more willing to try things on his own." This aligns with Bervell and Arkorful's (2020) finding that familiarity reduces anxiety, increases perceived ease of use, and strengthens behavioural intention. For Dr M, familiarity was not merely technical; it reshaped his professional mindset regarding what he could achieve within the LMS. His experience illustrates the strong reciprocal relationship between familiarity, ease of use, and the motivation to explore more advanced digital practices in future teaching.

7.2.4.5 Synthesis and interpretation of findings

Familiarity with Technology-added as an extension to TAM and UTAUT in this study-emerged as a decisive factor shaping how the four science teacher educators engaged with the LMS, both during and after the strategy. This construct encompasses educators' prior exposure to digital tools, their comfort with technological environments, and the extent to which past experiences facilitated or constrained their learning. As Law et al. (2018) note, digital familiarity forms the foundation for effective engagement with online learning platforms, enabling users to access, process, and apply digital information with confidence. In this study, participants' differing baseline familiarity levels significantly influenced their initial attitudes and the rate at which they adopted LMS functionalities during the strategy.

Across the cases, participants entered the strategy with uneven levels of digital readiness-a trend widely reported in developing-country contexts, where digital access,

exposure, and prior training are highly variable (Saudi et al., 2018; Mwakyusa & Mwalyagile, 2016). Those with greater comfort navigating everyday digital tools progressed more quickly during hands-on sessions, whereas participants with limited exposure required more scaffolding, repetition, and reassurance. This pattern aligns with Martin's (2008) view that digital literacy-and by extension, technological familiarity-is a combination of skills, attitudes, and knowledge that collectively influence an individual's ability to interact meaningfully with digital systems.

Despite these differences, all participants demonstrated notable growth in familiarity as the strategy unfolded. The opportunity to practise in a personalised LMS Sandpit site was particularly impactful, providing a low-risk environment that mirrored real teaching contexts while allowing participants to experiment without fear of making errors-a common barrier identified in the literature (Bhalalusesa et al., 2013). By reducing risk, the strategy encouraged participants to explore features they had previously avoided or been unaware of. Tasks such as embedding media in announcements, creating structured sections, setting up communication tools, and hosting synchronous sessions via BigBlueButton transformed from perceived "complex" activities (Naveh et al., 2010; Kakasevski et al., 2008) into familiar, manageable practices.

Familiarity increased not only with the tools themselves but also with the broader digital logic of the LMS. Participants became more confident navigating menus, understanding hierarchies, identifying where features are located, and predicting system responses-skills Calvani et al. (2008) describe as the technological and cognitive dimensions of digital literacy. This growth fosters transferable competence: once educators understand the structure of one LMS tool, they are better positioned to explore others independently. The resulting shift from dependence to autonomy represents a key indicator of increased familiarity and digital confidence.

Prior experiences also influenced how participants internalised new skills. Those who had historically relied on basic LMS functions-such as uploading files or checking announcements-began to articulate why they had previously avoided more advanced features. Consistent with Dahlstrom et al. (2014), limited familiarity had led to avoidance behaviours, reinforcing minimal LMS use. The structured progression of the strategy

disrupted this cycle by introducing tools gradually, modelling their pedagogical purpose, and providing guided practice-an approach literature identifies as highly effective for adult learners in technology-mediated environments (Edeh et al., 2022).

Importantly, gains in familiarity translated into broader shifts in professional identity and confidence. As participants became more comfortable with digital tools, they increasingly saw themselves as capable digital educators within an open distance learning environment. This aligns with Saripudin et al. (2021), who argue that structured exposure to technology can elevate educators' digital proficiency and self-efficacy, regardless of age or prior training. It also reinforces Venkatesh et al.'s (2003) proposition that familiarity moderates key UTAUT constructs-strengthening perceived ease of use, perceived usefulness, and ultimately, behavioural intention.

In summary, familiarity with technology emerged not merely as a background condition but as a transformative outcome of the strategy. The intervention effectively closed the familiarity gap among participants, strengthened their digital confidence, reduced anxiety, and enabled them to navigate the LMS with increasing independence. This enhanced familiarity served as a foundational enabler for broader shifts in ease of use, usefulness, performance expectancy, social influence, and behavioural intention-demonstrating its central role in sustainable LMS adoption within a South African open distance learning context.

7.3 Cross-Case synthesis of LMS strategy outcomes

The findings presented in this chapter demonstrate a consistent pattern across all four cases, despite differences in teaching experience, module level, student enrolment, and specialisation. Prior to implementation of the LMS enhancement strategy, participants generally relied on a limited range of LMS functionalities and reported challenges relating to confidence, familiarity with advanced tools, communication practices, and the perceived complexity of the platform. These findings were consistent with the challenges identified during Phase 1 and provided the foundation for the development of the strategy presented in Chapter 6.

Following implementation of the strategy, all participants reported positive changes in their perceptions and use of the LMS. Participants demonstrated increased confidence in

navigating the platform, greater familiarity with a wider range of LMS tools, and improved understanding of how these tools could be used to support teaching and learning. The guided and practical nature of the intervention contributed to improvements in perceived ease of use, while exposure to previously underutilised LMS functionalities enhanced perceptions of usefulness.

Furthermore, the strategy strengthened participants' willingness to experiment with LMS tools and encouraged more purposeful integration of communication, content delivery, and student engagement features. The inclusion of BigBlueButton as part of the intervention further expanded participants' awareness of opportunities for synchronous and asynchronous teaching within the LMS environment. Collectively, these findings suggest that structured, contextually relevant, and hands-on professional development can positively influence science teacher educators' engagement with Learning Management Systems in an open distance learning context.

Figure 7.2 provides a visual summary of the relationship between the Phase 1 findings, the LMS enhancement strategy, and the outcomes reported by participants following the implementation.

