AN EVALUATION OF THE EFFECTIVE USE OF MOODLE AS A LEARNING MANAGEMENT SYSTEM AT NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

Dissertation Manuscript

Submitted to Unicaf University
in partial fulfillment of the requirements
for the degree of

Doctor of Philosophy (Ph.D.) in Education

Jacqueline Teresa Charmaine Bock

October 2022

Approval of the Thesis

AN EVALUATION OF THE EFFECTIVE USE OF MOODLE AS A LEARNING MANAGEMENT SYSTEM AT NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

This Thesis by Jacqueline Teresa Charmaine Bock has been approved by the committee members below, who recommend it be accepted by the faculty of Unicaf University in partial fulfilment of requirements for the degree of

Doctor of Philosophy (Ph.D.) in Education

Thesis Committee:

Dr Muraina Kamilu Olanrewaju, Supervisor

Dr Elena Papadopoulou, Chair

Dr Aletta Mwenen Hautemo, External examiner

Dr Leonorah Nyaruwata, Internal examiner

Abstract

AN EVALUATION OF THE EFFECTIVE USE OF MOODLE AS A LEARNING MANAGEMENT SYSTEM AT NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

Jacqueline Teresa Charmaine

Unicaf University

The Namibia University of Science and Technology (NUST) has been challenged to fully realise the advantages of the university's learning management system. NUST implemented the Modular Object-Oriented Dynamic Learning Environment (Moodle) in 2011; however, students' performance levels have not increased as anticipated. The theoretical framework that underpinned this study included Khan's Octagonal Framework, the Orbital E-Education Framework and The Community of Inquiry Theory. The purpose of this study was to evaluate the effective use of Moodle as a learning management at NUST. Within the context of a pragmatic research paradigm, this study used a sequential explanatory study design as part of a mixed methods approach to evaluate the effective use of Moodle as a learning management system at NUST. Probability sampling was used to select a sample of 278 students and 64 lecturers randomly as study participants. Non-probability sampling was used to select a small sample to collect qualitative data from participants through semi-structured interviews conducted virtually. Survey questionnaires were administered through Google Forms to participants. Quantitative data were coded and analysed with the Statistical Package for the Social Sciences. The Cronbach alpha test ensured content validity of quantitative survey items.

Descriptive and inferential statistics were applied. The Chi-square and Spearman's rho correlations were computed. Qualitative data were coded and analysed using NVivo 13 and thematic analysis to present qualitative findings, themes and nuanced discussions. Quantitative and qualitative data were integrated to inform meta-inferences.

Results showed a low level of activity in the usage of Moodle tools. Utilising Moodle as an LMS has led to increased student course engagement. Communication between students and faculty and the development of problem-solving abilities using Moodle remained significant concerns. Professionals with challenging workloads and students affected by digital divide suffered psychological problems at the research site. The study concluded that the effective usage of Moodle as an LMS necessitates a steady internet connection, dependable learning devices, capable technical support and ample continuous training/orientation. NUST should introduce firmer Moodle password requirements, offer wider access to on-campus computers, and improve student data bundle packages. The study introduced an e-learning strategy crafted to augment Moodle's effective and safe use to enhance the learning and teaching experiences of Moodle users at NUST.

Declaration

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

Copyright Page

Dedication

This study has been dedicated to my husband, Nico, my children, Nico (JR), Brandon and Caroline Bock

Acknowledgments

I am grateful to the Lord for providing me with the knowledge and insight I needed to carry out this study and complete His grand plan. My profound appreciation is extended to Dr Muraina Kamilu Olanrewaju, for his assistance and direction during the investigation while overseeing my research. I sincerely appreciated the involvement of the academic team, administrative support personnel, and participants who formed part of this study. My profound gratitude to Mr Jonas Ileka, former senior business partner for organisational development at NUST, for his assistance and consolation through challenging times. Dr Hautemo and Ms Mildred Besser deserve special thanks for their ongoing support and motivation. My sincere gratitude goes to Dr Vida de Voss, who assisted with the language editing of this dissertation. Furthermore, the involvement of Armin Cloete, who assisted with the transcription of interviews, is acknowledged and appreciated. I want to express my appreciation to my family for their continuous support during this journey, especially to my mother, Caroline de Vries, and my father, Jacobus de Vries. To Esme, Queeny, Helmien, Lititia, and Chantal, as well as my brothers Burnett, Ashley, Derick, and Michael, who believed in me, thank you for helping me stay motivated and focused. To all my friends and colleagues, thank you so much for your love and encouragement. Finally, I would like to express my gratitude to my encouraging spouse, Nico, and our children, Nico JR (26), Brandon (24), and Caroline (11), for their unwavering support, assurance, comprehension, and inspiration during this research. I am grateful of the happiness my entire family and friends brought into my life, their support and encouragement throughout a tough journey.

TABLE OF CONTENTS

List of Tables

List of Figures

Abbreviations and Acronyms

CDT	Course Development Team
CMS	Content Management System
CKSFC	Christ the King Sixth Form College
CoI	Community of Inquiry
CoIT	Community of Inquiry Theory
COLL	Centre of Open and Lifelong Learning
COVID-19	Coronavirus disease of 2019
DDoS	Distributed Denial-of-Service
DICT	Department of Information Communications and Technology
FSF	Free Software Foundation
GUST	Gulf University of Science and Technology
GUTEI	Greek Universities and Technological Educational Institutions
HODs	Heads of Departments
HTTPS	Hypertext Transfer Protocol Secure
ICT	Information Communication Technologies
IPBL	Interdisciplinary Project-Based Learning
IT	Information Technology
LMS	Learning Management System
LTI	Learning Tools Interoperability
MIT Lab	Massachusetts Institute of Technology Laboratory
MIT	Massachusetts Institute of Technology

Moodle	Community of Inquiry Theory Modular Object-Oriented Dynamic Learning Environment
MS	Micro-Soft
MTC	Mobile Telecommunications Limited
NSFAF	Namibia Students Financial Assistance Fund
NUST	Namibia University of Science and Technology
PDF	Portable Document Format
PhD	Philosophiae Doctor (Doctor of Philosophy)
PHP	Hypertext Preprocessor
PLATO	Programmed Logic for Automated Teaching Operations
SCORM	Shareable Content Object Reference Model
SMS	Short message services
SPSS	Statistical Package for the Social Sciences
SQL	Structured Query Language
SRL	Self-regulated learning
TLU	Teaching and Learning Unit
UNAM	University of Namibia
UNESCO	United Nations Educational, Scientific and Cultural Organization.
UREC	University Research Ethics Committee
Web	World Wide Web
XSS	Cross-Site Scripting

CHAPTER 1: INTRODUCTION

Higher education institutions have made significant changes to teaching and learning during the past two decades to better address students' different needs in the twenty-first century. Teaching and learning in higher education circles worldwide have been changed significantly by incorporating information technology in all areas of education. As a result, cutting-edge technology has to be used to supplement conventional classroom instruction.

Adopting the Modular Object-Oriented Dynamic Learning Environment (Moodle) as a Learning Management System (LMS) in higher education settings is one of the creative technologies that have gained popularity over the past 20 years. Moodle was established in 2002 in Australia and is currently rated amongst the top five learning management systems worldwide (Cavus & Zabadi, 2014; Fenton, 2018; Mylavarapu, 2016). In January 2020, statistical evidence confirmed the operation of 103,000 registered Moodle sites, 21,000,000 courses and 178,000,000 users worldwide (Moodle, 2020). The United States of America (USA) had taken the lead with 9,368 registered Moodle sites, followed by Spain with 8,089 Moodle sites, whereas Namibia accounted for 12-registered Moodle sites (Moodle, 2020). However, in April 2022, statistics confirmed 179,208 registered active Moodle sites from 242 countries and 132,096 Moodle sites had sought anonymity (Moodle, 2022). It was further reported that in April 2022, the USA recorded 13,605 registered sites, followed by Spain, with 13,329 in second place, and Germany, with 10,179 registered sites. At the time of this study, Namibia recorded 209 registered sites (Moodle, 2022).

The benefits of using the Moodle LMS include, amongst others, teaching and learning support, ease to use, no licensing fee, solution for online courses, scalability (users vary from a few to a million), security and privacy, accessibility and community support (Moodle, 2018). In addition, the use of Moodle as an LMS also provides a mixture of face-to-face classroom teaching and opportunities for synchronous e-learning experiences through live online teaching

sessions, self-paced e-learning, and distance learning (Francescucci & Rohani, 2018). Mulhayatiah et al. (2019) state that e-learning via Moodle strengthens student-student and student-lecturer collaboration and problem-solving possibilities. Furthermore, Fenton (2018) agrees that Moodle provides more comprehensive access for students to join higher education institutions and has become convenient for driving costs down and concurrently increase the flexibility of the curriculum.

Despite the numerous benefits offered by e-learning through Moodle as a learning management system, not all higher educational institutions have utilised this technology to its fullest capacity (Aguti et al., 2013). Generally, much agreement exists that Moodle, as an open source, offers a range of features that, if efficaciously utilised, institutions can benefit tremendously from advancing learning and teaching experiences to decrease operational costs (Pankaja & Mukund, 2013; Webb, 2015). However, if higher education institutions endeavour to use Moodle to its total capacity for successful teaching and learning, a sound understanding of the signifying factors that affect blended and online learning is fundamental in blended and online learning environments (Khan, 2016).

Moodle sites require frequent updates and configurations to capitalise optimally on the wide range of benefits Moodle offers. Literature confirms that the absence of specific plugins deprives Moodle users of access to a wide range of features, which may hamper service delivery and the cost-effectiveness of the open source (Schiavone, 2018). Although each tool has a primary function to allow users to benefit from a range of learning and pedagogical benefits, there is no one correct or wrong way to use Moodle tools (Moodle, 2018). Nonetheless, if users are not aware of how to use these features, they will not benefit from the advantages offered by such features.

Regardless of the numerous benefits of Moodle as an LMS, there is a reason for concern as flaws in the Moodle LMS pose severe threats to e-learning websites. Constantin (2017)

claims that organisations using Moodle as an LMS should stay abreast with upgrades to fix vulnerabilities and block opportunities for cyber attackers to take over web servers. Moodle statistics revealed that only 9.2% of Moodle sites globally are fully updated with the most current Moodle version, 3.8, followed by 28.8% of locations depending on the 3.7 Moodle version. Consequently, 62.0% of Moodle sites worldwide rely on outdated Moodle versions, ranging from Moodle 1.9 to 3.6. Some Moodle sites still depend on Moodle 1.9, which puts the users at risk of severe security issues. According to Hawkins (2019), a range of Moodle versions is regarded as vulnerable software in terms of cross-site scripting (XSS) risks on some pages, such as Moodle versions 3.7 to 3.7.2, 3.6 to 3.6.6, 3.5 to 3.5.8, and earlier unsupported versions. XSS attacks are described as cyber-attacks on end-users when attackers use a web application to send malicious codes. These malicious codes are generally sent to different end-users through a browser-side script (Owasp, 2020). It is, however, confirmed that Moodle 3.7.3, 3.6.7 and 3.5.9 were fixed. Should hackers gain administrative privileges on the Moodle platform, they can install a Hypertext Pre-processor (PHP) backdoor. They may upload malicious plugins or templates with disastrous implications if institutions fall prey to such malicious cyber-attacks (Haworth, 2021).

Nonetheless, many higher education institutions use Moodle as a learning management system globally, including leading universities such as Stanford, the University of Cambridge and the University of Oxford. Universities in developing countries in Sub-Saharan Africa have also shown increased adoption of e-learning technologies to improve teaching, research, and support student learning experiences (Trines, 2018). The latest version of Moodle allows for increased insight into forum discussions of students, advanced student engagement with the H5P tool for interactive content, increased insight through learning analytics and the availability of emojis in communication tools. Conversely, several explanations discourage the use of Moodle as an open source. Possible reasons for the latter challenge include (1) the

interoperability and migration issues faced by Moodle users, (2) lack of support, (3) claims of poor-quality software and not being what users want, (4) of staff expertise to offer Moodle users support, (5) claims of increased training needs, and (6) challenges with an open-source solution for Moodle users (Wilson, 2014). In addition, inadequate budgetary provision by the government cripples public higher education online providers from offering essential infrastructural facilities and teaching-learning resources (Dakowska, 2017; Saskar, 2016; Scheuermann, 2014).

Another annoying aspect is that Moodle is simply used as a repository to give students access to course content. Concerns concerning the efficiency of using Moodle as an LMS in blended learning environments have been highlighted by this problem, which needs more research (Cabero-Almenara et al., 2019; El Bahsha et al., 2016; Zainuddin et al., 2016). University leaders are recommended to look at many strategies to ensure the effective adoption and secure usage of Moodle as an LMS due to the complexity of learning management systems (El Bahsha et al., 2016).

In 2004, a student in the then Information Technology Program at the Polytechnic of Namibia researched the suitability of Classroom Management Systems (CMS) for Online Learning via Intranet, Extranet, or Internet, the focus on how such technologies can be applied to support on-campus training. That was the beginning of e-learning at the then Polytechnic and the now Namibia University of Science and Technology (NUST) (Kretzschmar, 2004). As a free, open-source, web-based CMS, Moodle was an e-learning solution available in a mixed mode, combining in-person instruction with online learning in selected courses but only for on-campus students (Kangandji, 2008). In 2007 the institution moved from Moodle to KEWL, another open-source web-based CMS. The decision was made because the then Polytechnic of Namibia and other interested parties agreed to utilise a single CMS to share resources and

expedite training processes. However, in 2011, Moodle was re-instated at the Polytechnic of Namibia.

1.1 Statement of the Problem

The 21st century, shaped by the Fourth Industrial Revolution, requires tertiary institutions to use available technologies optimally to enhance student performances. By integrating traditional teaching practices with modern educational technologies, learning institutions use blended learning to improve student productivity. Technologies facilitate learning, provide conveniences and promote the interactive nature of learning (Trines, 2018). Moodle is one of several technologies that may be used in teaching and learning. High student accomplishment results from using Moodle efficiently, which also produces the necessary human capital to support national economies (Francescucci & Rohani, 2018). Despite the realisation that the effective use of educational technologies yields high student achievements, the Namibia University of Science and Technology (NUST) has yet to reap the full benefits of Moodle as a learning management system that the university uses for online teaching and learning. More than ten years after the implementation of the learning management system, Moodle, student performance levels have not improved as anticipated, despite the assertion that educational technologies in teaching and learning improve student performances significantly (Mulhayatiah et al., 2019). Given the student performance not being impressive, despite the university using Moodle, this study sought to explain the challenges facing the implementation of Moodle at NUST, with the view of designing measures on how the identified challenges can be addressed. Such a strategy may ensure that the university optimally uses Moodle as an LMS, maximising student performances as an outcome of teaching and learning.

1.2 Purpose of the Study, Research Aims, and Objectives

This mixed-methods case study aimed to investigate the effective use of Moodle as an LMS at NUST, a public, non-profit university offering full-time, part-time and distance

education learning opportunities through blended and full-fledged online learning. The study was conducted in 2021 at the main campus of NUST, located in the capital city of Namibia, Windhoek, and extended to ten distance education centres across the country. Furthermore, the study is premised on three theoretical models, Khan's Octagonal Framework, the Orbital E-Education Framework and the Community of Inquiry Framework (CoI). As such, this study aims to develop a strategy to increase the responsiveness of students and lecturers at NUST to capitalise optimally on the benefits offered by using Moodle as an LMS and concurrently slash operational costs at NUST institutional-wide.

In addressing the above purpose, the study sought to address the following objectives:

1. Establish the level of responsiveness of NUST students and lecturers to capitalise optimally on the existing features of Moodle.
2. Explore the signifying factors that affect blended learning using Moodle at NUST.
3. Establish the impact of using Moodle at NUST on students' course engagement.
4. Establish the impact of using Moodle at NUST on students' communication.
5. Establish the impact of using Moodle at NUST on the development of students' problem-solving skills.
6. Develop a strategy for NUST to capitalise on the effective and safe use of Moodle.

1.3 Nature of the Study

Research Methodology

The study was approached from a pragmatic paradigm. A sequential explanatory study design was used as part of a mixed methods approach to evaluate the effective use of Moodle as a learning management system at NUST. Mixed-method research, as defined by Tashakkori & Teddlie (2003), is a research strategy that combines qualitative and quantitative methods to carry out a study. Adopting a mixed-method approach enabled the researcher to triangulate

numerical data with textual data to better understand the subject under investigation (Creswell & Creswell, 2018).

Researchers who undertake case studies have the flexibility to employ different methods to collect and analyse data, such as quantitative, qualitative, or a combination of both (Hartley, 1994). Using an explanatory sequential research design allowed the researcher to utilise the degree of flexibility regarding the data collection tools (Bertram & Christiansen, 2014). In this mixed-method case study, the researcher commenced with quantitative data collection by administering survey questionnaires to participants. Quantitative data were collected from students and lecturing staff and analysed. Informed by the results of the quantitative data, interviews were conducted with a small group of participants to obtain qualitative data. Adopting multiple data collection methods to explore the phenomenon under investigation strengthened the credibility of the case study findings, which was possible through triangulating quantitative and qualitative data. 'Triangulation' describes the practice of applying multiple data collection approaches to analyse data to increase the credibility of studies (Kulkarni, 2013; Salkind, 2010).

The survey administered to the students and lecturers included demographic questions, Likert scale-type questions and yes/no responses, designed following a literature review of relevant theoretical models and contributions from lead theorists in the focal area of the study. The researcher used a panel of knowledgeable Moodle users to secure the validity of the content included in both survey items.

Sampling

The study included three different samples to select a sample population comprising 354 participants from a targeted finite population of 1,108 elements. The first sample was drawn randomly from a target population of 1,001, including second and third-year students. This sample was a combination of full-time, part-time- and distance education undergraduates

selected from the Faculty of Human Sciences from students who were registered for the core university course, Sustainability and Development at NUST. All student participants were included in the research voluntarily as higher education students. All participants had sound intellectual abilities and made informed decisions about whether they would like to participate in the study or not.

The second sample included 64 lecturers, drawn randomly from a target population of 77 lecturers in the Faculty of Human Sciences. These participants comprised a combination of male and female participants between 30 and 65 years old.

A third sample was drawn purposively and included seven participants: two instructional designers, two lecturers, two academic coordinators, and one Moodle systems analyst. Purposive sampling in qualitative studies allows the researcher to use a case study and limited resources and identify and select rich information from small sample sizes of selected participants with adequate knowledge of the phenomenon under investigation (Creswell & Clark, 2011; Patton, 2002).

Data Collection

The NUST Research Committee, through the Office of the Registrar, granted permission to collect data from participants on the main campus of NUST in Windhoek, Namibia, and ten regional distance education centres across Namibia between April and August 2021. A combination of open and close-ended anonymous web-based survey questionnaires was designed and administered to participants. Quantitative data were collected through anonymous web-based surveys administered to students and lecturers via Google Forms, adhering to all ethical standards and principles. Consequently, the researcher collected data on the responsiveness of NUST Moodle users to establish the extent to which Moodle users capitalise on the benefits of the e-learning platform tools.

The researcher capitalised on the advantages of the mixed methods study strategy by presenting findings in figures, charts, tables and summaries of in-depth interviews, consistent with the findings of Bertram & Christiansen (2014) and Gall et al. (2007). In this way, the researcher could determine if Moodle usage has boosted student involvement, communication, and problem-solving abilities. Following all ethical guidelines and standards, qualitative data were acquired through in-depth interviews with a mixture of administrative and academic employees. Consequently, the researcher collected data, which was analysed and interpreted to provide answers to the signifying factors that affected blended e-learning at NUST and informed the researchers to develop a strategy to address the phenomenon under investigation.

The study relied on a pilot and used frequency tables and trustworthy measures to improve the survey's validity and reliability (Creswell, 2014; McMillan & Schumacher, 2001). The researcher performed the Cronbach alpha reliability test to establish internal consistency and strengthen the survey questionnaire items' reliability. The use of descriptive statistics allowed the researcher to describe the basic features of the data in a study and provide summaries of the samples and the measures (Trochim, 2016).

Data Analysis

The researcher used SPSS version 27 to process and analyse quantitative data collected from students and lecturers via Google Forms. To analyse the demographic data of the surveys, the researcher relied on univariate and multivariate statistical procedures. To analyse the demographic information, participant replies, and various responses on each survey scale, cross-tabulation and frequency counts were utilised. According to Gilbert (2008), quantitative designs are used to produce numerical descriptions through 'coding' verbal or textual data. Additionally, the internal consistency of the survey questionnaires, made up of several Likert-scale questions, was evaluated using Cronbach's alpha. Descriptive and inferential statistics were computed, and the data were presented in tables and graphs, followed by a discussion.

The Chi-square test of independence and Spearman's rank-order coefficient as nonparametric tests were computed. These were done to demonstrate correlations between variables as the data lacked normality. The Chi-square independence test is an inferential statistical test which enables researchers to draw inferences about a population based on a sample and assists in determining if two variables in the population are connected (Creswell & Creswell, 2018).

The computer software, NVivo 13, assisted the researcher in analysing qualitative data collected from participants. Dollah et al. (2017) encourage researchers to use the computer software NVivo, a practical multimedia web-based application for data analysis. Moreover, this software allows researchers to map the pattern of key ideas and concepts, present keywords in groups, themes, and sub-themes, and organise the thematic representation of the data (Nowell et al., 2017). Themes were established and interpreted to produce meanings based on the research questions. Applicable themes were discussed based on transcribed data from in-depth interviews, the researcher's worldview, and the relevant theoretical frameworks that guided the study (Creswell, 2014).

In addition to using NVivo 13, which assisted with the management and analysis of the qualitative data, this study also used thematic analysis to increase the trustworthiness of the qualitative findings. Thematic analysis is a type of data analysis often used in qualitative research. It is frequently used to analyse qualitative research projects without providing the necessary details about how the data was reduced to manageable topics and the conclusions reached (Nowell et al., 2017).

Significance of the Study

The study's outcome generated a strategy to guide academics, administrative support staff and instructional designers at NUST toward the effective use of Moodle as an LMS. The study may motivate blended learning institutions using a learning management system to embrace blended and e-learning for improved student performance. The e-learning strategy

developed may prompt innovative skills among NUST information technology experts and the Moodle support team to become responsive to provide timely support to Moodle users at NUST. The study outcomes are of value to NUST management, heads of departments, deans, and policy makers as they would alert the NUST community about the factors that affect blended and fully online learning in higher education using Moodle as an LMS. The Ministry of Higher Education and Internet Service Providers may increase the value of support to the institution and students regarding e-learning.

The study outcomes are of value to NUST management to encourage e-learning units to utilise Moodle effectively and securely to ensure the smooth integration and sustainability of blended learning at NUST. The study may also be significant to instructional designers to guide decisions related to the training and orientation of Moodle users. The study created awareness about the strengths and weaknesses of online course design, delivery and development to promote blended learning at NUST. The study's outcomes may also assist the e-learning unit in conjunction with the instructional design team at NUST to adopt strategies to improve course design, monitoring and evaluating Moodle courses. The faculty heads may be better positioned to advise academics to strengthen teaching, learning and assessment at the research site.

Finally, the outcome of this study would alert the NUST community about the factors that affect blended learning in higher education. Courseware developers may need to re-evaluate their roles and responsibilities at NUST in terms of planning, learning design, management and administration of the learning process, as well as delivery of learning content.

1.4 Research Questions

The following main questions guided this study:

RQ1. What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

RQ2. What signifying factors affect blended learning using Moodle at NUST?

RQ3 What impact does the use of Moodle at NUST have on students' course engagement?

RQ4 What impact does the use of Moodle at NUST have on students' communication?

RQ5 What impact does the use of Moodle at NUST have on the development of students' problem-solving skills?

RQ6 Which strategies can NUST adopt to increase the effective and safe use of Moodle as an LMS?

1.5 Delimitations

The sustainability and development topic module was provided at NUST as a fully-fledged online course housed in the human sciences faculty. The study's main focus was on the effective use of Moodle as a learning management system. The perspectives of first-year and post-graduate students were not included in the population sample. The fully online module, Sustainability and Development, has been provided as a third-year module. However, depending on the coping capabilities of students in their second year of study, permission was granted to qualifying students to register for this module,

Academics from the Faculties of Human Sciences and Management Sciences were included in the survey. Students registered for Sustainability and Development belonged to all six faculties. Thus, the survey included data drawn from second and third-year students that belonged to all six faculties at the research site. The in-depth interviews were conducted with academics from the Faculties of Human and Management Sciences.

The findings of this study from data acquired from faculty and students may not be generalised to other institutions unless such institutions share common characteristics as the sampled faculties that formed part of this case study investigation.

1.6 Definitions

Blended learning: Blended learning involves the use of technology, the internet, and distance learning in addition to conventional face-to-face instruction (Avazmatova, 2020).

Community of inquiry: It has been asserted that the framework helps comprehend and create blended learning because of its wide character and the way it resonates with in-person and online learning. Purposeful, transparent, and ordered discussion and reflection create the community of inquiry that is the goal and centre of higher education. It is built on three different forms of presence: social presence, teaching presence, and cognitive presence (Garrison & Vaughan 2008).

Khan's Octagonal Framework: This framework makes it easy to choose the correct elements for successful course design and delivery. Khan's framework provides a context for planning, developing, delivering, managing, and evaluating blended learning programs. The framework's eight dimensions include institutional, educational, technological, interface design, assessment, management, resource support, and ethical considerations (Amalou, 2006).

Learning Management System (LMS): AN LMS is essential to any online course's success and can potentially improve or harm an institution’s image in the fiercely competitive higher education market. The LMS must facilitate fast and accurate communication between students, course facilitators, and other institutional stakeholders and provide learning resources to learners (Yildirim et al., 2004).

Moodle: Moodle is a web-based learning platform that enables teachers to create online courses, assign tasks, and monitor students' progress. It also allows educators to engage with students and encourages them to communicate through forums and discussions (Kokoulina, 2020).

Critical thinking: Singh (2018) describes critical thinking as a person's ability to deconstruct and reassemble what they have learnt by devising new ways to achieve the same result.

E-Learning: The method of imparting education and training using digital resources is known as e-learning. Despite having its roots in traditional education, e-learning is delivered through internet-connected gadgets like computers, tablets, and even mobile phones (Lawless, 2018).

Online learning: A learning mode that requires an internet connection and a device to allow students access to learning resources in a virtual learning environment (Stern, n.d.).

1.7 Organisation of the Study

This dissertation consists of five chapters, as discussed below:

The study's background and reason for the inquiry are provided in Chapter 1, which focuses mainly on the researcher's perspective, the problem statement and the purpose of the study. This chapter examined the study's key themes, the research design and methodologies, and the theoretical underpinnings. Chapter 2 contains thorough literature on several frameworks that were used to develop the study's core principles, including Khan's Octagonal Framework, The E-Education Framework and the Community of Inquiry Framework.

Chapter 3 discusses the study's research design and provides the reason for utilising a sequential explanatory mixed-methods research design. The third chapter covers data collection techniques and data analysis and interpretation strategies. The last section of Chapter 3 discusses the study's ethical philosophies.

In Chapter 4, the data collected to address the study topics are presented and examined. The data are arranged following the main points of the debate, which centre on the effective use of Moodle as a learning management system in a hybrid and fully online

environment. The study is wrapped up in Chapter 5, which summarises the methodology used, the main findings, and their ramifications. The chapter recommends using Moodle as a learning management system effectively and crafting an earning that promises to address the e-learning needs of higher education for sustainable LMS integration and presents an e-learning framework as a potential study contribution. The chapter concludes by outlining prospective study areas or opportunities to build on the debate on blended and fully-fledged learning in higher education contexts.

Summary

With a brief declaration on how this thesis would contribute to the broader literature on the effective use of Moodle as a learning management system in higher education, the chapter concluded with an explanation of the background, purpose, and character of this study. The chapter serves as a jumping-off point for further debate to evaluate the effective use of Moodle as a learning management system in a Namibian context. The literature review of several learning technology topics in relation to the objectives of this inquiry and multiple blended learning frameworks are discussed in the next chapter.

CHAPTER 2: LITERATURE

This mixed-methods case study aimed to investigate the effective use of Moodle as an LMS at NUST, a public, non-profit university offering full-time, part-time and distance education learning opportunities through blended and fully-fledged online learning. Hence, this chapter discusses blended learning frameworks, concepts and themes associated with using Moodle effectively as an LMS in higher education.

The Community of Inquiry Framework (CoI), Garrison et al. (2000), Khan's Octagonal Framework (Khan, 2001), and The Orbital E-Education Framework (Elameer & Idrus, 2012) are the three theoretical frameworks and models that are evaluated in the first section of the chapter. The second section of the chapter derives conclusions from the history, evolution, and interdependence of the critical components connected to the successful application of Moodle as a learning management system in higher education. The primary focus of this study is the deconstruction of concepts like blended learning, blended learning methods, online learning, e-learning, learning management systems, and e-learning management. The third section explores the main features of Moodle as an LMS to address the responsiveness of Moodle users to capitalise optimally on the features available in Moodle. An overview of the key success and critical factors in blended learning settings is provided. The essential elements that impact blended learning in higher education settings are highlighted in the fourth section. The fifth section explores how the use of Moodle affects the level of students' engagement, communication, and critical thinking skills. The sixth section examines the approaches higher education institutions may consider augmenting for the effective and safe use of Moodle as an open source. The chapter ends with a summary highlighting the main points discussed and provides areas for further investigation.

Seminal, peer-reviewed publications and eBooks from various electronic databases were accessed to conduct an extensive literature review ranging from 2000 to 2022. The

multidisciplinary ProQuest database allowed access to over 100,000 dissertations and 450,000 working papers from various organisations. The electronic database of the Education Resources Information Centre (ERIC) allowed access to approximately 1.3 million items. The electronic database ScienceDirect, provided by Elsevier, was beneficial, which allowed access to more than 2,500 journals and 40,000 e-books of multidisciplinary nature. The identified databases were accessed to compile a summary of articles and books on frameworks and models for the effective use of learning management systems in higher education institutions. Additional related searches were conducted to access publications aligned to the focal area of the study, including various combinations of searches to address the research questions. Useful searches were conducted on, amongst others, (1) the responsiveness of course participants to Moodle features, (2) the use of a learning management system for increased course engagement, (3) using Moodle to augment communication, (4) using Moodle for the development of critical thinking and problem-solving abilities, and (5) safety vulnerabilities in Moodle as an open source.