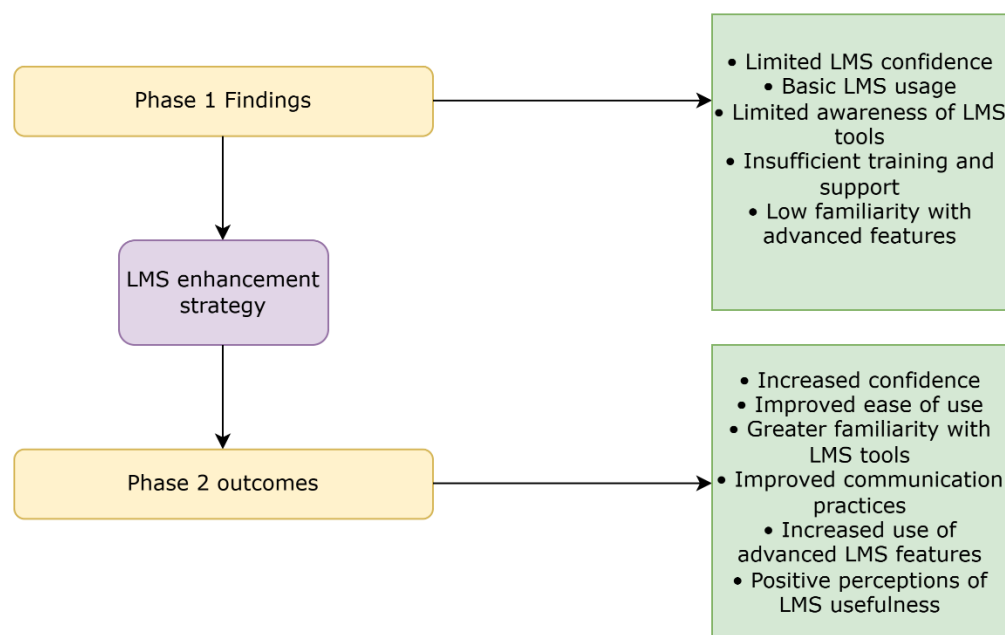


Figure 2.2 Summary of LMS Strategy Outcomes

7.4 Behavioural intention

Behavioural intention refers to an individual's willingness and commitment to continue using a technology in the future (Venkatesh et al., 2003). Within this study, behavioural intention was evident in participants' expressed plans to continue using LMS functionalities introduced during the intervention and to further expand their use of the LMS beyond basic administrative purposes.

Across all four cases, participants indicated that the strategy had influenced not only their perceptions of LMS ease of use and usefulness, but also their intentions regarding future LMS integration. Several participants expressed a commitment to incorporating tools such as discussion forums, announcements, communication features, and BigBlueButton into their teaching practice. These intentions reflected a shift from viewing the LMS primarily as a repository for learning materials towards recognising its potential as an interactive teaching and learning environment.

Dr K indicated an intention to make greater use of communication and engagement tools within her module, recognising their potential to improve interaction with students. Similarly, Mr L expressed interest in exploring additional LMS functionalities and integrating these into future module offerings. Dr E noted that the strategy had increased his confidence in using LMS tools and motivated him to continue experimenting with features that could enhance student engagement. Although Dr M acknowledged the need for additional practice and support, he nevertheless indicated a willingness to continue using the LMS and further develop his skills.

These findings suggest that the strategy contributed to positive behavioural intentions by reducing perceptions of complexity, increasing familiarity with technology, and enhancing perceptions of usefulness. The findings further indicate that behavioural intention was influenced by the interaction of multiple constructs within the conceptual framework. Improvements in effort expectancy, facilitating conditions, social influence, and familiarity with technology appeared to strengthen participants' willingness to continue engaging with LMS technologies.

The findings are significant because behavioural intention is widely regarded as an important precursor to actual technology use (Venkatesh et al., 2003). While the study

was not designed to measure long-term LMS usage behaviour, participants' stated intentions suggest that the strategy may have created conditions conducive to sustained LMS adoption. However, the extent to which these intentions translate into long-term behavioural change remains an area for future investigation.

7.5 Remaining challenges and areas of caution

Although the findings indicate positive shifts in participants' perceptions of LMS use following the implementation of the strategy, several challenges and areas of caution remained. These findings suggest that LMS adoption should be viewed as an ongoing developmental process rather than an immediate or complete transformation.

One challenge identified across participants was the need for continued support and opportunities for practice. While the strategy enhanced confidence and familiarity with several LMS functionalities, participants acknowledged that mastery requires repeated use over time. Dr M, in particular, noted that additional time would be required to fully engage with and integrate some of the tools introduced during the intervention. This suggests that short-term professional development interventions may initiate change but are unlikely to guarantee sustained adoption without ongoing reinforcement and support.

Participants also highlighted concerns relating to student digital readiness. Although the strategy focused on teacher educators, several participants observed that students may not be aware of available LMS functionalities or may lack the confidence and skills required to engage effectively with tools such as discussion forums, synchronous sessions, and communication features. Dr K specifically emphasised the need for student training and orientation, suggesting that educator adoption alone may not be sufficient to realise the full pedagogical benefits of the LMS.

Infrastructure and access-related challenges remained evident despite the positive experiences reported. Participants acknowledged that technology use is influenced by factors such as device availability, system reliability, internet connectivity, and broader socio-economic realities. Mr L referred to challenges associated with hardware limitations, while Dr M raised concerns regarding unequal access to technology among students in under-resourced contexts. These reflections reinforce the reality that LMS

adoption occurs within broader institutional and societal constraints that cannot be addressed solely through training interventions.

A further area of caution relates to the sustainability of behavioural change. The post-implementation interviews were conducted shortly after the completion of the strategy, capturing participants' immediate reactions and intentions. While participants expressed enthusiasm regarding future LMS use, it was not possible within the scope of this study to explore whether these intentions translated into sustained long-term practice. Continued use of advanced LMS functionalities may be influenced by competing workload demands, institutional priorities, evolving technological requirements, and ongoing access to support.

Finally, participants emphasised that effective LMS use requires pedagogical judgement rather than indiscriminate adoption of technological tools. Dr M cautioned against using LMS functionalities simply because they are available, arguing that technology should support pedagogical goals rather than drive them. This highlights the importance of ensuring that LMS adoption remains pedagogically purposeful and responsive to the needs of specific teaching and learning contexts.

Collectively, these findings suggest that while the LMS strategy positively influenced educator perceptions and confidence, meaningful and sustained LMS integration depends on continued support, student preparedness, institutional commitment, contextual realities, and pedagogically informed implementation.

7.6 Conclusion

In conclusion, this chapter has provided a detailed account of how the four science teacher educators experienced and responded to the LMS strategy, framed through the integrated TAM–UTAUT model and the added dimension of Familiarity with Technology. The findings demonstrate clear growth in participants' perceived ease of use, perceived usefulness, and performance expectancy as they engaged with scaffolded, hands-on training. The strategy not only reduced effort expectancy but also strengthened their confidence, digital self-efficacy, and pedagogical willingness to adopt a wider range of LMS functionalities.

Social influence operated subtly through peer modelling, professional expectations, and student needs, while facilitating conditions—including targeted support, tool visibility, structured demonstrations, and the LMS Sandpit—played a pivotal role in enabling meaningful adoption. Notably, familiarity with technology emerged as a critical lens for understanding disparities in digital readiness, highlighting how prior exposure, personal experience, and professional identity shaped each educator’s trajectory.

Collectively, the participants’ reflections illustrate that the LMS strategy functioned as both a developmental and transformative intervention, moving educators from surface-level, habitual LMS use toward a more intentional, confident, and pedagogically integrated digital practice. These insights provide a strong foundation for the interpretation, synthesis, and implications that will be discussed in the next chapter.