To follow is an overview and evaluation of Khan's Octagonal Framework.

2.1 Khan's Octagonal Framework (The E-learning Framework)

Most frequently referred to as the "E-learning Framework," Khan's (2001) Octagonal Framework was developed by Badrul Khan in 2000 to direct e-learning institutions by taking eight characteristics into account throughout the design process of e-learning settings in higher education (Khan, 2010). The framework is focused on eight educational, technological, interface design, evaluation, management, resource support, ethical, and institutional components of the design, delivery, implementation, and assessment of e-learning. There is proof that several of the eight framework dimensions were particularly helpful in research that examined e-learning tools, resources, and programs (El-Tigi & Khan, 2001; Khan, 2010; Khan & Ally, 2011; Khan & Smith, 2007; Minh & Ngan, 2019;

Romiszowski, 2004; Singh, 2003). Several studies were conducted and confirmed the significance of Khan's Framework to be a sound and comprehensive theoretical e-learning model to guide instructional design elements and to offer a benchmarking tool for compelling e-learning offerings in higher education settings (Khan, 2003,2007; Minh & Ngan, 2019).

Figure 1

Khan's Octagonal Framework

Source: Khan, 2001

According to Khan (2001), the institutional dimension comprises administrative, academic and student services. The administrative services are related to issues, among other things, matters concerning the organisation and change, accreditation procedures and issues, considerations regarding budgets and return on investments and all services regarding information technology.

Figure 2

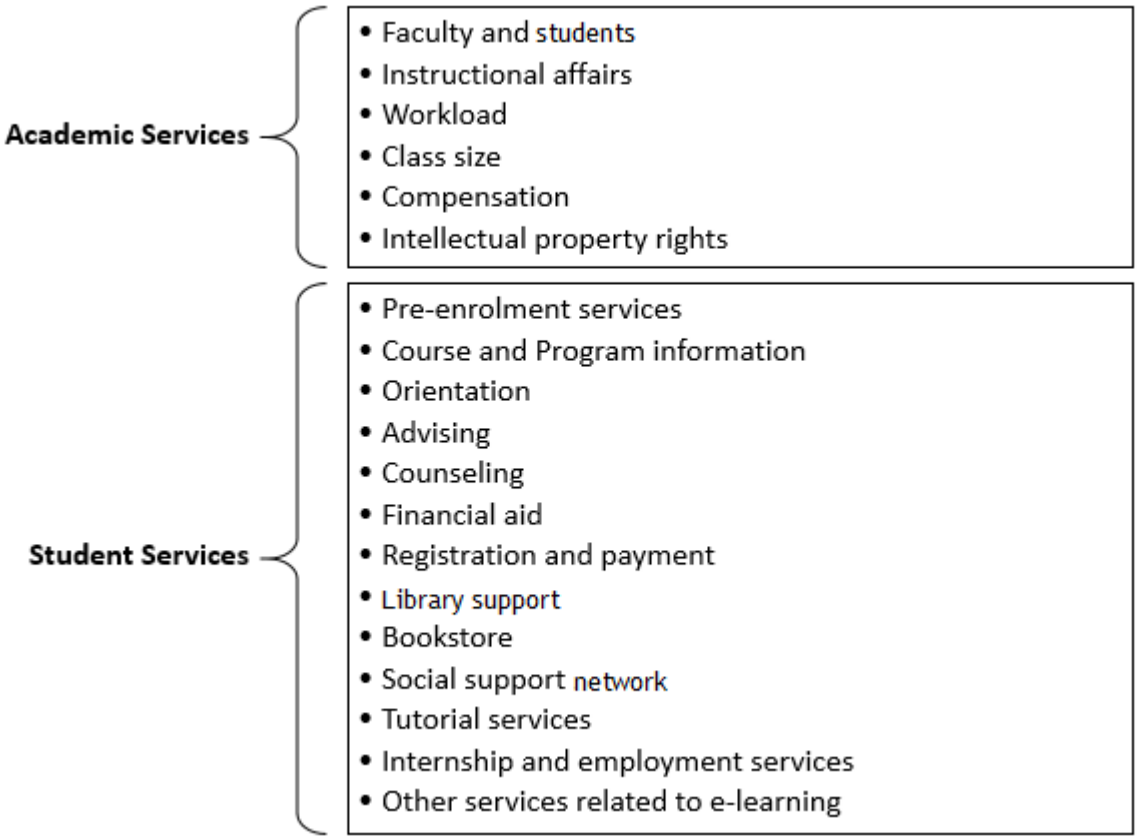
The Institution: Administrative Services

Note. Figure 2 provides a diagram of the administrative issues. Adapted from Khan, 2001

The second component of the Institution dimension is integrated into an institution's academic operations. It covers the following topics: intellectual property rights, workload, class size, salary, faculty and staff assistance, and instructional affairs (Khan, 2001). Student services were described as the third sub-element of critical relevance for the success of an e-learning program in a higher education environment under the Institution dimension. Figure 3 illustrates the various academic affairs and student services prevalent in higher education institutions (Khan, 2001).

Figure 3

Institution Dimension: Academic and Student Services



Note. Adapted from B. Khan, 2001.

The pedagogical dimension refers to all teaching and learning-related affairs and activities. These activities include, amongst many others, goals/objectives, organisation, design methods, medium of e-learning environments, content, techniques and strategies. Furthermore, the e-learning methods and techniques involve tutorials, presentations, games, simulations, discussion, storytelling, interaction, collaboration, facilitation and motivation.

According to Khan (2001), pedagogy is associated with teaching and the learning needs of online learners. Special attention is paid to the relationship between the content learners need to engage with in the online setting. Appropriate delivery methods need consideration to enable learners to achieve their learning objectives (Khan, 2001). One way to establish the needs of online course participants is to conduct a needs analysis.

The technology component considers infrastructure difficulties involving technology in blended learning environments, particularly e-learning features such as servers that support the learning program. An appropriate LMS, hardware, and software are also crucial components. The later provisions attempt to create a learning environment that includes the necessary resources for delivering a learning program (Singh, 2003). Amalou (2006) agrees that the technical component emphasises the need to determine the best learning management system. As a result, the technological dimension focuses on the gear, software, learning environment, and resources needed to deliver the course properly (Khan, 2003; 2010; Singh, 2003). Features including (1) page and site design, (2) content design, (3) navigation, and (4) accessibility are included in the interface design. However, in the larger context of institutional transformations to improve blended learning, accessibility can be seen as overly particular (Khan, 2003; 2010; Gardner & Tipton, 2003).

The effectiveness of a blended learning programme at universities is crucial and best achieved when opportunities are available for course participants to evaluate programmes offered in a blended learning mode. Additionally, the blended learning module should provide opportunities to assess course participants' performance in both face-to-face teaching and e-learning (Khan, 2005).

Management has to do with people, procedures, and goods. The concept "people refer to the management team," and the term "process" refers to the actual management of the delivery of e-learning materials in the e-learning environment (Khan, 2005). Course participants' resources include offline and online (Minh & Ngan, 2019; Romiszowski, 2004). The ethical component has socioeconomic and cultural diversity, worries about the digital gap, and ethical issues like netiquette, which is the term for proper behaviour online (Khan, 2003; 2010; Romiszowski, 2004). One of Khan's framework's primary criticisms, nevertheless, is that it does not consider a remote campus's infrastructure requirements and

lacks the planning tool for creating vocational learning pedagogy (Kurkela, 2011). It is concluded that Khan's Octagonal Framework is helpful for institutions searching for guidance to increase online learning opportunities in blended settings. However, it lacks the element of sustainability, which is crucial for institutions challenged with the effective integration of blended learning programmes (Elameer, 2012). Consequently, Singh (2003) adapted Khan's framework into a more convenient model to address the limitations of the original framework. Singh (2003) agrees that despite the efforts to adapt Khan's framework, the initial framework has the potential to guide to outline, create, deliver, organise and assess blended learning programmes.

Khan (2005) assessed the Octagonal Framework and admitted it fails to address the infrastructural needs of higher education institutions. Although Khan's Octagonal Framework lacked guidance pertaining to sustainable institutional and infrastructural changes, the remaining seven elements of Khan's Framework were combined with the E-Education Orbital Framework (Elameer & Indus, 2012) for guidance toward the effective use of Moodle as an LMS at NUST. As a result, because both of these frameworks are derived from the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model, the elements of pedagogy, technology, interface design, evaluation, management, resources, and ethical issues are intertwined with the aspects of the E-Education Orbital Framework. The Orbital E-Education Framework of Elameer & Idrus (2012) is evaluated in the next section as a valuable theoretical framework to support the claim in the current study.

2.2 The Orbital E-Education Framework

According to the literature, the Orbital E-Education Framework of Elameer & Idrus (2012) is descended from the ADDIE paradigm. In order to overcome the shortcomings of Khan's E-learning Framework, the Orbital E-Education Framework was created. As a result, the Orbital E-Education Framework was particularly pertinent to the current study as a

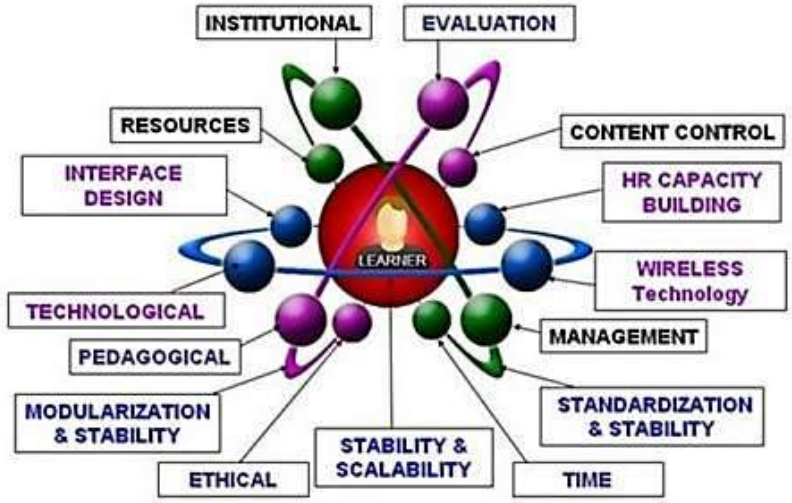
cutting-edge framework to assess the successful use of learning management systems in blended learning contexts. This framework covers essential components to support the subject, issue statement, research questions, and study design of the current study. The framework emphasises the requirement for vital human resources across the board and environmental education variables like wireless technology (Elameer et al., 2012).

Additionally, it provides prominence to the learner and learning content in a learner-centred setting with a strong dependency on technology. According to the view of these theorists, digital-based learning requires the availability of numerous learning resources to ensure effective learning (Elameer & Idrus, 2012). Furthermore, it is acknowledged that with a digital learning environment that evolves continuously, the crucial elements of functionality, scalability and modularity in e-learning need consideration for the adoption of stable technologies in a digital education setting (Elameer et al., 2011).

The Orbital E-Education Framework is particularly useful for designing and developing e-learning platforms and performances in blended learning settings (Elameer et al., 2011). A significant trait of the framework is nestled in its uniqueness to address sustainability issues about other contemporary e-learning and blended learning models (Elameer & Idrus, 2012). The Orbital E-education framework is shown in Figures 4 and 5.

Figure 4

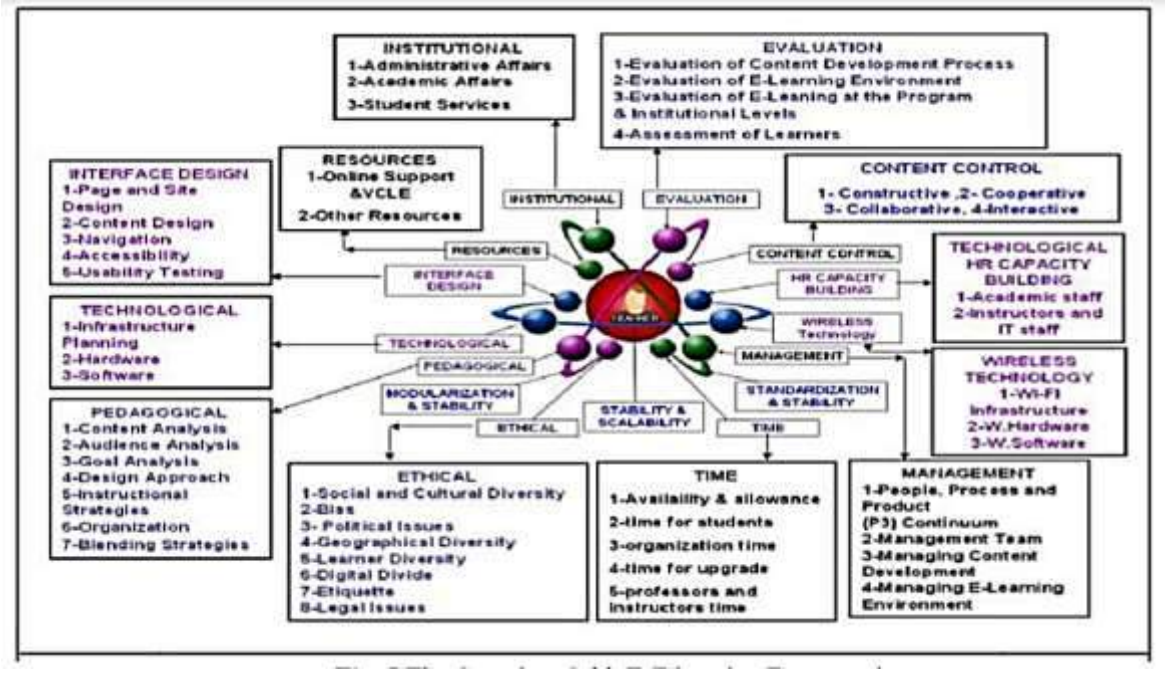
The E-education Orbital Framework



Note. Adapted from the E-education Orbital Framework. From Khan Octagon E-learning to the Orbital E-Education - A new E-Education framework for Iraqi Higher Education by A. Elameer & R. M. Idrus, 2012.

Figure 5

Complete E-Education Orbital Framework



Note. From The E-Education Orbital Framework. From Khan Octagon E-learning to the Orbital E-Education - A new E-Education framework for Iraqi Higher Education by A. Elameer & R. M. Idrus, 2012.

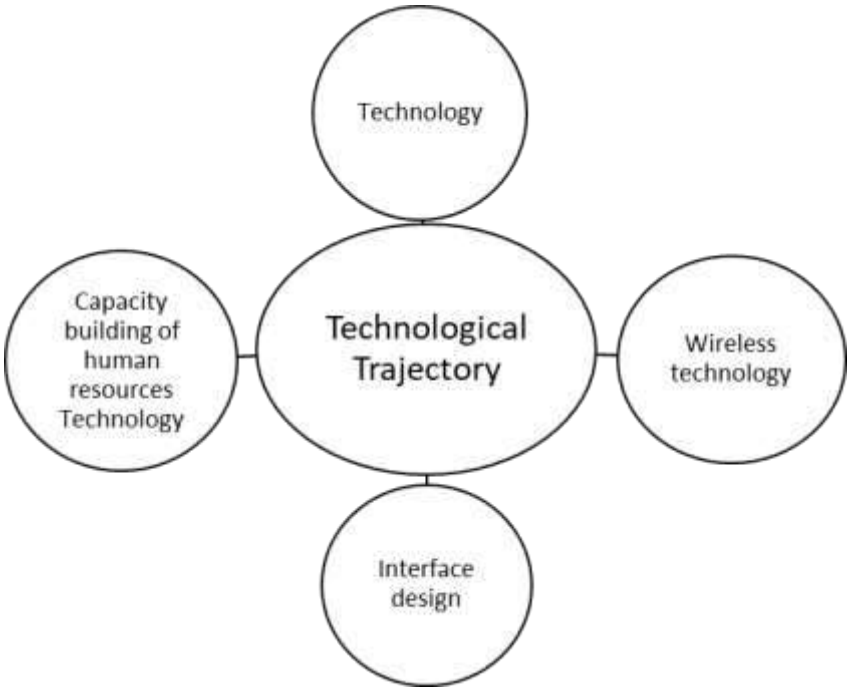
The term "institutional" relates to how ready an institution is for academic and administrative affairs. Student services, teacher and staff support, and organisational and change policies are a few examples of institutional preparation. Administrative and academic staff should be included in the design and implementation phases of blended learning programs, according to Minh and Ngan (2019). The readiness of the organisation, the availability and structure of the material and infrastructure, and the demands of the students must all be determined. Ismail et al. (2009) assert that having enough bandwidth is essential for e-learning in blended learning environments to give students and facilitators a pleasant online experience. The technological trajectory of the E-education Orbital Framework involves the elements of scalability and stability. Phankokkruad (2012) noted that classical e-learning systems usually lack scalability, flexibility, and interoperability due to

client/server architecture dependency. The technological trajectory contains key drivers of technology for effective e-learning and blended learning integration. These drivers include wireless technology, interface design, and capacity building of human resources (Ismail et al., 2009).

The four elements prominent in the technological trajectory are (1) technology, (2) human resources capacity building, (3) interface design and (4) wireless technologies. A visual depiction of the critical elements of the Technological Trajectory is presented in Figure 6.

Figure 6

Technological Trajectory of the E-Education Framework



Note: Adapted from Technological Trajectory of the E-Education Framework. By A. Elameer & R. M Idrus, 2012.

According to Ismail et al. (2009), emphasis is placed on the importance of sufficient bandwidth to promote online learning for online participants to experience a mixture of face-to-face and online learning interactions. The institution's technology infrastructure secures e-learning opportunities that require both infrastructure planning and important decisions

about software and hardware (Elameer et al., 2012). The strategic objective aimed at successfully integrating blended learning in educational settings involves specific infrastructural requirements, the accessibility of computers, reliable networks, communications, and a technical department (Nawaz & Khan, 2012). However, higher education institutions are challenged to uphold the formula of one computer to one learner (Bielefeldt, 2006). An equally important element is the speed of the internet or bandwidth, which has been identified as the primary issue that affects the performance of large e-education networks (Elameer & Idrus, 2012; U.S. Department of Education, 2017). Other essential technology elements include bandwidth, accessibility, security, hardware and software. Equally important is the initiative to create a learning environment equipped with the appropriate tools for effectively delivering a learning programme (Singh, 2003). According to Amalou (2006), the technological element underlines the need for a suitable learning management system. It is also essential to have measures to manage various delivery types and a content management system (Romiszowski, 2004).

Regarding human resource capacity building, the institution needs an ICT team with a positive attitude coupled with adequate knowledge about ICT to ensure a learning management system's effective and safe use (MacDonald et al., 2009). The technical department's ICT professionals are responsible for continuously maintaining and upgrading the infrastructure, providing technical support services, and offering training to users. Consequently, ICT knowledge, availability, and support staff skills directly influence participants' learning experiences in online environments (Pima et al., 2016).

Interface design describes the entire appearance and feel of e-learning applications (Elameer & Idrus, 2012). Additionally, the interface design includes five crucial criteria: navigation, accessibility, content design, page and site design, and usability testing (Khan,

2003; Moore et al., 2007). Wireless technologies have led to improving and redesigning organisations and educational settings (Saccol et al., 2009).

Four distinct dimensions of the organisational trajectory include the institution, resources, management and time. To enable technical and semantic interoperability between digital material and infrastructure, the indicated parts must adhere to the ongoing university standardisation (Moore et al., 2009). The organisational dimension must be steady and not be affected by societal aspects (Elameer et al., 2011). According to Khan (2001), the institutional dimension has not altered and consists of (1) administrative affairs, (2) academic affairs, and (3) student services relating to e-learning. The e-learning resource support dimension aims to investigate the resources and online help needed to refine successful learning. The aspect of managing e-learning is tucked away in the management's support of workable strategies for the efficient upkeep of the learning environment and distribution of knowledge. The institution must conduct meaningful reviews to promote an environment of continuous process improvement (Idrus, 2008).

Due to the disparity between student capability and individual effort, time is another success factor for the innovative deployment of an e-learning framework. In summary, users must be given sufficient time to become educated and skilled in using an innovation (Elameer et al., 2011). Users must be willing to invest learning time in using available technologies, just as organisations are willing to provide time (paid or unpaid) for users to become proficient in technologies. This need pertains to the organisation's preparedness to commit time (such as paid or unpaid time) and the users' readiness to engage in learning time to implement the innovation (Idrus, 2008). Aspects of (1) Pedagogy, (2) Evaluation, (3) Ethical control, and (4) Content control are all included in this trajectory. Modularising these components is required. The concept of modularity in learning allows for the encapsulation, exposing and separately reusing of parts of the learning resources. The E-education Orbital

Framework enables the utilisation of digital learning materials in various modules (Elameer et al., 2011; Elameer & Idrus, 2012).

The Education trajectory of the E-education Orbital Framework shows four dimensions, whereas Khan's Octagonal Framework only covers three dimensions (Elameer & Idrus, 2012). According to Elameer & Idrus (2012), the dimension of content control was missing in the Octagonal Framework of Khan (2009). Still, it is deemed crucial in the E-education Orbital Framework due to the necessity to include the content control element in the Pedagogical trajectory.

The Pedagogical dimension of e-learning includes teaching and learning. Thus, the pedagogical dimension of online courses in higher education is subjected to (1) content analysis, (2) audience analysis, (3) goal analysis, (4) media analysis, (5) design approach, (6) organisation and (7) learning strategies (Elameer & Idrus, 2012). The ethical considerations of e-learning include eight distinct elements, inter alia (1) social and political influence, (2) cultural diversity, (3) bias, (4) geographical diversity, (5) learner diversity, (6) digital divide, (7) etiquette and (8) legal issues (Elameer & Idrus, 2012). Khan (2005) agrees that pedagogy is associated with online learners' teaching and learning needs. Moreover, emphasis is placed on the ideology that different learners rely on unique learning paths following their learning needs and interest.

As a result, students adopt a variety of learning strategies since the pedagogy used to convey the knowledge affects their capacity to learn (Darling-Hammond et al., 2020). The assessment of learners' learning and training in an online learning environment are essential components of e-learning programs (Elameer et al., 2008). Since learning takes place in a technologically driven, much more learner-centred setting, content management of e-learning programs is essential. Moodle was created as an LMS primarily to provide collaborative content creation, organisation, control, and administration of document

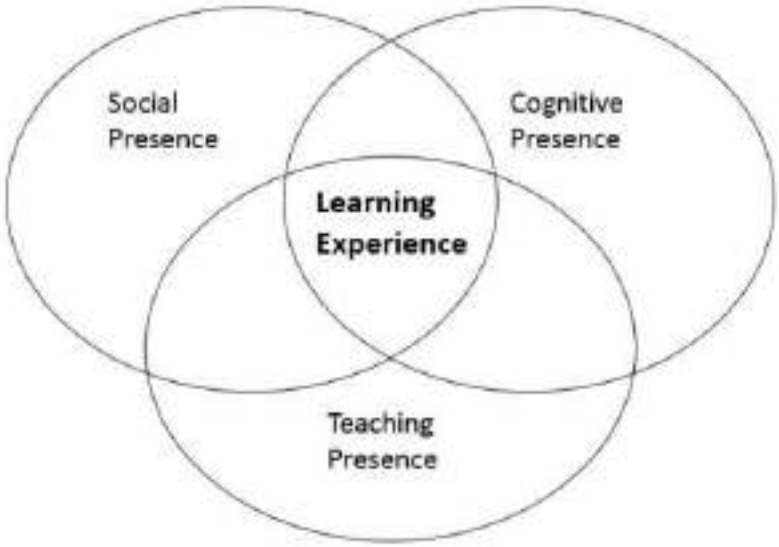
releases (Elameer & Idrus, 2012). The Orbital E-Education Framework is comprehensive and has been successful in Iraqi higher education institutions since 2011. It is a prototypical example of how technology and academia can collaborate to improve learning's stability, sustainability, modularity and standardability (Elameer & Idrus, 2012). Next, the Community of Inquiry Theory is evaluated due to its usefulness in assessing online course design to augment critical thinking development as a vital ingredient of problem-solving skills development in a technology-driven environment.

2.3 Community of Inquiry Theory (CoIT)

The Community of Inquiry Framework Theory is the product of a 1997–2001 initiative supported by the Canadian Social Sciences and Humanities Research Council. The project was named *"A study of the Characteristics and Qualities of Text-Based Computer Conferencing for Education Purposes"* and was created by Garrison et al. in 2000. This group is credited with creating the Community of Inquiry concept for online learning environments. The CoI Framework represents a method of establishing a profound and meaningful (collaborative-constructivist) learning experience through developing three interdependent elements: social, cognitive, and teaching presence (Garrison et al., 2001). The CoI Theoretical Framework is presented in Figure 7.

Figure 7

The Community of Inquiry Framework



Note. From Critical inquiry in a text-based environment: Computer conferencing in higher education model by D. R. Garrison, T. Anderson, & W. Archer, 2000, (https://doi.org/10.1016/S1096-7516(00)00016-6).

According to Garrison (2009), social presence relates to a factor connected to participants' capacity to identify with the study's focus on a particular community, which is the first important driver in the CoI Framework. The ability of course participants to interact meaningfully in a setting where there is trust, fosters the growth of interpersonal connections as reflected via individual personalities is connected to their social presence. The design of cognitive presence to promote and direct the personal and educational value of learning outcomes constitutes the second component of the CoI Framework (Anderson et al., 2001). The ability of students to create and reinforce meaning through participation in reflection and conversations is referenced in the third component of the CoI Framework, which emphasises instructional presence (Garrison et al., 2001).

In order to better understand course design and delivery as well as participants' online learning experiences, the Community of Inquiry (CoI) Framework has been widely applied in educational environments. Garison (2009) is also confident that the primary goal of the idea of community in an online learning environment is to provide course participants with access to information. Additionally, emphasis is placed on the learning experiences of course participants and their collaborative involvement to explore, create meaning and confirm understanding. The starting point of accessing information is an exploration, and the process ends with validation, defined as "inquiry".

These theorists argue that an overlap exists amongst social, cognitive and teaching presence, and follow-up studies on each identified element are encouraged (Anderson et al., 2001). Thus, the CoI Framework is supportive of the design of online and blended courses to create active learning opportunities for students, as it is argued that blended and online learning environments create opportunities for information and opinion sharing between the instructor and the student.

Collaboration among students and instructors is associated with the social phenomenon of "presence". Consequently, the CoI Framework has gained growing popularity with its emphasis on the value of discussion boards, blogs, and videoconferencing. The CoI Framework (Garrison et al., 2000) assumes that higher-order learning in any educational setting requires the development of a community anchored in active collaboration amongst study participants (the students) and the instructor.

Numerous criticisms of the CoI Framework were made, particularly concerning its social presence component and the requirement to modify the original definition. Kreijns et al. (2014), however, concluded that the concept of social presence needed to be split into two separate conceptions. The "degree of the realness of other participants in the

conversation" and the "degree to which social-interpersonal interactions are salient" were recognised as these constructs (Kreijns et al., 2014).

Garrison and his colleagues concurred that the idea of "social presence" had thoughtfully changed since it was first conceived. The first definition fell short of reflecting the concept of "social presence" in all its complexity, especially in establishing a purpose-driven educational community (Garrison, 2009). In order to emphasize the "progressive" quality of the construct, which is embodied in the participants' ability to relate to the community, for example, in a study course, a new definition was thus proposed. A study was conducted to determine how blended learning affected Communities of Inquiry and how high school students attending a public charter school felt about learning. According to this study, the Community of Inquiry Framework is useful for studying how distance learning affects students' academic performance in grades K–12 and for adapting the CoI framework to classroom settings (Harrell & Wendt, 2019).

According to Anderson (2017), the CoI model supports research and course development within online conferencing and educational settings with a robust technological base. The study *"The Influence of Using Collaborative Tools on the Community of Inquiry in an Interdisciplinary Project-Based Learning Context"* validates the efficacy of the CoI model theoretical framework in describing and explaining the relationships among the three presences, cognition, social interaction, and teaching in the context of interdisciplinary project-based learning (IPBL). The study's findings revealed that teaching and social presence had a favourable impact on students' cognitive presence, lending validity to the theoretical CoI paradigm. (Hsu & Shiue, 2017).

In order to better understand how receptive students and instructors were to the benefits of adopting Moodle as an LMS, the CoI Framework was used in the current study. The CoI Framework is also pertinent to this study to determine if using Moodle boosted

course engagement and the development of students' communication and problem-solving abilities. Additionally, it was critical to include the opinions of the systems analyst, instructional designers, academic coordinators, and lecturers when suggesting actions to improve NUST's usage of Moodle as an LMS.

The next part covers the background, evolution, and interrelationship of the key constructs connected to the efficient use of Moodle as a learning management system in higher education to gain a greater knowledge of the effective use of LMSs in blended learning contexts.

2.4 Key Constructs for the Effective Use of Moodle

In higher education, the use of Moodle as an LMS to supplement conventional classroom teaching and learning has grown in popularity over the past ten years. It is necessary to grasp several vital notions to increase the understanding of the current study. There will then be a discussion on the essential concepts of the present study, including blended learning, blended learning techniques, online learning, e-learning, learning management systems, and e-learning management, among others.

Blended Learning

In 2000, the idea of blended learning was established as a framework to assist conventional face-to-face instruction (Marsh, 2012). In search of an ideal definition for blended learning, Hrastinski (2019) reports that, although blended learning is frequently used, its meaning still appears to be ambiguous, as many scholars conceptualise the concept based on how it is internalised. A ProQuest Central search between 5 January 2016 and 24 May 2020 brought up 3,299 results for blended learning. Additionally, the most popular cited blended learning definitions in the literature (ProQuest Central, 2020) suggest that of Graham (2006) and Osguthorpe & Graham (2003). Constructs that yield the same meaning as blended learning is mixed learning or hybrid learning. Additionally, the use of the term

blended learning has been reported to be relatively new, as the construct of hybrid learning is mostly used in higher education circles (Graham, 2009; Watson, 2008).