Chapter 8: Summary of findings and conclusion

8.1 Introduction

Chapter 8 provides a comprehensive synthesis of the study's findings, integrating the key insights generated across both phases of data collection and analysis. While Chapter 7 offered an in-depth, case-based examination of each participant's perceptions and experiences-structured around the constructs of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT)-this chapter moves from within-case analysis to a broader consolidation of what the study reveals about LMS adoption in science teacher education at an open distance learning institution.

The chapter begins by addressing the research questions directly, drawing on both pre-implementation (Phase 1) and post-implementation (Phase 2) data to illustrate how teacher educators' perceptions evolved, strengthened, or remained consistent throughout the study. It then examines the influence of the developed LMS usage strategy on adoption, highlighting the extent to which the strategy addressed previously identified barriers, needs, and enabling factors.

Subsequent sections discuss the study's conceptual, theoretical, and practical contributions to LMS adoption in science teacher education, particularly within the South African open distance learning context-a field with limited empirical research to date. The chapter also provides recommendations for practice, professional development, institutional policy, and future research, all grounded in the evidence generated across both phases.

The study's limitations are acknowledged to contextualise the scope, applicability, and transferability of the findings. Finally, the chapter synthesises the overarching implications, reflecting on how the research advances understanding of LMS adoption and contributes to strengthening digital pedagogical practices in higher education.

8.2 Answering the research questions

8.2.1 What are science teacher educators' perceptions of the ease of use and usefulness of the LMS for teaching and learning? (Phase 1)

The Phase 1 data revealed that science teacher educators held mixed perceptions of the LMS prior to the implementation of the strategy. While all participants recognised the platform's usefulness for storing content, distributing study materials, and administering assessments, their engagement was largely limited to basic functionalities. Perceived ease of use was notably constrained by the system's complexity, limited prior exposure, and inconsistent training-reflecting global trends in LMS adoption (Dahlstrom et al., 2014; Ssekakubo et al., 2011). Participants reported difficulties navigating advanced tools, uncertainty about where to locate features, and a lack of confidence when attempting unfamiliar functions.

Perceived usefulness was similarly limited by the participants' narrow use of the platform. Although they valued the LMS for uploading study guides, managing assessments, and centralising communication, they were largely unaware of features that could enhance interactivity, engagement, and synchronous teaching. As noted by Bhalalusesa et al. (2013) and Lavidas et al. (2022), perceptions of usefulness are often constrained when users lack exposure to a system's full capabilities.

Social influence played a varied role: some participants benefitted from collegial support, while others relied primarily on institutional policy mandates to engage with the LMS. Facilitating conditions-particularly training, institutional expectations, and technical support-were insufficient, contributing to inconsistent adoption and underscoring the need for a structured intervention.

Overall, Phase 1 demonstrated that teacher educators perceived the LMS as useful but difficult to use, with engagement shaped by limited familiarity, uneven or impersonal training, and constrained institutional support.

In response to these findings, the LMS strategy was developed to address the key challenges identified in Phase 1. The strategy focused on three major activities: uploading content, communicating with students, and using BigBlueButton-a tool for both

synchronous and asynchronous lessons directly within the LMS. The sessions were preceded by an introductory meeting and an orientation phase, which communicated expectations, provided an overview of the strategy's structure, and familiarised participants with basic LMS terminology and layout. This ensured a consistent baseline of understanding across all participants and set the stage for effective, hands-on engagement with the platform. Figure 8.1 illustrates the phases of the LMS strategy

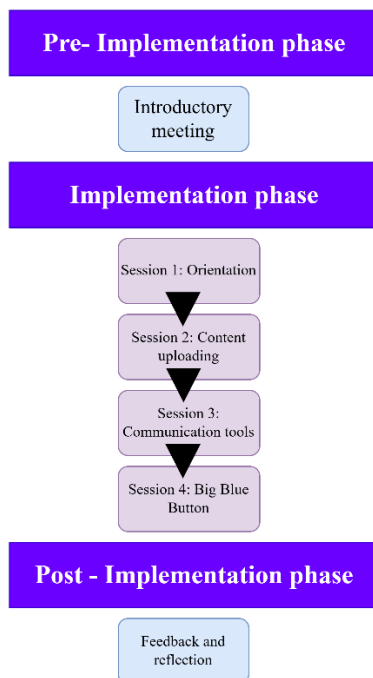


Figure 8.1: A diagrammatical representation of the structure of the LMS strategy

The feedback and reflection session, which took place after the implementation of the strategy, provided data relevant to answering the final research sub-question.

8.2.2 What are science teacher educator experiences of the LMS strategy?

The Phase 2 data demonstrated that the structured, step-by-step strategy had a significant positive impact on the science teacher educators' confidence, skills, and willingness to use the LMS more extensively. By employing a guided, experiential approach-including individual sandpit sites, personalised coaching, checklists, and reflection prompts-participants transitioned from surface-level use to deeper engagement with both basic and advanced functionalities.

Across the four cases, the strategy enhanced **Effort Expectancy**, as participants consistently reported that the LMS felt “easier” to use following the guided sessions. Exposure to previously underutilised features-such as forums, messaging tools, embedded multimedia announcements, and BigBlueButton-demonstrated that these functionalities were far less complex than initially perceived.

The strategy also strengthened **Performance Expectancy**, with all participants recognising the potential for improved teaching efficiency, clearer module organisation, enhanced communication, and more effective management of assessments. They further reported a better understanding of synchronous and asynchronous practices, supporting prior research that hands-on LMS training fosters purposeful pedagogical use (Panigrahi et al., 2018; Henderson et al., 2017).

Facilitating conditions improved markedly, as the strategy provided the structured guidance that had previously been lacking. Participants highlighted the value of the timing, pacing, and personalised nature of the sessions, noting that these elements addressed earlier frustrations with inconsistent or generic institutional training.

Finally, **Familiarity with Technology** increased across all four participants. Repeated practice, reflection, and hands-on experimentation enabled teacher educators to explore LMS tools independently, reinforcing findings that digital familiarity is a critical precursor to sustained technology adoption (Law et al., 2018; Edeh et al., 2022).

8.2.3 Achievement of the study aim

The aim of this study was to investigate science teacher educators' perceptions of Learning Management System (LMS) use within a South African higher education open distance learning context and to develop a strategy to enhance LMS adoption by addressing the challenges educators experience when using the system. The findings presented in Chapters 5 and 7 indicate that this aim was achieved. Phase 1 findings identified participants' perceptions of LMS ease of use and usefulness, together with the challenges influencing LMS adoption. These findings informed the development of the LMS enhancement strategy presented in Chapter 6. Phase 2 findings demonstrated that the strategy contributed positively to participants' confidence, familiarity with LMS tools, and willingness to integrate LMS functionalities into their teaching practices. The study

therefore achieved both its investigative and developmental objectives by generating an evidence-based strategy for enhancing LMS use among science teacher educators in an open distance learning context.