Graham (2006) defines blended learning more explicitly as "blended learning systems," which refers to a combination of in-person education and technologically supported learning. According to more prominent definitions offered by other writers, blended learning is a methodology that provides students with individualised teaching and learning activities based on their unique learning requirements (Chew et al., 2008). However, implementing a blended learning approach in higher education necessitates deliberate planning of the learning process to incorporate in-person and online contact. In order to address the various demands of individual students, Mirmoghtadaie et al. (2020) describe blended learning as the compelling mix of face-to-face and online education. This is the term that best fits the study's purpose and environment (Yigit et al., 2014).

Some theorists view blended learning as a complementary tool to aid students' engagement with their studies outside the physical class, such as watching videos on missed lectures, among many other benefits (Kabassi et al., 2016). Nonetheless, most definitions of blended learning agree that this model is functional in blending traditional face-to-face and online education. Consequently, blended learning closely relates to adopting various blended learning approaches to increase students' learning experiences.

Blended Learning Approaches

While the focus on blended learning involves combining traditional teaching with technology, it is equally valid that blended learning approaches place a high premium on the output of the action. As such, blended learning approaches are associated with instructional strategies used to combine classroom teaching with technology in an effective manner to create opportunities for active learning, most commonly in an online environment (Cleveland-Innes & Wilton, 2018; Kintu & Zhu, 2016). An agreement exists that adopting a

blended learning approach requires institutions to rely on integrated instructional strategies by blending face-to-face interactions and online activities. Therefore, educational institutions depend on blended learning approaches to promote active learning and, concurrently, shift the responsibility to learn to the student while the lecturer becomes less prominent (Cleveland-Innes & Wilton, 2018). Consistent with the latter claim, Yeou (2016) confirms that educational settings that rely on blended learning approaches create various opportunities to augment student-student interaction, student-teacher interaction and flexible access to learning resources to complement instruction.

A study conducted at the Greek Universities and Technological Educational Institutions (GUTEI) to evaluate the learning management system stressed six dimensions: student, teacher, course, technology, system design and the environmental dimension. Study results confirmed that open online classes effectively complement face-to-face instruction at the GUTEI of the Ionian Islands. Notwithstanding the lecturers' concerns about the passive involvement of students in watching video lectures uploaded in the course, this study found that blended learning did not diminish the physical presence of the students in the classroom (Kabassi et al., 2016).

Therefore, adopting blended learning approaches offers complementary tools to augment further study beyond a physical classroom. Students can watch missed lectures conveniently (Cleveland-Innes & Wilton, 2018; Kintu & Zhu, 2016; Kabassi et al., 2016; Ramesh, 2015; Yeou, 2016). Furthermore, they can enjoy flexible learning opportunities and take increased responsibility for their learning, among many other benefits linked to the integration of blended learning, which will be unpacked in the following paragraphs.

Advantages of Blended Learning

Adopting a blended learning approach stimulates student learning experiences, increases their engagement with course material and creates enjoyable learning experiences for

students (Kabassi et al., 2016; Kintu & Zhu, 2016; Ramesh, 2015; Yeou, 2016). Additionally, traditional physical classroom interactions help encourage collaborative activities like discussions, one-on-one or group debates, viva voce presentations, and clarifying queries (Professional Learning Board, 2020). The claims that prominent advantages are possible through blended learning, for example, that learning is extended beyond the classroom, adds to the flexibility and convenience of blended learning, as students have access to study the content at a time of their convenience (Professional Learning Board, 2020; Shah & Barkas, 2018).

However, the effective integration of technology in instruction depends on several environmental characteristics to ensure the accessibility of learning. As stated in the Office of Technology (2017), accessibility is associated with the design of technological devices, the use of technologies, materials and environments that hone and enable access to instructional material and educational activities for all learners. A practical example of accessibility, in the context of blended learning, includes access to text-to-speech applications to access content and a combination of auditory and digital text formats of instructional materials. These courses differentiate instruction, adaptive testing, built-in accommodations and assisting technology (Office of Technology, 2017).

Informed by the preceding discussion, adopting a blended learning approach allows students to have increased social interaction due to their responsibility to become more prominent during class debates (Garrison et al., 2001). Consequently, it produces exciting, stimulating and fun learning experiences, as the learning process becomes interactive, convenient, and more accessible due to the openness and flexibility of online learning and its potential. However, not embedding accessibility tools in the online learning environment may restrict access to learning (Kabassi et al., 2016; Wisconsin Council of Administrators of Special Services (WCASS), 2019). Henceforth, as much as the integration of blended

learning yields several advantages, one cannot overlook the drawbacks associated with this type of learning. Next, the disadvantages associated with blended learning integration are explored.

Disadvantages of Blended Learning

The dependency on blended learning may also create a great deal of havoc, especially when the educational environment lacks the readiness to accept all the challenges associated with introducing and using such an innovation. Winstead (2020) reports at least six disadvantages of blended learning integration, which include, among other things:

- infrastructural technological challenges institutions may encounter;
- the mental impact of technological challenges;
- the risk that students may fall behind due to not watching a class recording promptly;
- extra load on teachers to prepare and sustain 'hybridisation' and technical training teachers may need to survive as hybrid teachers;
- the issue of cognitive load students are experiencing in blended learning environments; and
- plagiarism and credibility concerns.

Boelens et al. (2018) claim that the advantages associated with blended learning may outweigh its disadvantages. As such, the study's findings at Ghent University emphasise the importance of student support for the successful implementation of blended learning in higher education. The instructors at Ghent University agreed that blended learning design should differ from designs associated with classic learning. In addition to this, blended learning should be custom-made to suit the needs of the students. Although blended learning offers several advantages, professional support is crucial during the period a course is provided to unlock the full benefits of blended learning (Boelens et al., 2018).

The next paragraph zooms in on the meaning and relevance of online learning to gain insight into the online component of blended learning.

Online Learning

Online learning is defined as a distance education method that uses computers and internet connectivity to ensure the actual delivery of learning. Additionally, for a course to qualify as an online course, at least 80% of the instructional material needs to be offered in the online environment (Allen & Seaman, 2013; Leon, 2016; Shelton & Saltsman, 2005). Literature reveals that the first computer-based training programme, the Programmed Logic for Automated Teaching Operations (PLATO), was designed for students at the University of Illinois (Talent LMS, 2020). PLATO was introduced in 1960 and is commonly known as the CBT programme to provide course material to students predominantly static.

The online learning phenomenon originated during the 1980s, whereby companies used computer-based learning to educate employees in the corporate arena mainly for training purposes (Rudestam & Schoenholtz-Read, 2002). The innovation followed the unveiling of the World Wide Web (Web) in 1999 to introduce a broader range of educational experiences at the Open University in Britain, including email communication with students (Bryant, 2011). Furthermore, the University of Phoenix has been among the pioneers in offering online learning opportunities to students. Subsequently, online educational programmes at the University of Phoenix were introduced in 1989, with CompuServe, one of the first consumer online services. As online education continues to develop, initiatives were introduced to fund institutions that presented online programmes to expand the quality of online education (Kenton, 2015).

Informed by the abovementioned discussions, one may conclude that the initial introduction of online learning aimed predominantly at creating and strengthening training opportunities (Adekola, et al. (2017). This initiative has led to the reality that this type of

learning can increase students' learning experiences. To ensure effective online learning, students require internet connectivity to enjoy the full benefits of online learning. Most importantly, in an online setting, the students must display specific techniques to get the most out of their learning experiences. Therefore, online learning contains elements of blended learning using an LMS and e-learning to warrant efficacious content delivery (Cheung et al., 2017). One can draw a close relationship between blended and e-learning, as it is impossible to offer blended learning without e-Learning (Adekola, et al., 2017). Hence, the subsequent discussion provides insight into the background of e-learning as a concept.

Concept of e-learning

Although the origin of the construct remains unknown, Moore et al. (2010) report that electronic learning (e-learning) was introduced in the late 1980s. Computer-aided learning, delivery mechanisms and media are among the requirements to offer e-learning. The construct 'media' refers to including multimedia, educational programming, simulations and games in the course design. Electronic learning is commonly referred to as e-learning, a type of learning offered via the Web that relies on advanced networking, communication and broadcasting technologies (Shah & Barkas, 2018). Ulker and Yilmaz (2016), on the other hand, define e-learning as a type of learning that requires interaction between the student and teacher but takes place in an online setting. Consequently, a student does not go to a physical class to take a course, as teaching and learning have shifted online from physical spaces. Both the teacher and the student may be in the same building, but the teaching, learning and communication happen online.

Agreement exists that e-learning provides access to learning tools (learning resources) conveniently at any time and place (Holmes & Gardner, 2006; Yılmaz, 2012). Furthermore, Rosenberg (2001) agrees with Shah and Barkas (2018) that e-learning requires internet connectivity for increased performance. Rosenberg (2001) stated that the e-learning

process is managed through an LMS. Thus, e-learning offers a wide range of advantages over classical learning (El-Bahsh & Daoud, 2016; Rosenberg, 2005).

Furthermore, Broder (2014) postulates that e-learning involves online and offline engagement. The offline component may require a student to produce an offline response using a computer that does not necessarily require internet connectivity. However, an active internet connection is needed to submit tasks or projects online (Broder, 2014). In a recent study, Ken Research (2018) reports that e-learning is estimated to play a significant role in the market's overall development due to its capacity to drive quality and revenue to promote improved knowledge transfer.

Informed by the abovementioned debate, one may conclude that e-learning requires online and offline interaction with course material from students (Adekola et al., 2017). Firstly, students must access the material (online engagement using an electronic device). Secondly, students engage with the task (offline engagement using an electronic device). Thirdly, students need to submit assignments for grading (online engagement via an LMS using an electronic device). Thus, e-learning may facilitate quality education, improve students' learning experiences, and create revenue, as this type of learning is infiltrating various educational markets globally at an exponential rate (Ken Research, 2018; UNESCO, 2002). For e-learning to be offered effectively, universities need to decide on a learning management system based on a needs assessment. Thus, to get insight into how e-learning is provided, the following discussion explores the purpose and importance of an LMS.

A Learning Management System (LMS)

The construct learning management system originates from the 1990s and is defined as technologies applied to assist with the delivery and support of e-learning via the internet (Coates et al., 2005). LMSs are commonly used in educational sectors around the globe, including the use of Moodle, Blackboard, WebCT, Desire2learn, and eLeaP LMS (Kiget et

al., 2014). AN LMS is particularly useful in administering and facilitating the content, designing learning activities, setting online assessments, evaluating lessons, and augmenting communication between the lecturers and students (Jakchaikul, 2015).

De Oliveira et al. (2016) report the lack of clear definitions to stress the relationship between learning management systems and e-learning management. Moreover, the lack of empirical research to adequately differentiate between the different technological platforms to avoid them being treated generically is a matter of concern. The implications for the e-learning management field using LMS cannot be weighted unless there is a research agenda (De Oliveira et al., 2016). Additionally, Lohn and Teasley (2009) define an LMS as a web-based system that enables instructors and students to interact by sharing instructional materials, making class announcements, submitting and returning course assignments, and communicating online. Furthermore, an LMS is a valuable tool for administering and facilitating content groups and learning activities. While content grouping refers to the actual learning resources, learning activities include quizzes, tests, examinations, lesson activities, and interactive communication opportunities between the students and lecturers. The meaning of an open-source learning management system is explored next.

Open-source Learning Management Systems

Higher education institutions can choose from various learning management systems based on a unique set of needs (Alsadhan et al., 2014; Shannon & Rice, 2017). Learning management administrators should decide on the choice of LMS, which entails rigorous institutional needs analyses and an assessment of available software (Elameer & Idrus 2012). Many higher education institutions may find open-source learning management systems particularly useful. However, adopting open learning management systems requires open-source users to budget for technical overheads. It has been reported that deciding on the type of LMS to invest in is rather tedious and highly challenging (Shannon & Rice, 2017).

Systems administrators and university management must remember that the expression "open-source software" does not always mean such a choice is free. The opposite is true: "being free does not always mean the software is an open-source".

The prominence of e-learning technologies as a support mechanism for helping students increase course engagement is equally important to ensure effective online learning. The following paragraph discusses the significance of information technology for an LMS to function smoothly to draw insight into the relevance of information technology.

The Use of Information Technology

The Harvard Business Review developed the information technology construct to distinguish between devices explicitly intended to do a single job (purpose-built devices) and devices meant to perform various activities (general-purpose machines). The information technology sector was founded in the middle of the 20th century (Adeola, 2018). Over the past 50 years, there has been a revolution in how technology has affected teaching and learning. The use of computers in the classroom in the 1990s, video teleconferencing in the 1980s, and social media technologies in the present are all examples of how advancements in information technology have impacted how students learn and how professors instruct (Harnish et al., 2018).

Indeed, a new study reveals that information technologies may affect how pupils learn positively and negatively. This trend of acquiring high-tech commodities at reasonable pricing is increasing as different technologies are penetrating various markets at an alarming rate. The use of any computers, storage, networking, and other physical devices, infrastructure, and processes to create, process, store, secure, and electronic exchange data is therefore included in a proposed definition of information technology (IT) (Bigelow, 2019). Organisations rely on IT for the smooth functioning of daily operations (Courtney & Wilhoite-Mathews, 2015).

Furthermore, IT encompasses numerous layers of hardware and software. Hardware denotes physical equipment, such as virtualisation and management or automation tools, whereas software comprises operating systems and applications. The dependency on IT includes a range of user devices, such as laptops, smartphones, recorders, peripherals and software. Additionally, IT is linked to designs, techniques, and rules for archiving information (Durlach et al., 1995). Moodle as an LMS is one technology that has evolved into the foundation for successful online and blended learning in higher education contexts worldwide, which will be discussed in more detail in the following paragraph.

Moodle as a Learning Management System

Martin Dougiamas invented and created Moodle, also known as the Modular Object-Oriented Dynamic Learning Environment, as an open-source platform in 2002. It was designed to deliver an open, robust and secure learning platform to educators, administrators and learners (Shan & Barkas, 2018). Moodle provides opportunities for users to learn in a personalised environment. It has been reported that Moodle is particularly user-friendly as an LMS and supports the learning and training needs of students and academics globally (Courtneyand & Wilhoite-Mathews, 2015). On the contrary, Aljeeran (2016) conducted a study at the Gulf University of Science and Technology (GUST). It was concluded that the faculty members found particular Moodle tools quite complex.

Moodle is a forerunner in open-source learning management systems, as 60% of higher institutions use it worldwide. In April 2022, more than 179,000 registered Moodle sites worldwide provided learning opportunities to millions of students. An estimated 313,419,191 Moodle users had access to more than 40,000,000 courses globally (Moodle, 2022). The Moodle headquarters are based in Perth, Australia, and several satellite offices are situated worldwide. As much as Moodle is a well-known platform among academics and

students, it has gained popularity at the enterprise level of varying sizes (Kabassi et al., 2016).