8.3 Contributions of the study

This study makes several important contributions to the field of teacher education, particularly within open distance learning environments. **First**, it advances empirical understanding of how science teacher educators engage with Learning Management Systems (LMS) by providing a multi-dimensional, construct-driven account of their perceptions, practices, and challenges. While much of the existing literature focuses on student use of LMS, this study foregrounds the often-overlooked role of science teacher educators, offering insights into their technological decision-making, pedagogical needs, and contextual constraints.

Second, the study contributes a practically tested LMS enhancement strategy, developed directly from empirical data and refined iteratively through a pilot implementation. This strategy addresses core constructs from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT)-including perceived usefulness, effort expectancy, facilitating conditions, and behavioural intention-while extending them to incorporate familiarity with technology, a construct particularly relevant in science education where digital confidence varies widely among educators.

Thirdly, the study offers a contextually grounded contribution to the transformation of South African science teacher education through the integration of ICT. It highlights structural barriers such as digital literacy gaps, institutional pressures, and uneven support systems, while demonstrating how targeted, scaffolded interventions can shift teacher educator practice toward more interactive, student-centred, and digitally supported pedagogies. These insights have practical implications for institutional policy, the design of professional development programmes, and future research on technology integration in science teacher education, both locally and in similar developing-world contexts.

Finally, from a theoretical perspective, the study contributes to the ongoing application of TAM and UTAUT within higher education technology adoption research. The findings

suggest that familiarity with technology functions as an important enabling factor that influences educators' perceptions of effort expectancy, perceived ease of use, and ultimately their willingness to engage with LMS technologies. By incorporating familiarity with technology into the adapted conceptual framework, the study extends existing technology acceptance models within the context of science teacher education and open distance learning. The findings further demonstrate that LMS adoption is influenced not only by perceptions of usefulness and ease of use, but also by opportunities for guided practice, contextualized support, and repeated exposure to technology, highlighting the importance of professional development processes in technology acceptance.

8.4 Recommendations for practice

Because facilitating conditions emerged as a major barrier to LMS adoption during Phase 1, institutions should provide structured and continuous LMS training for teacher educators rather than relying on one-off workshops. The findings demonstrated that personalised, hands-on support contributed significantly to increased confidence and LMS engagement. Institutions should therefore embed ongoing professional development opportunities into routine academic practice to support sustained technology adoption.

Given the importance of social influence and collegial support identified across both phases of the study, departments should establish formal and informal peer-support mechanisms that encourage collaboration, knowledge sharing, and the exchange of effective LMS practices. Participants frequently indicated that collegial learning and access to experienced colleagues positively influenced their willingness to engage with LMS technologies.

In response to participants' concerns regarding student digital readiness, institutions should provide targeted LMS orientation and digital literacy support for students. Several participants indicated that limited student competence and confidence may reduce the effectiveness of LMS-based teaching and learning activities, suggesting that successful LMS adoption requires support for both educators and students.

Because participants reported increased usefulness of BigBlueButton and other interactive LMS functionalities following the intervention, institutions should encourage

the integration of synchronous teaching tools within the LMS environment. Embedding communication, collaboration, and live teaching functionalities within a single platform may reduce platform fragmentation and enhance the overall teaching and learning experience.

The findings further demonstrated that opportunities for experimentation and guided practice enhanced familiarity with technology and reduced perceptions of LMS complexity. Academic units should therefore create opportunities for educators to explore LMS tools in low-risk environments where mistakes are viewed as part of the learning process. Consistent module design templates and access to sandbox environments may further support educator confidence and LMS engagement.

Finally, because positive behavioural intentions were strengthened through recognition, support, and successful experiences with LMS tools, institutions should consider recognising and rewarding effective LMS use. Formal and informal recognition mechanisms may reinforce continued engagement and contribute to the development of a sustainable culture of digital teaching excellence.

8.5 Recommendations for further research

The present study was conducted with four science teacher educators within a single South African open distance learning institution. Future research should investigate the applicability and effectiveness of the LMS enhancement strategy across a broader range of disciplines, institutions, and educational contexts to determine its transferability and adaptability.

Given that the post-implementation phase captured participants' experiences shortly after completion of the intervention, longitudinal research is recommended to examine the sustainability of changes in LMS perceptions, behavioural intention, and actual LMS use over time. Such studies could explore whether the positive shifts observed in this study are maintained over extended periods and identify factors that support or hinder long-term adoption.

Future studies could also investigate the impact of the strategy on student learning experiences and engagement. While this study focused on science teacher educators,

understanding how changes in educator LMS practices influence student participation, satisfaction, and academic outcomes would provide valuable insights into the broader educational impact of LMS adoption.

In addition, comparative studies involving larger samples and different institutional settings could be conducted to explore how contextual factors such as organisational culture, infrastructure, institutional support, and disciplinary differences influence LMS adoption. Mixed-methods studies may further strengthen understanding by combining qualitative insights with quantitative measures of LMS usage and engagement.

Finally, future research could examine the role of emerging educational technologies, including artificial intelligence–supported tools, learning analytics, and adaptive learning systems, in enhancing LMS adoption and pedagogically meaningful technology integration within open distance learning environments.

8.6 Limitations of study

This study was conducted with a small group of four science teacher educators, which, while appropriate for a multi-case study design, limits the generalizability of the findings beyond similar open distance learning contexts. The availability of participants posed a significant constraint, as their demanding workload and competing academic responsibilities affected the scheduling and pacing of both the training sessions and post-implementation interviews. This may have influenced the depth of engagement with certain LMS functionalities.

Additionally, the study relied heavily on self-reported data, which may be subject to recall bias or the desire to present favourable responses. The research was also confined to a single LMS platform within one institution, meaning that the strategy and findings may not fully translate to institutions using different digital ecosystems or support structures.

While the findings may offer insights relevant to other open distance learning environments, the study was exploratory in nature and was not intended to produce statistically generalizable findings. The transferability of the LMS strategy to other institutional contexts may depend on factors such as organizational culture, technological infrastructure, institutional support structures, and educator readiness. Consequently, the

strategy should be adapted and evaluated within different contexts before broader implementation.

Although observations and interviews strengthened the credibility of the data, the researcher's active role during training sessions may have unintentionally influenced participants' confidence or behaviour. The researcher's prior involvement in LMS support within the institution may have influenced participant responses and interactions. Although measures were implemented to enhance trustworthiness and minimize bias, the possibility that participants may have viewed the researcher as an LMS expert or support provider cannot be entirely excluded.

Lastly, the post-implementation interviews were conducted shortly after the completion of the LMS strategy. Consequently, the study was able to capture immediate changes in perceptions and reported practices but could not determine whether these changes were sustained over an extended period. Future research should incorporate longitudinal follow-up studies to investigate the durability of LMS adoption and behavioral change over time.

8.7 Conclusion

This study explored science teacher educators' perceptions of LMS usefulness and ease of use within a South African open distance learning institution and developed a targeted strategy to enhance their digital engagement. Initial findings revealed limited LMS adoption, driven by perceived complexity, low digital confidence, and insufficient institutional support. In response, a structured, hands-on LMS enhancement strategy was designed and implemented. Post-implementation results showed notable improvements in educators' confidence, familiarity with advanced LMS functionalities, and appreciation of the platform's pedagogical potential. The strategy also fostered positive shifts in behavioral intention, demonstrating that personalised, context-specific professional development can meaningfully strengthen LMS adoption in distance science education. Overall, the study contributes a practical and replicable model for building digital teaching capacity in open distance learning environments and highlights the critical role of sustained training, institutional alignment, and user-centered support in realizing the transformative potential of LMS tools in science education.

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Appendices

APPENDIX A: Ethics certificate



UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2024/03/13

Ref: 2024/03/13/62224077/23/AM

Name: Ms J Broadhurst

Student No.: 62224077

Dear Ms J Broadhurst

Decision: Ethics Approval from
2024/03/13 to 2029/03/13

Researcher(s): Name: Ms J Broadhurst
E-mail address: 62224077@mylife.unisa.ac.za
Telephone: 0824115120

Supervisor(s): Name: Prof AV Mudau
E-mail address: mudauav@unisa.ac.za
Telephone: N/A

Name: Mr S Mampa
E-mail address: mampas@unisa.ac.za
Telephone: N/A

Title of research:

**A STRATEGY FOR USING LEARNING MANAGEMENT SYSTEMS IN SCIENCE TEACHER
EDUCATION IN A SOUTH AFRICAN DISTANCE LEARNING UNIVERSITY**

Qualification: PhD Natural Science Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2024/03/13 to 2029/03/13.

*The **low risk** application was reviewed by the Ethics Review Committee on 2024/03/13 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.



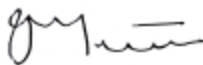
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2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2029/03/13**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **2024/03/13/62224077/23/AM** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,



Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
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APPENDIX B: Permission to use employees



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

30 May 2024

Decision: Permission approval 30
May 2024 to 13 March 2029
(Aligned to the Institution's ethics
certificate)

Ref #: 2024_RPC_035
Ms Jodi-Leigh Broadhurst
90392485/ #62224077

Principal Investigator:

Ms Jodi-Leigh Broadhurst
School of Teacher Education
CEDU
62224077@mylife.unisa.ac.za / ebroadj@unisa.ac.za ; 0824115120

Supervisor: Prof Awelani V. Mudau; mudauav@unisa.ac.za; 0727062710

A Strategy for Using Learning Management Systems in Science Teacher Education at a South African Distance Learning University

Your application regarding permission to involve Unisa staff, students and data in respect of the above study has been received and was considered by the Research Permission Subcommittee (RPSC) of the UNISA Senate, Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC) on 21 May 2024.

I am pleased to inform you that permission has been granted for the study. You may invite lecturers in the Department of Science and Technology Education (n=5) to participate in a voluntary online interview and online questionnaire. You may access the Unisa staff directory for their e-mail addresses.

Adherence to the National Statement on Ethical Research and Publication practices, principle 7 referring to Social awareness, must be promoted: " Researchers and institutions must be sensitive to the potential impact of their research on society, marginal groups or individuals, and must



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consider these when weighing the benefits of the research against any harmful effects, with a view to minimising or avoiding the latter where possible."

The personal information made available to the researcher(s)/gatekeeper(s) will only be used for the advancement of this research project as indicated and for the purpose as described in this permission letter. The researcher(s)/gatekeeper(s) must take all appropriate precautionary measures to protect the personal information given to him/her/them in good faith and it must not be passed on to third parties. The dissemination of research instruments through the use of electronic mail should strictly be through blind copying, so as to protect the participants' right of privacy. The researcher hereby indemnifies UNISA from any claim or action.

Note: The reference number **2024_RPC_035** should be clearly indicated on all forms of communication with the intended research participants and the Research Permission Subcommittee.

Kind regards,



Dr Retha Visagie – Deputy Chairperson

Email: visagrg@unisa.ac.za, Tel: (012) 429-2478

Prof Lessing Labuschagne – Chairperson

Email: llabus@unisa.ac.za, Tel: (012) 429-6368

APPENDIX C: Phase 1 Science Teacher Educator interview protocol

Perceived Ease of Use

Effort Expectancy

Interface

- 1.** What was your initial reaction to the LMS interface?
- 2.** Could you detail aspects of the LMS interface that are user-friendly?
- 3.** Could you detail aspects of the LMS interface challenging?

Learning Curve

- 4.** How long did it take before you were comfortable with the LMS? In the questionnaire you had indicated more than 4 months
- 5.** What were the key challenges you encountered during the learning process of the LMS?

Complexity

- 6.** You had indicated in the questionnaire that you find the LMS to be “somewhat complex”. On a scale of 1-10, one being not complex at all, 10 being extremely complex, could you rate the complexity of the LMS?
- 7.** Are there any features of the LMS that you found notably complex?
- 8.** Are there any features of the LMS that you found notably straightforward?

Facilitating Conditions

Technical Support

- 9.** How would you describe the technical support provided?
- 10.** Can you recall a time when technical support was particularly helpful or problematic?

Resource Accessibility

- 11.** How easy is it to locate and access needed resources/activities within the LMS?
- 12.** Are there resources you need that are not available in the LMS?

Infrastructure

- 13.** Do you believe the technological infrastructure offered by your institute is sufficient for your needs?
- 14.** Have you faced any technical problems that affected/influenced your LMS usage?

Familiarity with Technology

Prior Experience

15. How has your past experience with similar technologies influenced your LMS usage?
16. What are the most striking similarities or
17. differences compared to other platforms you've used?
18. How would you rate the effectiveness of the LMS training? 1-10
19. What training elements could be enhanced to better support educators?

Self-Efficacy

20. How confident are you in your ability to effectively use the LMS?
21. Could you share an instance where you overcame a challenge using the LMS?

Perceived usefulness

Performance Expectancy

Teaching Efficiency

1. How has the LMS aided in the planning, execution, and assessment of your lessons/module? Please provide examples.

Student Engagement

2. What has been the effect/influence of the LMS on student engagement in your courses?

Content Delivery

3. How useful is the LMS in delivering educational content? What features stand out as particularly beneficial or inadequate?