As an open-source, Moodle offers flexible learning experiences to its users. Various plugins provide convenient tools for educators to assist with designing, developing, and managing online courses. Moodle promotes social networking through its interactive and networking features, forums and wikis (Ulker & Yılmaz, 2016). It is particularly suitable as it augments collaborative learning, allows Moodle instructors to create roles, assigns permission, and adds and moderates discussion forums. It also allows users to subscribe to forums, receive notifications, and attach resources, among many other functionalities available to instructors. Instructors are also offered the opportunity to either add a grade or rate Moodle forums (Moodle, 2020). However, Moodle requires that administrators host their own LMS, which is also applicable to e-commerce (Servidio & Cronin, 2018). The following section considers the responsiveness of students and lecturers to capitalise optimally on the existing features of Moodle.

2.5 Responsiveness of Course Participants to Utilise the Features in Moodle

The following discussion focuses on utilising the main features of Moodle, followed by a discussion on the responsiveness of course participants to use the available tools.

The Main Features of Moodle

Fourteen different activities are available in the standard Moodle version to teachers if the editing feature is enabled and the link "Add an activity or resource" is activated (Moodle, 2019; Sathian, 2016). These activities include:

- Assignments: Teachers use the assignments tool to create tasks or assignments for students. Students complete and upload projects through the assignment activity. Teachers grade students' projects submitted online, and students can view grades and feedback in the grade book.

- Chat: Participants can have synchronous conversations in real-time through the chat activity.
- Choice: In this exercise, students are given a choice of many possible answers to the teacher's question.
- Database: Using this tool, users may create, maintain, and search a database of record entries.
- Feedback: It enables educators to design and carry out surveys to gather information or feedback.
- Forum: Using this feature, members can have asynchronous conversations at various times. It is not necessary for everyone to be online at once.
- Glossary: Participants can use this to compile and remember a collection of definitions, much like a dictionary.
- Lesson: The purpose of this tool is to provide material in various ways.
- Learning Tools Interoperability (LTI) External tool: This tool allows participants to interact with LTI-compliant learning resources and activities on external websites. This tool needs to be set up by the site administrator to make it available to teachers.
- Quiz: Teachers use this tool to design and set various tests, examinations or quizzes.
- Shareable Content Object Reference Model (SCORM): It allows adding SCORM packages as course materials.
- Survey: Teachers might design surveys to gather information from students to understand their classes better and reflect on their own teaching.
- Wiki: With this technology, users may construct web pages that anybody can edit or add to.

- Workshop: The Workshop feature provides opportunities for peer review.

Moodle tools can be classified into learning skill tools, communication tools and productivity tools (Wichadee, 2015). The learning skills tools allow course designers or teachers editing rights to create student learning activities. In addition to the editing rights afforded to the course designers or teachers, the study skill tools allow course designers to create quizzes and assignments (Kraleva et al., 2019). Additionally, the quiz feature provides feedback, scores online tasks, tracks students' progress, and manages question databases (Moodle, 2020; Wichadee, 2015).

Furthermore, the communication tools allow course designers or teachers to set up discussions to promote student-student and student-teacher communication on the e-learning platform. The most commonly used communication tool is located on the course's home page and is referred to as the announcement tool (Kraleva et al., 2019; Wichadee, 2015). Teachers use the announcement tool to provide one-way communication with course participants, make course announcements, or share information with course participants (Padayachee, 2017).

For a higher degree of interactivity, instructors create forums that allow both the instructors and learners to post messages and read the comments from other course participants. Course editing rights are open to the instructor only, who may upload content on the course, organise learning content, and manage available discussion groups and information that provide rights to delete inappropriate content from the course (Rodríguez et al., 2019). Student engagement is crucial for improved learning experiences (Ding et al., 2017).

The productivity tools include the software functionalities embedded in the LMS to allow course designers and teachers to upload and download various documents. With the vast number of features available in Moodle, instructors are better equipped to facilitate

teaching successfully and offer students the necessary support. Researchers agree with Moodle's capacity to provide ample opportunities for student support, motivation and engagement (Amandu et al., 2013; Çelik, 2011). Additionally, Dhakal and Sharma (2016) agree that students' engagement is viewed holistically, as they benefit emotionally, socially and cognitively from studying in a virtual environment. Thus, the following section sheds light on the factors associated with the responsiveness of users to use existing Moodle tools effectively.

The Utilisation of Moodle Features

The responsiveness of course participants to engage with Moodle online course content, activities, and resources has been a topic of increasing interest over the past decade (Badia et al., 2018; Jackson, 2017; Mbuva, 2015; Servidio & Cronin, 2018; Shah & Barkas, 2018). However, the effective implementation of Moodle to capitalise optimally to reap the benefits of Moodle tools depends on several factors.

As stated by Estacio and Raga (2017), it is quite challenging to assess the impact of the frequent use of Moodle tools on students' overall course performance. A question to ponder is: Does students' responsiveness in using the features in Moodle affect the overall course performance of students? Therefore, one needs statistics to clarify the latter question. According to Macfadyen and Dawson (2010), the type of Moodle activity students frequently engages in needs to be looked at to find an answer to the question. Moodle has been designed in such a way to collect routinely detailed data on the logs of students on the Moodle platform. This unique feature of Moodle to collect student activity log data enables researchers to easily access a tremendous amount of data (Blikstein, 2011).

One fascinating observation reported by Estacio (2017) confirms that the low activity level on a specific Moodle course in his study did not lead to students' lower overall course scores. According to the latter study, the number of hours spent on Moodle courses should

not be regarded as a success factor in gauging students' performances. However, the quality of instruction available to students should be crucial to instructors.

Aljeeran (2016), who investigated the role of socio-cultural factors in faculty members' acceptance of Moodle at GUST, reports that some tools and functions of Moodle are complex to use. A mixed-method case study was conducted at GUST by administering surveys and conducting interviews to study participants. The study results pointed out that the complexity of Moodle leads to the inability of course participants to use some of the Moodle tools effectively. As such, faculty members become frustrated and discouraged from using some features of Moodle. Subsequently, the study proposed that faculty members need more training to sharpen their skill set in using more complex tools of Moodle. Thus, the frustration of not being able to use some tools and functions in Moodle accounts for the discouraging attitude Moodle users have adopted.

A similar case study was conducted in Kufa on the complexity of Moodle. Survey questionnaires were administered to 242 faculty members at the University of Kufa to investigate the adoption challenges of e-learning using quantitative data analysis techniques. The results revealed that faculty members agreed that the Moodle platform provides some challenges. Very interestingly, the faculty perceived using social media to be convenient and less complex than using Moodle as a learning management system (Karkar et al., 2020). The preference of faculty members to use social media platforms instead of Moodle to share course material with students is quite an interesting observation. Educators and students are discouraged from using the Moodle platform, irrespective of its actual usefulness. Henceforth it was suggested that Moodle trainers should consider some means of motivation even in the event of training programmes to encourage end-users towards the effective use of the LMS (Karkar et al., 2020).

It is also evident that some course participants lack interest in engaging in forum discussions, although the course design promotes ample interaction opportunities. A study conducted among PhD students at a university in Cyprus confirmed that most PhD students failed to participate in online discussion forums, despite many opportunities for student engagement available on Moodle (Rezaei et al., 2015). Thus, a matter of concern is the reluctance of students to participate actively in discussion topics, especially if the contributions do not carry any weight towards the course grades.

Lin (2016) conducted a study in Texas to analyse the use of course management systems in online courses. This study proposed that faculty members require training of at least 15 hours to learn the basic features of an LMS and three years of training to reach the level of intermediate skillset. Lin's study revealed that experienced LMS users were more proficient in using bulletin boards, discussion forums, grade books and email, regardless of the training offered to faculty members (Lin, 2016).

When students use Moodle for the first time, they lack positive experiences (Aljeeran, 2016). However, once students have become familiar with the structures and functions of the learning management system, they adopt a more positive attitude towards using the platform. Also confirmed by literature, students who can use the internet are faster in familiarising themselves with Moodle (Mbuva, 2015).

In a study conducted to determine the relationship between external factors and attitude, Baturay et al. (2017) reveal that the environment, culture and learning atmosphere are regarded as external factors that impact educators' attitudes regarding their responsiveness to the use of e-learning. Furthermore, Marikar and Jayarathne (2016) conducted a study at a Sri Lankan University, of which 61.0% of sampled students indicated that their results improved by using Moodle as an LMS. According to Costa et al. (2012), the majority of students indicated that Moodle is helpful for downloading materials, turning

in assignments, and watching course news. This finding is consistent with the findings of the latter research. The variables effort expectation, performance expectancy, enabling circumstances, social influence, and behavioural intention were shown to be positively correlated with faculty members' reactivity to Moodle (Saleem et al., 2016).

Furthermore, as far as the adoption of Moodle is concerned, four dynamics were identified to be significant, namely: gender, age, the voluntariness of use and the experience of Moodle users. Although some faculty members did not use Moodle at all, users were doubtful about the potential of Moodle to influence the academic outcomes of students (Wichadee, 2015). On the contrary, Saleem et al. (2016) claimed in their study that some faculty members describe Moodle as an ineffective tool to enhance students' skills.

The following section sheds light on some factors that affect successful blended learning integration in higher education settings to understand the factors that impact successful blended learning integration.

2.6 Signifying Factors to Affect Blended Learning in Higher Education

Successful integration and satisfactory adoption of blended learning in universities may advance student learning experiences. Additionally, to ensure pleasurable learning experiences for online course participants, course facilitators and university management need an understanding of key success and critical factors that may put students at risk of failure. Hence, this section unpacks various dynamics that may impede the successful engagement of students in blended learning settings.

E-Learning Readiness

Factors such as e-learning readiness, isolation, sense of loss, and the absence of online communication abilities of students, directly affect learning experiences in an online or blended setting (Oblender, 2002; Wojciechowski & Palmer, 2005). As stated by Atchley et al. (2013); Oblender (2002), a significantly higher dropout rate has been reported for

students who study online compared to students who engage in face-to-face learning. A matter of concern is the high dropout rate of students enrolled in online courses compared to traditional face-to-face learning (Atchley et al., 2013; Oblender, 2002).

According to Kaur and Abas (2004), e-learning readiness plays a significant role and is associated with the usability and application of online learning. The motivation level of online students and facilitators, according to Rosenberg and Rannelluci (2017); Selim (2007), as well as the readiness of students for the adoption of blended learning, are crucial factors for the successful implementation of blended learning (Al-Ayed & Al-Tit, 2021; Halverson & Graham, 2019; Kurt & Yildirim, 2018).

In a study conducted at the Satya Wacana Christian University, Indonesia, survey questionnaires were administered to 108 participants to assess the readiness of students to engage in blended learning, with a focus on their attitudes towards learning. The findings of this study confirmed the importance of students' readiness level to engage in online learning. Students' positive attitudes include learning flexibility, positive online learning experiences, online interaction, and study management. The findings of this study revealed that student readiness is crucial for the successful implementation of blended learning (Yulia, 2016).

Much agreement exists regarding the importance of the level of readiness of course participants to study online (Moftakhari, 2013; Piskurich, 2003). Despite claims of a growing tendency among university students to rely heavily on technology (Prensky, 2001), combining traditional classroom teaching with learning technologies is still an emerging teaching approach for many course facilitators and students. Since the usefulness of blended learning is not understood fully by university management (Hao, 2016), adopting blended learning approaches impacts student learning experiences considerably (Yulia, 2016). Many students are challenged to adjust to blended learning approaches successfully. Thus, such

students may not capitalise optimally from the flexible learning opportunities this mode of study offers. Next, the construct of learning flexibility is unpacked.

Learning Flexibility in Blended Learning Settings

Learning flexibility is one of the many advantages blended learning offers, as it enables students to balance their studies, work and family life to manage their various responsibilities. Blended learning allows learners of all levels to advance their studies at their own speed, allowing fast learners to advance more rapidly, while challenging students may proceed at their own pace and receive individualised guidance where they are stuck. A study by Chandra et al. (2022) reported that blended learning allows for more flexibility when engaging with blended learning through an LMS. Similarly, an investigation to establish the advantages and challenges pre-service teachers experienced participating in a blended course revealed flexibility and pace as one of the main themes of the study (Shand & Farrilly, 2018). One may agree that blended learning creates online learning experiences that cater to the needs of shy students and those who lack confidence in publicly sharing opinions and ideas directly (Howard, 2009).

Furthermore, blended learning augments student learning management, as this mode of study requires students to take ownership of their studies. One may agree with Tsai (2010), who claims that blended learning creates opportunities for students to become self-regulated learners, which is a learning process to simplify planning, management, and direction of the learning activities ideally to share the responsibility of learning between learners and teachers. Hence, the following paragraph explores the significance of self-regulated learning in a blended learning setting.

Self-regulated Learning (SRL)

Students who participate enthusiastically in a blended course, both with course content and participants, possess an acceptable level of self-regulation. Broadbent (2017)

agrees with Zimmerman (1986) that a high display of self-regulated learning skills promotes optimum course engagement and increases student learning experiences in blended learning contexts. Such students take ownership of their learning and employ various learning approaches throughout the learning journey.

Several studies identified the challenges students experience in a blended learning environment. Literature confirms that students who have already obtained a degree in a study programme display a higher level of self-regulation in their learning than cohorts without degree qualifications. Consistent with Boelens et al. (2018), similar studies on self-regulation confirm that the higher the education level of students, the higher the levels of self-regulation amongst students (Owston et al., 2013; Postareff et al., 2016).

While Broadbent (2017) claimed that SRL strategies are crucial in blended and online learning settings, Littlejohn et al. (2016) found that learners who rely on different SRL approaches display different behaviour in online learning environments. Consequently, internet access to online course content and activities ensures successful blended teaching and delivery in higher educational settings (Hau, 2016; Prensky, 2001). Conversely, SRL is impossible without access to the internet, as the lack of internet connectivity may deprive students of opportunities to maintain active online course engagement (Mässing, 2017). Furthermore, Hamilton (2019) is convinced that easy access to study material and the ability to use digital technologies are crucial elements for successful integrating blended learning in higher education settings. Therefore, the next section zooms in on the importance of internet access in blended and online learning environments.

Access to the Internet and Educational Resources

Learners in contemporary classrooms are referred to as "digital natives" because of their intense awareness of the use of technology to obtain information and ensure increased online engagement between peers and teachers beyond the physical classroom (Basitere &

Ivala, 2015). Moreover, the popularity of learning technologies in educational settings in contemporary classrooms challenges educators to broaden their horizons in finding solutions to increase the learning experiences of digitally orientated learners (Tshabalala et al., 2014).

Literature confirms that course participants with open access to internet services outcompete those who experience connectivity challenges (Basitere & Invala, 2015; Hamilton, 2010; Mässing, 2017). Similarly, a study conducted to explore student experiences of blended learning in a physics module at a university of technology in South Africa confirms that the students residing on campus are more likely to excel academically. One may agree with Panyajamorn et al. (2018) that the absence of facilities and amenities in higher education institutions, such as high-speed internet connections, affects the learning experiences in blended and online learning environments.

However, in terms of the online test results, it was evident that students residing off-campus indicated that their test results of online tests were better than traditionally written tests (Tshabalala et al., 2014). Shockingly, similar study results revealed that high test scores attribute to collaborative cheating, as students residing off-campus collaborate with students on campus to score higher grades (Basitere & Ivala, 2017). The latter study confirms that universities must be mindful of students' potential challenges using educational technologies to support blended learning due to limited access to resources, specifically in developing countries.

Developing and developed countries differ considerably in terms of the success indicators and key challenges students and course facilitators are experiencing to ensure blended and online learning integration. While access to the internet appears to be a challenge for students in developing countries, this dynamic does not seem to be an issue for students in developed countries. Adekola et al. (2017) conducted a study at the University of Glasgow in the United Kingdom. The study results confirm that several elements

contribute to the successful integration of blended learning in universities. The latter elements include: (1) the convenience of blended learning, (2) flexibility and control over learning, (3) ease of contact with lecturers, (4) encouragement of independent learning, (5) the blended course was easy to use and (6) the potential of peer learning through forums and opportunities for active learning.

On the contrary, the same study also points out some challenges to the successful integration of blended learning, including, among other things: (1) challenges with time management, (2) a sense of loneliness due to reduced face-to-face contact, (3) technical challenges that restrict easy access to study resources, (4) lack of quality instructional materials, (5) absence of input from others, (6) challenges to ask questions online and (7) failure to interact synchronously with the course facilitator or peers (Adekola et al., 2017). Thus, the discussion above shows that internet access is crucial, especially in blended and online educational settings, as teaching, learning, assessment, and engagement depend on access to devices and stable internet connectivity.

Despite several critical factors to confine the successful integration of blended and online learning in higher education institutions, empirical evidence revealed that blended and online learning is perceived as the favourite mode of teaching and learning by students in developed countries (Tham & Tham, 2011). In a study conducted in Turkey to examine the individual dynamics that affect learners' method of teaching and learning delivery preferences, study participants agreed that blended learning is regarded as the preferred mode for teaching and learning (Keskin & Yurdugül, 2019). Furthermore, this study revealed a positive correlation between blended learning as the preferred study mode and the concept of self-efficacy, the value of the task, and e-learning analysis. According to the same study, cognitive strategies, self-directed learning, fear of tests and learner control affected blended learning.

According to Mässing (2017), who conducted a study at the University of Namibia (UNAM) to investigate success dynamics and challenges for e-learning technologies in the Namibian higher education system, the following factors crippled successful blended learning integration and e-learning at UNAM.

- Access: Slow bandwidth is one of the main issues at UNAM. Students also indicated that they experience internet connectivity challenges with devices.
- Lack of user motivation: Most instructional designers lack the motivation to engage in online learning. Staff members are reluctant to participate in e-learning training and workshops.
- The absence of a clear plan and the lack of systematic approaches since the inception of information communication technologies (ICT) at UNAM in 2005.
- Evaluation and analytical challenges: The lack of evaluation of the e-learning initiatives at UNAM and the continuous challenge with monetary support for the technologies and their licenses are issues of concern.

Conversely, Yulia (2016) conducted a study in Indonesia. The study results revealed that internet access, use of technology and online activities do not seem to affect blended learning. Interestingly, Khan (2015) indicates a different view from Yulia (2016), Mässing (2017) and Keskin and Yurdugül (2019), as he points out three categories that affect blended learning.

These categories include multi-modality, the use of multi-media and hypermedia. Firstly, the multi-modality of education depends on ICT usage as a tool for learning and communication. Much emphasis is placed on social media and instructional media in this category. Jones et al. (2010) agree that social media sites can augment the student learning process in blended learning environments, as students' learning experiences are positively impacted in teaching and assessment. Secondly, Khan (2015) is convinced that ICT

contributes significantly to the enrichment of the learning environment. Thirdly, the usage of ICT is fundamental to e-learning, distance learning and open and flexible learning. Fourthly, the functionality of ICT as a training tool has been highlighted. Hence, it is also claimed that ICTs are ideal for using presentations, simulations and representations through multimedia (Atchley et al., 2013).

One group of scholars concentrate on ICT-related dynamics to affect blended learning experiences (Atchley et al., 2013; Khan, 2015; Oblende, 2002; Tshabalala et al., 2014). On the contrary, Cook (2007), Liu et al. (2016), Wojciechowski and Palmer (2005) focus on the psychological effects associated with blended learning. The next section examines literature evidence on the significance of feelings of isolation in online learning settings.

Feelings of Isolation

The element of students suffering "feelings of isolation" has been an area of keen interest. However, research results revealed contradictory evidence regarding the claim that blended learning causes feelings of isolation. Liu et al. (2016) reported that studying in blended learning settings is not associated with feelings of isolation or decreased interest in the subject content. Additionally, Cook (2007) claimed that "social isolation" has been reported as a direct consequence of blended learning. Clearly, blended and online learning experiences present subjective views based on a student's learning experience and environment. Some studies over-emphasised high self-regulation skills of students as a success factor (Dembo et al., 2006; Lee, Hong, & Ling, 2001); whereas Rosenberg and (2017); Selim (2007) focused predominantly on "students' source of motivation" as a critical concern in e-learning and blended learning settings. In the following paragraph importance of access to computer technology is discussed.

Access to Computer Technologies

Access to computer technologies in higher education has contributed significantly to the successful integration of multimedia content and multimedia communication in blended learning settings (Horton, 2006). Similarly, Khan (2016) agrees that the availability of ICT in higher educational settings has contributed to globalised education and ensured the use of media for text, graphics, animations, simulations, games and other audio and video tools. Thus, various techniques are available to design instructional materials, incorporate the diversity and styles of students, and ensure increased participation in learning activities (Darling-Hammond et al., 2020).

As learning activities focus on elements of presentation and design factors, one may agree with scholars who claim that multimedia presentations enhance student engagement in ICT-rich environments facilitated by desktop computers and laptops (Khan, 2016; Kosuke et al., 2004). Furthermore, the use of hypermedia has led to learning that is more virtual and authentic than traditional learning, as instructors and students may shift from one medium to another and from one community to another in the virtual setting. Therefore, the claim that hypermedia does affect learning students' online learning experiences may carry weight (Khan, 2016; Surjono et al., 2017).

Access to flexible social media software applications and smartphones strengthen collaborative and social interactive environments. Additionally, access to smart devices leads to shared information exchange and establishing a shared understanding in a community of practice in learning communities. Moreover, multimedia integration in the learning process makes the learning process more effective with audio-visual aids for simulations. Consequently, multimedia integration is a major factor in advancing learning experiences in blended learning settings (Darling-Hammond et al., 2020; Khan, 2016; Mässing, 2017).

2.7 The Use of Moodle towards Increased Student Engagement

The availability and use of the Moodle LMS as a digital technology hold numerous advantages for instructors, especially in blended and online learning settings. The following discussion sheds light on opportunities for engagement, communication and the development of critical thinking abilities of course participants.

Student Engagement Opportunities in Moodle

Moodle provides four different forums to augment student engagement in an online environment. These provisions include standard forums for general use, question and answer forums, simple discussions and standard forums displayed in a blog-like format (Moodle, 2020). The forum activity functionality in Moodle is a feature to create opportunities for course participants to increase their engagement in blended learning environments and online classrooms. Furthermore, the forum functionality allows course participants to engage in online conversations.

Another engagement opportunity associated with online forums is exchanging ideas and posting comments as part of a 'thread'. A 'thread' in Moodle is a specific discussion topic that allows course participants to reply to a particular subject initiated by the teacher (Centre for Technology Enhanced Learning, 2020). Additionally, course participants may create new 'threads', usually new topics for discussion, depending on the forum's settings. It is important to note that the general forum functionality allows both students and teachers to create a new thread to augment discourse (Sathian, 2016). If teachers opt to create forums for simple discussions, question and answer forums and standard forums displayed in a blog-like format, Moodle restricts students from starting new threads. Consequently, the latter forum choices make it mandatory for all students to respond to a topic initiated by the teacher (Moodle, 2020).

Dixson (2010) conducted a study at the Midwest University in the USA by administering a survey to 186 students. However, the study results found that no particular activity will automatically help students increase online course engagement. It is thus suggested that teachers employ multiple ways of communication in an online setting to improve the course engagement of students. The same study confirmed that the higher student-student and instructor-students communication, the higher student engagement is likely to be.

On a more positive note, forum discussions allow course participants to include files, images and media in forum posts. Contributions of course participants can then be graded or rated by teachers. Additionally, teachers can allow students to rate each other's posts. Ding et al. (2017) agree that online forums are potentially valuable for various learning contexts and play a key role in developing a sense of community as learners are allowed to share the knowledge that leads to developing critical thinking. Moreover, student engagement in forum discussions promotes active online learning, leading to increased student engagement.

Thus, the Moodle instructor must create opportunities for students to collaborate actively in blended learning settings. An agreement exists that active learning emerges if learners can share ideas and actively add contributions to online forums. Thus, Jackson (2017) suggests that a thorough induction programme should be offered to course participants to gain the necessary competence to use the Moodle platform at the beginning of the academic year. In so doing, students get insight into the relevant learning features available in Moodle.

Informed by the preceding paragraphs, one may conclude that management at higher education institutions must enforce mandatory orientation opportunities for both academics and students in the university's strategic plans. Without training opportunities for Moodle users, teachers and students may lack the knowledge to use Moodle features best to promote

active learning. Recent studies agree that Moodle as an LMS offer increased opportunities to its users to augment collaboration. A study conducted at three campuses south of London in Christ the King Sixth Form College (CKSFC) confirmed that Moodle as LMS offers collaborative learning opportunities. Furthermore, using an LMS permits students to maintain collaboration beyond the four corners of the classroom. Additionally, students agree that access to various Moodle tools has enhanced their learning experiences (Jackson, 2017).

However, the study results revealed some concerns about the effectiveness displayed by faculty members regarding the use of Moodle to ensure the design and delivery of quality teaching and learning. On a positive note, staff agrees that Moodle offers a great opportunity for interactivity and flexibility. Yet, a matter of concern is the inability of faculty to utilise existing tools and features available in Moodle (Jackson, 2017). Interestingly, the same study failed to prove whether Moodle as an LMS correlates positively with enhancing course participants' teaching and learning experiences.

Furthermore, several studies agree that using Moodle as an LMS allows for improved collaboration between educators and students due to the feature of a visual messaging tool available on the e-learning platform (Amandu et al., 2013; Baturay et al., 2017; Çelik, 2011; Moffat & Robinson, 2015). It is further argued that Moodle educators can create a community of support in gaining skillsets in developing quality course materials and sharing best practices with colleagues (Dhakal & Sharma, 2016). To establish a deeper level of course collaboration, course facilitators should select astute forum topics and attach specific weightings to forum contributions to encourage increased course engagement. The next section zooms in on using Moodle as an LMS to augment communication.

2.8 The Use of Moodle to Augment Communication

According to Lopes (2014), Moodle as an LMS allows students to access study material on a platform that promotes flexible learning and increased communication opportunities. Furthermore, it is argued that students studying online through an LMS have an advantage over students using conventional methods to study, because of the communication tools available in Moodle. On the contrary, Sathian (2016) claims that students can approach teachers directly to ask questions in the traditional classroom system. It is also argued that communication in the conventional classroom is more open between the teachers and students, which affords ideal opportunities for teachers to provide students with updates personally.

Furthermore, direct conversations make communication in traditional learning open and unmediated. Consequently, when it comes to online and blended learning, teachers need to create and initiate opportunities to establish effective communication through the LMS (Cleveland-Innes & Wilton, 2018; Fry et al., 2009). There are various tools in Moodle available to course participants to augment effective communication. Hence, the subsequent paragraphs highlight the communication tools embedded in Moodle as an LMS.

Moodle's communication tools allow course participants to send and receive emails. The functionality of emailing is an essential platform for communication. Moodle also provides engagement in discussion forums/chats to create communication opportunities in the Moodle course. Additionally, the chat activity benefits real-time communication, also known as synchronous communication (Moodle, 2020; Cleveland-Innes & Wilton, 2018). By using the notes widget, teachers can send short messages to members of the Moodle LMS in the form of personal statements visible to all course participants on the LMS.

Another communication tool in Moodle is the upcoming events feature that allows offline or online planned activities to occur at a specific time. Moodle enables course

participants to add events to the calendar. The upcoming events feature the system to communicate the scheduled events to course participants on the LMS. Another category pointed out as a communication tool in Moodle has been reported as information channels, which include announcements, wikis, glossaries and providing access to the member profile (Moodle, 2020; Sathian, 2016).

Information can be distributed to students or fellow participants using other tools besides communication channels. Thus, it is concluded that Moodle offers a range of communication tools. Moodle administrators are welcome to download additional plugins to provide opportunities for course feedback, rating of courses and Quick mail (Ethridge & Russo, 2020).

The Moodle Checklist widget allows Moodle teachers to generate a to-do list that students can use to provide an easy visual representation of what has been accomplished on the platform at any given time. This feature of Moodle allows teachers to monitor students' progress as they complete items on the list. With this feature, students may see a progress bar indicating the exact percentage of the course that has been completed (University of Massachusetts Amherst, 2020).

Although the use of Moodle as an LMS creates opportunities for effective communication between course participants, a study conducted in Zambia by Akakandelwa and Mkulama (2017) showed that study participants failed to use Moodle for communication purposes due to internet connectivity challenges and restricted access to Moodle. Other challenges that students experienced with Moodle as an LMS were the lack of timely feedback from lecturers, technical troubles in uploading assignments, login problems, frequent failure of the Moodle server, inadequate training in the use of Moodle and lack of technical support.

One may thus conclude that studies are inconsistent about the role of Moodle in increased communication opportunities (Mkulama, 2017). However, it is claimed that a need exists to explore critical thinking development in blended and online settings (Haber, 2020). Hence, a discussion on critical thinking development follows below.

2.9 The Use of Moodle for the Development of Critical Thinking Skills

Concept of Critical Thinking

Singh (2018) defines critical thinking as an individual's capacity to break down and reconstruct what was learned by creating different ways to obtain the same output. Individuals who possess the necessary thinking skills go beyond textbook learning, as critical thinkers would experiment with any available resources to exceed their intellectual growth (Haber, 2020). It is argued that e-learning strengthens the ability to think critically, as it offers limitless growth to students. Therefore, online course facilitators have a responsibility toward students to enable them to practice critical thinking by promoting (1) rational thinking, (2) independent thinking, (3) allowing students to evaluate multiple paths to reach the same outcome and (4) allowing students to distinguish between paths depending on their feasibility (Singh, 2018).

Additionally, as critical thinkers, students should be able to think in a structured way. Critical thinkers have been described as individuals who think in a productive, structured, logical manner to reason systematically (Al-Husban, 2020; Lackner, 2014). A driving question would be: How do online teachers inculcate the habit of critical thinking in students? Hence, the following paragraphs discuss various ways to stimulate critical thinking abilities in online and blended learning settings.

Critical Thinking Stimulation in Moodle

The foundation for critical thinking development is embedded in trial and error. The literature agrees that students develop the necessary freedom to experiment, explore, get

opportunities to try out things, fail, and try again before they succeed (Bergland, 2016). Using Moodle as an LMS gives options to teachers and students to use multiple ways to develop critical thinking capabilities, for example, through discussion boards. Discussion boards are a good starting point for inculcating the habit of critical thinking skill development (Cole et al., 2015). The discussion board is also referred to as an online forum. However, online teachers should create critical thinking skills development opportunities by allowing students to engage in online discussions frequently, or at least after each unit (Foo & Quek, 2019).