Social Influence

Collegial Endorsement

4. How have your colleagues' recommendations affected/influence your use of the LMS?

Institutional Support

5. How do institutional policies and support influence your use of the LMS? Can you provide an example?

Recognition

6. How does institutional recognition of LMS usage influence your use of it? Does it motivate you to utilize it more effectively?

Familiarity with Technology

Digital Literacy

7. Describe how your comfort level and proficiency with digital tools and how it impacts/relate to your LMS usage. 1-10 extreme

Innovativeness

8. How open are you to adopting new technologies in your teaching?

APPENDIX D: Phase 1 questionnaire

Biographical Information:

1. Age:

- ☐ Under 30
- ☐ 30-39
- ☐ 40-49
- ☐ 50-59
- ☐ 60 or older
- ☐ 65 or older

2. Gender:

- ☐ Male
- ☐ Female
- ☐ Prefer not to say
- ☐ Other (please specify)

3. Years of tertiary Teaching Experience:

- ☐ Less than 1 year
- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ More than 20 years

4. Have you received formal training on using LMS?

- ☐ Yes
- ☐ No

Perceived Ease of Use:

5. How would you rate the user-friendliness of the LMS interface?

- Very difficult
- Difficult
- Neutral

- Easy
- Very easy

6. How much time did it take you to become proficient in using the LMS?

- Less than a week
- Less than a month
- 2-4 months
- More than 4 months
- I still do not feel proficient

7. How complex do you find the LMS to be?

- Very complex
- Somewhat complex
- Neutral
- Somewhat simple
- Very simple

8. Is technical support readily available when you encounter issues with the LMS?

- Always
- Often
- Sometimes
- Rarely
- Never

9. How accessible are the necessary resources/tools within the LMS?

- Very inaccessible
- Somewhat inaccessible
- Neutral
- Somewhat accessible
- Very accessible

10. How adequate is the technological infrastructure supporting the LMS?

- Very inadequate

- Somewhat inadequate
- Neutral
- Somewhat adequate
- Very adequate

11. Based on your previous experience with similar technologies, how easy was it to learn to use the LMS?

- Very difficult
- Difficult
- Neutral
- Easy
- Very easy

12. How effective was the training provided for the LMS?

- Not effective at all
- Slightly effective
- Moderately effective
- Very effective
- Extremely effective

13. How confident are you in your ability to use the LMS effectively?

- Not confident at all
- Slightly confident
- Moderately confident
- Very confident
- Extremely confident

14. How often do you use the LMS for teaching?

- Daily
- Several times a week
- Once a week
- A few times a month

- Rarely

15. For which of the following activities do you primarily use the LMS? (Select all that apply)

- Disseminating course materials
- Assigning and collecting homework
- Conducting quizzes and exams
- Facilitating discussions
- Tracking student progress
- Communicating important information
- Other (please specify)

16. Do you integrate multimedia content (videos, podcasts, etc.) into your LMS-based lessons?

- Yes
- No
- Occasionally
- I am not sure

17. Do you utilize the LMS's communication tools (e.g., announcements, messaging) to interact with students?

- Frequently
- Sometimes
- Rarely
- Never

18. How do you assess student engagement and participation within the LMS?

- Through built-in analytics and reporting tools
- By monitoring assignment submissions
- By tracking discussion participation
- I do not assess engagement through the LMS
- Other (please specify)

19. Have you customized the LMS interface or settings to better suit your teaching style?

- Yes, extensively
- Yes, but only minor changes
- No, I use the default settings

Perceived Usefulness

21. How do you rate the contribution of the LMS to the efficient planning of your lessons?

- Very Inefficient
- Inefficient
- Neutral
- Efficient
- Very Efficient

22. To what extent has the LMS enhanced the execution of your lessons?

- Not at all
- Slightly
- Moderately
- Greatly
- Exceptionally

23. How effective do you find the LMS in the assessment of student performance?

- Very Ineffective
- Ineffective
- Neutral
- Effective
- Very Effective

24. What impact has the LMS had on student participation and interaction in your courses?

- No Impact
- Minimal Impact
- Moderate Impact

- Significant Impact
- Unsure

25. Rate the effectiveness of the LMS in delivering educational content:

- Very Ineffective (1 star)
- Ineffective
- Neutral
- Effective
- Very Effective (5 stars)

26. How much do your colleagues' recommendations influence your decision to adopt the LMS?

- Not at all
- Slightly
- Moderately
- Greatly
- Entirely

27. How significant is the role of institutional policies and support in your use of the LMS?

- Not significant
- Slightly significant
- Moderately significant
- Very significant
- Extremely significant

28. Does recognition of the use of LMS by your institution influence how you use it?

- Not at all
- Slightly
- Moderately
- Greatly
- Entirely

29. How comfortable are you with using digital tools and platforms for teaching?

- Not comfortable
- Slightly comfortable
- Moderately comfortable
- Very comfortable
- Extremely comfortable

30. How willing are you to adopt new technologies and integrate them into your teaching?

- Not willing
- Slightly willing
- Moderately willing
- Very willing
- Extremely willing

APPENDIX E: Phase 2 Interview guidelines Science teacher educator

- How would you describe your overall experience of participating in the LMS enhancement strategy and its relevance to your teaching practice?
- How did the orientation and initial sessions influence your comfort with LMS interface, layout, and navigation?
- Which aspects of using the LMS felt intuitive, and which required more support or practice?
- Compared to before the strategy, how would you now describe your confidence and familiarity with LMS core tools?
- How did learning to upload, organise, and manage content influence the way you now plan and deliver your online courses?
- Which LMS tools (content, communication, or BigBlueButton) do you find most useful for promoting engagement and interactivity in ODeL contexts?
- Have you integrated any of these tools into your live teaching since the sessions? If so, what impact have you noticed?
- What types of institutional, peer, or technical support helped you use the LMS effectively during the strategy?
- What obstacles-such as bandwidth, platform limitations, or time constraints-affected your ability to use these tools fully?
- Which tools or practices from the strategy are you most likely to continue using, and why?
- What kind of ongoing support or training would help sustain or extend your LMS use?
- In what ways has participating in this strategy influenced your confidence, teaching identity, or approach to technology-enhanced learning?
- What improvements would you recommend for future iterations of this strategy to make it even more effective?

APPENDIX F: Information letter to participants

Dear XXX

I, Jodi-Leigh Broadhurst, am conducting research under the supervision of Professor Awelani V Mudau, a Professor in the Department of Science and Technology Education towards a PhD at the University of South Africa. My study is also co-supervised by Mr S Mampa, a lecturer in the same department. I am seeking permission for you to be a participant in my study entitled "**A Strategy for Using Learning Management Systems in Science Teacher Education in a South African Open distance learning University**" at the University of South Africa.

This letter serves as an information letter, providing you with an overview of the study and data collection process, which will inform your consent to be a participant.

The main aims of this study are to investigate science teacher educators' perceptions of the use of **Learning Management Systems (LMS)** in a South African higher education, open distance learning context, with the goal of developing a strategy to improve the use of these LMS by mitigating any challenges perceived by teacher educators when using the system.

These aims will be achieved through realizing the following objectives:

- Identifying science teacher educators' **perceived ease of use** of LMS in open distance education.
- Identifying the **perceived usefulness** of LMS in open distance education
- Investigating the science teacher educator experiences of the implementation of the developed strategy for using LMS in open distance education.

The Department of Science and Technology Education has been selected for its relevance to the research focus.

The study will involve the following procedures:

1. **Questionnaires:** Utilized for basic profiling and gathering baseline information. They will inform interview questions and serve as a diagnostic tool for understanding teacher educators' opportunities and challenges in using LMS.

The questionnaire will be the first step in data collection and will be conducted using a link to a Microsoft form.

2. **Interviews:** Semi-structured interviews will be conducted to obtain rich descriptive data, corroborate questionnaire responses, and explore additional lines of inquiry. The interview transcripts will be made available to each participant to ensure accuracy of the information captured.

Interviews will take place twice-before the development of the strategy to gather information on teacher educator opportunities and challenges, and then again post-implementation of the strategy to gather data which reflects the teacher educator experiences of the strategy implementation. All interviews will be conducted on Microsoft Teams.

3. **Observations:** Structured observations conducted on-site (**on the XXX module site**) to supplement interview data, aiming to gain evidence of the influence of the LMS strategy on educators' utilization of the platform. The data collection will take place directly on the module site, in the absence of the participant and observation notes will be readily available to all participants.

Figure 1 below shows the process of data collection from the initial questionnaire to the final interview.

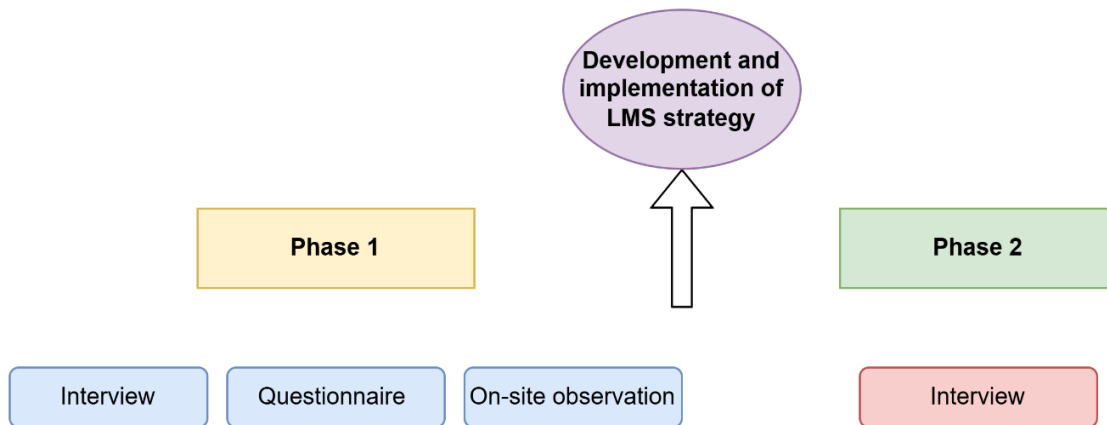


Figure 1: A diagrammatical representation of the data collection process

The study will involve a sample size of 5 lecturers from the Department of Science and Technology Education as participants. Your consent as a participant will fill the role of one participant in the sample.

There will be no reimbursement or any incentives for participation in the research. The feedback procedure will entail:

-Individual Reports: Participants may receive individualized reports summarizing their own responses or insights from the research activities in which they participated. These reports can offer personalized feedback and insights specific to each participant's contributions.

-Feedback Sessions: Dedicated feedback sessions may be organized where participants have the opportunity to engage directly with the researchers to discuss the findings, ask questions, and provide input. These sessions can facilitate dialogue, clarification, and deeper understanding of the research outcomes among participants.

If you have any questions, please do not hesitate to ask

Yours sincerely,

Jodi-Leigh Broadhurst

62224077@mylife.unisa.ac.za

+27 82 411 5120

APPENDIX G: Informed consent

Developing a Strategy for the Implementation of LMS in Science Teacher Education

Researcher's Name: Jodi -Leigh Broadhurst

Contact Information: Email: 62224077@mylife.unisa.ac.za Cell: 08241151520

Introduction:

You are invited to participate in a research study examining the perceptions of science teacher educators in using Learning Management Systems (LMS) in open distance education. Please take the time to read this document carefully and ask any questions you may have before deciding to participate.

Purpose of the Study:

The main aims of this study are to investigate science teacher educators' perceptions of the use of **Learning Management Systems (LMS)** in a South African higher education, open distance learning context, with the goal of developing a strategy to improve the use of these LMS by mitigating any challenges perceived by teacher educators when using the system.

Procedures:

If you agree to participate, you will be asked to:

1. Complete a questionnaire regarding your experiences and perceptions related to LMS.
2. Participate in a semi-structured interview to explore in-depth your opportunities and challenges when using LMS.
3. Grant permission for the interviews to be recorded for accurate transcription and analysis.
4. After the strategy implementation, participate in a second semi-structured interview to share your experiences and feedback regarding the strategy's impact on LMS usage.
5. Allow the researcher to make on-site observations of your module site for: **XXX**

Risks and Benefits:

There are minimal risks associated with this study, primarily related to the inconvenience of participating in interviews. The benefits include contributing valuable insights to the development of a strategy to enhance the use of LMS in science education and potentially improving overall teaching practices.

Confidentiality:

Your identity will be kept confidential to the extent permitted by law. Personal information will not be disclosed in any publications or presentations resulting from this study.

Participation:

Participation in this study is entirely voluntary. You may refuse to participate or withdraw at any time without penalty.

Consent:

I have read and understood the information provided above. I voluntarily agree to participate in this study and give permission for the recording of interviews, including the second interview post-strategy implementation.

Participant's Name: _____

Date: _____

Additional Information:

If you have any questions or concerns about the study, please contact the researcher, Jodi-Leigh Broadhurst, at Email: 62224077@mylife.unisa.ac.za or on 0824115120. If you have concerns about the conduct of the study or your rights as a participant, please contact the Research Ethics Committee at UNISA

APPENDIX H: Session Checklists

Step 1: Orientation

Objective: Familiarise with the LMS interface, navigation, and course layout.

Task	Description	Completed (✓)	Notes
Watch orientation video	View the 5-minute introduction video		
Log in to LMS	Use your login credentials to access your Moodle account		
Access course shell	Open your practice site		
Activate “edit mode”	Navigate towards edit mode and turn it on		
Explore dashboard	Identify navigation drawer, course blocks, and main content area		
Navigate Announcements	Click on 'Announcements' to see updates		
Check Grades	Click on 'Grades' to view where results appear		
View Participants	Open 'Participants' to see the course roster		
Explore Resources	Identify where files, readings, or activities are uploaded		

Note useful tools	Make notes of useful tools (e.g., quizzes, forums)		
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Reflection:

- Any feature I found easy to use/locate: _____
- Any feature I found confusing: _____

Step 2: Content Uploading

Objective: Upload and organise learning materials using folders, files, and labels.

Step 2: Content Uploading – Checklist

Task	Description	Completed (✓)	Notes
Watch tutorial	View the tutorial on content uploading.		
Turn Editing On	Enable editing mode in your course.		
Locate Topic Section	Scroll to the section where you want to upload content.		
Edit Topic Section	Rename or edit an existing section if needed.		
Delete Sections (Optional)	Remove any sections not needed.		
Create Topic Section	Add a new topic section at the bottom of the course page.		
Add File	Upload a single resource file (e.g., PDF, Word, PPT).		
Add Folder	Upload multiple files grouped into one folder.		
Check Uploaded Files	Ensure all files open correctly for students.		
Add Label/ Text or media area	Insert short instructions or summaries directly into the course page.		
Add Page	Create a standalone page for longer content with text, media, or links.		

Organise Content	Use the Move tool to rearrange items logically.		
Review Layout	Preview in Student View to ensure it appears correctly.		
Reflection	Note what was simple and what required more effort.		

Reflection:

- Any aspect that was simple: _____
- Any aspect that required more effort: _____

Step 3: Communication Tools – Checklist

Objective: Use Moodle’s communication tools to inform, engage, and support students effectively.

Task	Description	Completed (✓)	Evidence / Notes
Watch tutorial	View the tutorial video on communication tools		
Create Announcement	Post a new announcement in the Announcements forum		
	Add a table to your announcement		
	Change font colour		
	Add a sound recording to your announcement		
Create a Q&A Forum	Add a Q&A Forum for content-related questions		
	Add a thread		
	Read a reply and respond		
Send an Individual Message	Use Participants → Message to contact a student/ member of module site		
Use Quickmail	Use Quickmail block to email		

	selected students or groups		
Use Chat (synchronous)	Add a Chat activity for real-time discussions		
	Reply to a message		
Run a Quick Poll	Add Choice activity to collect feedback or preferences		
Check Student View	Switch role to Student and confirm visibility		

Reflection

- Benefit/s of using communication tools/ positive reflection:

- Challenge/s experienced: _____

Step 4: Using BigBlueButton for Live Teaching and Attendance Tracking

Task	Description	Completed (✓)	Evidence / Notes
Watch tutorial	View the tutorial on using BigBlueButton		
Access BigBlueButton	Navigate to course page and click “BigBlueButtonBN” activity		
Create Session	Enter session name and enable recording option		
Join Session	Click “Join Session” to open virtual classroom		
Share Screen	Use share screen icon to present slides or desktop		
Use Chat	Open chat panel to communicate with participants		
End Session	Click end meeting to close session and save recording		
Download Attendance	Access reports tab and download attendance report		
Access Recording	Go to BigBlueButton activity and view recording link		

Reflection

- Benefit/s observed: _____

• Challenge/s experienced: _____

APPENDIX I: Data analysis scheme

Phase 1

Research question	Theme	Category	Sub- Categories
What are the factors that influence science teacher educators perceived ease of use of LMS in open distance education?	Perceived ease of use	Effort expectancy	Intuitive Design: How user-friendly and intuitive is the LMS interface?
			Learning Curve: The time and effort required for teacher educators to become proficient in using the LMS
			Complexity: Teacher educators' perceptions of the complexity/simplicity of the LMS
		Facilitating conditions	Technical Support: Availability and quality of technical support for teacher educators. Resource Accessibility: Ease of access to necessary resources within the LMS

			Infrastructure: Adequacy of the technological infrastructure supporting the LMS.
		Familiarity with technology	Prior Experience: Previous experience with similar technologies or LMS platforms.
			Technology Training: Availability, attendance and effectiveness of training programs for the LMS.
			Self-Efficacy: Educators' confidence in their ability to use the LMS effectively.
What are the factors that influence science teacher educators	Perceived usefulness	Performance Expectancy	Teaching Efficiency: How LMS contributes to efficient planning, execution, and assessment of lessons.

perceived usefulness of LMS in open distance education?			Student Engagement: The impact of LMS on student participation and interaction.
			Content Delivery: The effectiveness of LMS in delivering educational content
		Social Influence	Collegial Endorsement: The extent to which colleagues' recommendations influence the adoption of the LMS.
			Institutional Support: The role of institutional policies and encouragement in the use of the LMS.
			Recognition: What role does the recognition of the use of LMS influence how it is used?

		Familiarity with technology	Digital Literacy: The level of comfort and skill with digital tools and platforms Innovativeness: The willingness to adopt new technologies and explore their potential in education.
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Phase 2

What are the science teacher educator experiences of the implementation of the strategy for using learning management systems in open distance education?	Theme	Category
	Perceived ease of use	Effort expectancy
		Facilitating conditions
		Familiarity with technology
	Perceived usefulness	Performance Expectancy
		Social Influence
		Familiarity with technology

APPENDIX J: Turnitin report

Similarity Report	
PAPER NAME	AUTHOR
62224077 Ms J Broadhurst Thesis.docx	JODI-LEIGH BROADHURST
WORD COUNT	CHARACTER COUNT
68529 Words	417973 Characters
PAGE COUNT	FILE SIZE
260 Pages	1.4MB
SUBMISSION DATE	REPORT DATE
Jan 14, 2026 11:43 AM GMT+2	Jan 14, 2026 11:48 AM GMT+2
15% Overall Similarity	
The combined total of all matches, including overlapping sources, for each database.	
• 9% Internet database • 13% Publications database • Crossref database • Crossref Posted Content database • 10% Submitted Works database	
Excluded from Similarity Report	
• Manually excluded sources	

APPENDIX K: CERTIFICATE OF EDITING



Shiraz 16
50 Quail Avenue
Thatchfield Close
Centurion, Pretoria
0157

Date: 13 January 2026

To whom it may concern

This letter confirms that the Thesis entitled **"A STRATEGY FOR USING LEARNING MANAGEMENT SYSTEMS IN SCIENCE TEACHER EDUCATION IN A SOUTH AFRICAN OPEN DISTANCE LEARNING UNIVERSITY"** written by **JODI-LEIGH BROADHURST** has been edited by Sam Ramaila.

Sincerely,

Sam Ramaila

Sam Ramaila (PhD)
Cell: 0646566387