Students' engagement in online forums allows them to share their thoughts on what is understood with fellow students and the teacher (Dixson, 2010). Therefore, a healthy transfer of ideas between students and the teacher assists course participants in broadening their scope of thinking. The quick messaging tool can develop critical thinking skills development among Moodle users due to its effectiveness in reaching out to course participants (Cole et al., 2015). Thus, students must be aware of the availability of the quick messaging tool and gain knowledge of how to use it. Using the quick messaging tool, students may share thoughts, perspectives and doubts with peers and the online teacher (Al-Husban, 2020).

Additionally, teachers can teach the development of critical thinking by allowing students to do additional assignments, which can be attempted during their leisure time. Therefore, it is suggested that different assignments are based on real-time problems solving an issue in a particular unit. Engagement in authentic problem-solving initiatives will put students in a position to look at authentic workplace-related matters objectively. As such, students will be able to practice employing multiple paths to find solutions to real workplace problems. Moodle allows students to submit their responses via the assignment tool for

grading (Lackner, 2014). Discussion on how quality assessment and constructive feedback can stimulate critical thinking abilities amongst course participants follows next.

Grading of Moodle Assignments and Feedback to Promote Critical Thinking

The importance of quality assessment and feedback in online and blended learning settings cannot be overemphasised. Recent studies agree that cultivating a habit of critical thinking in online and blended learning is nestled in quality assessment and feedback (Clinton, 2011). Students find it demotivating if their efforts are not acknowledged by not receiving feedback when they have added a contribution in online forums or submitted an assignment for grading. Online facilitators should share constructive feedback with course participants and create a feeling that students' efforts are appreciated (Bernstein & Isaac, 2018). When students' assignments are graded and quality feedback is provided, a sense of value is established. The provision of constructive feedback encourages students to learn more and grow further.

Informed by the discussion above, one may agree with Singh (2018) that critical thinking is crucial in providing effective e-learning and blended learning opportunities. A question to ponder is if students possess essential thinking abilities, are they equally able to solve problems?

Empirical evidence reveals that about 75.0% of students who finished 12 to 16 years of formal education lack the skill to solve workplace problems (Darling-Hammond et al., 2020). Educators claim that much effort is invested in preparing students to augment critical thinking abilities with problem-based tasks in formal education. According to Arum and Roksa (2011), students do not make satisfactory progress in problem-solving abilities while studying in colleges or universities. As the ability to solve problems has become a severe workplace limitation for many individuals who have finished formal education successfully,

educators have to devise strategies to help students strengthen their abilities to gain skills to solve real-world problems.

Furthermore, it is claimed that problem-solving skills need to be developed, but it takes practice and time to develop such skills (Alsaleh, 2020). Although scholars have invested a great deal of effort into researching critical thinking theory and pedagogy, getting students to an acceptable level of thinking critically to solve problems did not seem to be fruitful. Hatcher (2013) agrees with Kuhn (1999) that developing problem-solving skills in individuals is a timely process.

Al-Husban (2020) conducted a study to examine the problem-solving abilities of course participants by posting online discussion forums on the LMS at Arab Open University in Jordan. Garrisons' Models Garrison (2003) was applied to analyse the online behaviour of nineteen students' problem-solving abilities. Study results following the Garrisons' model revealed that study participants could identify and explore problems. However, they were unsuccessful in evaluating issues and integrating solutions based on their existing knowledge. The outcomes of the latter study reveal evidence that participants possess some essential critical thinking skills, but they depend on assistance to evaluate problems. As such, the participants need to work harder to develop their higher-order thinking skills. Additionally, the study concluded that online facilitators need the necessary training to formulate online tasks to augment higher-order thinking and assist students in solving problems.

Evidence from a review of the literature on Garrisons' successive thinking skills stages (Garrison, 1992) and the model of Newman et al. (1995) confirmed that online teachers have to be mindful when creating discussion forums and ensure deep learning of what is understood is a priority amongst participants. Therefore, online teachers should be

specific about the kind of critical thinking required by students for engaging in various types of activities as well as the stages of critical thinking students should reach.

Furthermore, Garrisons' model provides an overall idea of critical thinking levels. Consistent with Garrison (1992) and Newman et al. (1995), Beckmann and Weber (2016) are convinced that the model of Newman provides adequate information about each stage of Garrison's model. Hunter (2018) confirms that engagement in online forums allows students to develop in different stages of critical thinking, especially in higher education settings. However, Garrison (2003) claims that online teachers need to follow certain guidelines and strategies to develop problem-solving abilities. For example, they ask open-ended questions that can develop critical thinking. Moreover, it is suggested that online teachers provide threaded discussions at the end of the studied topic.

This way, students may find the information they are searching for and return to the thread when needed (AlJeraisy et al., 2015). According to Groff (2013), using technology, especially access to the internet, enables the student to explore and provide access to a wealth of resources beyond the textbook. As such, learning with technology has also been identified as an element that may contribute to the development of critical thinking skills, which will be discussed in the next section.

Development of Critical Thinking and Problem-Solving Abilities using Technology

Students in the 21st century do not regard teacher and classroom resources as prime sources of information. Having access to the internet allows students to become better-informed consumers as they apply the technologies at hand to produce and edit information (Himmelsbach, 2019). If students are informed that their work will be posted on the internet, it may change their perception as they produce output for a teacher and a global community. They perceive their efforts as more critical and invest time in analysing their work to a higher level. They know they have to deliver output for a highly crucial global community (Shilo

& Ragonis, 2019). Consequently, students' work gets meaning, as they contribute to a large worldwide community and not only submit work for grading to their teachers (Klein, 2019).

Further, technology allows students to become critical of their work and others when they contribute to wikis (Mohottala, 2016). Contributions to online blogs enable students to reflect on their learning, as students can connect to global audiences to gain new insight and learn beyond what is offered in the traditional classroom (Fettahlıoğlu & Kaleci, 2018).

On the contrary, several studies agree that technology integration still seems challenging (Hartman, 2019; Johnson et al., 2016; Klein, 2019). Very interesting to note is the claim that the development of critical thinking skills in students cannot be secured by technology; the teacher is crucial in assisting with the development of this skill (Singh, 2018). Hartman et al., 2019 confirm that the teacher plays a significant role in developing critical thinking skills amongst students. Despite claims of the effectiveness of 21st-century tools, the teacher is responsible for using the technologies at hand to develop essential thinking abilities and prepare students to solve workplace problems. Hence, teachers are expected to plan well to create ideal opportunities for students to use the tools optimally (Klein, 2019).

One way of using technology to deliver direct instructional materials in multiple disciplines includes using a learning management system, such as Blackboard or Moodle. In this instruction delivery method, educational institutions use logic software, the internet, websites, and sometimes computer simulations to deliver teaching (Astleitner, 2002).

Despite controversial global debates about the advantages of technology-aided education and its disadvantages (Asteitner, 2002; Klein, 2019), blended learning provides excellent opportunities for developing critical thinking skills in higher education settings. Giraldo-García, Roy and Alotebi (2015) conducted a study titled *'The Interplay of Technology and Critical Thinking Skills in the 21st Century Blended Classroom',* which

confirms the significant role blended learning plays in helping students to develop their critical thinking skills in a 21st-century workforce. The effective use of blended learning to enhance critical thinking skills will prepare the students to solve problems in the 21st-century workforce. Thus, the authors in the latter study agree that the use of technology in online settings and interpersonal interactions, in the form of face-to-face learning opportunities, are two important ingredients to help students become critical thinkers and problem solvers (Giraldo-García et al., 2015).

2.10 The Effective and Safe Use of Moodle as an Open-Source

In line with Elameer and Idrus (2012) and Khan (2003), the management team's involvement in support and guidance is crucial in a blended learning setting for the successful offering of the online components of academic programmes. The section starts with a discussion on the effective use of Moodle as an open source to draw insight into the effective and safe use of Moodle as an open source, followed by a discourse on the common safety vulnerabilities associated with the help of open sources. The section ends with a discussion on security measures universities may consider adding to the safe use of Moodle as an LMS. Some important resolutions regarding the university's strategic vision could lead to some points to ponder when choosing an open-source software such as LMS. Ulker and Yilma (2016) suggest the following factors to consider before an institution decides on the adoption of a specific LMS:

- The number of people that will use the software;
- Statuses of experiences of people using the software;
- Availability of human capital to train employees on the use of the open software;
- Considerations about the requirement and scope of the project;
- Number of people that will benefit from training to effectively use the LMS;

- Capacity required in the future;
- Suitability of LMS features offered as open-source;
- The extent to which customisation is required;
- Sufficient amount of hardware and network connection available for the proposed project;
- The cost implication of setting up the LMS;
- Important discussions about technical support, due to the scarcity of technical support services in an open-source LMS;
- The capacity of the IT unit to merge their expertise and knowledge with documentation and forums to solve problems;
- Considerations in terms of the sustainability of the LMS;
- To secure regular updates and following of trends;
- Considerations of the time frequencies required in terms of new hardware and web technologies included in the LMS; and
- The timeframe to address any security vulnerability.

Considering the lengthy planning process and initial discussions before the adoption of a specific LMS as listed above, one cannot overemphasise the importance of technical experts and available information technologies throughout the implementation and management of LMSs (Elameer & Idrus, 2012; Khan, 2003; 2004; 2010).

As much as adopting blended learning approaches may positively affect student learning experiences, higher institutions management should be mindful of the impact such a choice may have on students and academics (Galvis, 2018). Therefore, management should be aware of the necessary infrastructural changes that adopting blended learning approaches may require (Elameer & Indrus, 2012; Khan, 2003). Apart from infrastructural decisions to ensure effective blended learning integration, such innovation may intensify the workload

amongst academics and cause various psychological implications for students and academics (Elameer & Idrus, 2012; Galvis, 2018). In the context of offering blended learning opportunities to students in any educational setting, systems administrators, faculty, students, and various educational stakeholders suffer the consequences of such managerial decisions in the absence of related IT hardware and software (Durlach et al., 1995).

Rossett and Frasee (2006) suggest that management teams in higher education settings recognise the multi-dimensional framework of blended learning. Education takes place in various locations, such as formal, non-formal and informal learning environments. This is possible by building on the strength of each learning setting. In the context of the multi-dimensional framework, formal education refers to the classroom, and non-formal education refers to learning in the workplace and through communities of practice. In contrast, informal learning settings include media and websites.

Furthermore, universities need a selective combination of human facilitators and digital technologies to strengthen student learning experiences. Curriculum plans should emphasise alternative and complementary learning means to promote active learning and personal growth. Students should accept the value of physical and digital interaction with course content, facilitators, peers and co-workers. The latter interactions provide opportunities to create compelling, flexible, prosperous and sustainable learning experiences. According to Galvis (2018), adopting transformative blended learning programmes enables institutions to realise educational transformation aligned with the institutional development plan through the combination of operational, educational and organisational success factors.

Relying on a practical managerial commitment, as noted by Galvis (2018), enables management to recognise the effort of lecturers to invest time into the development of course material responsibilities as course facilitators and course moderators. In line with Elameer

and Idrus (2012), lecturers should be compensated when their contribution to the e-learning or blended learning programme is beyond the scope of teaching duties. Consequently, the successful design and implementation of the e-learning/blended learning programme require institutions to access sound financial resources. Management should rethink the current fundamental institutional processes and align technical, administrative and financial support processes with the essential strategies to strengthen blended learning integration across the institution (Galvis, 2018).

Although Moodle offers various tools to augment positive online learning experiences, much effort is needed to provide the necessary training and orientation opportunities to Moodle users. The availability of a wide variety of tools in Moodle does not guarantee users can use the various tools effectively. Thus, the importance of continued technical assistance is significant for the effective use of this open source (Elameer & Idrus, 2012).

Students who spend long hours on Moodle do not necessarily score higher course grades than cohorts spending fewer hours on the platform. Thus, course designers must redesign the online component more effectively to ensure quality instruction (Estacio, 2017). Online teachers should incorporate meaningful and multiple methods to interact with students and encourage students constantly to interact with each other to promote active learning (Dixon, 2010).

Moodle instructors are also responsible for creating quality and stimulating instructional material that optimises students' use of available resources. (Yeou, 2016). This implies that teachers must invest ample time in designing instructional material to foster students' responsiveness and promote active course engagement (Servidio & Cronin, 2018). Consistent with the above findings, Badia et al. (2018) highlight the significance of evaluating students' acceptance of e-learning platforms, as the quality of online courses

affects student acceptance of the PerLe platform following a study conducted at the University of Calabria in Italy (Kaur & Abas, 2004).

Consequently, for an e-learning platform to run successfully, special attention should be given to the course design. Although the study participants indicated their satisfaction with the interface of the PerLe user interface, there were doubts about the usefulness of the e-learning interface of the university. Consequently, it was suggested that the PerLe user interface requires some improvements to promote interaction with external educational software available on the platform. Hence, to strengthen the usability and effective use of a learning management system, universities should be responsive to their students' levels of e-learning readiness (Kaur & Abas, 2004).

Role of Lectures to Assist Students Adapting to Online Learning

A matter of concern is the claim that students are challenged to acclimate to online classrooms (Sanchez-Gordon & Luján-Mora, 2014). The ultimate purpose of teaching, learning and assessment in any educational setting is to prepare students to excel academically. Moreover, technology-enabled settings increase student opportunities for optimum learning. However, this is only possible if students have adapted well to the unique demands associated with blended learning (Al-Ayed & Al-Tit, 2021; Halverson & Graham, 2019; Kurt & Yildirim, 2018).

Thus, lecturers and course facilitators need to engage with students to communicate the programme's value and allow ample opportunities to reflect and expound on the responsibilities of the students to excel in blended learning environments.

Therefore, one may agree with Rushby and Surry (2016), who argue that teachers and students in technology-enabled settings are challenged to identify their roles clearly, particularly in situations where the course facilitators have created the course as well as in

scenarios where students are expected to construct their learning resources. Next, the relevance of management intervention is explained.

Management Intervention

The Student Union in Namibia (SUN) expressed their concern that many students at UNAM depend on university resources to study online. It was reported that university management to reconsider the decision to migrate fully online as a single mode of learning while students are challenged with poor connectivity in rural areas (Kamati, 2020). A recent survey conducted at NUST indicated that 25.0% of students registered at the institution do not have laptops or desktop computers to complete online tasks. The affected students could not take advantage of the numerous benefits of blended and online learning at NUST (NUST, 2020). The following section discusses Moodle's effective and safe use as an open source.

2.11 Security Vulnerabilities in Moodle

This section zooms in on the origin of open sources and sheds light on the vulnerabilities clients may encounter by utilising Moodle as an LMS. Finally, strategies are suggested to Moodle clients to minimise some of the most commonly experienced security vulnerabilities in Moodle as an LMS.

Origin of Open Sources Software and Moodle

Melwani (2019) reports that the construct ‘open source’ was coined during the late 1970s when it was first referred to as the open-source revolution. Richard Stallman, a young software engineer from Harvard University, developed the first open software in 1971. Stallman joined the Massachusetts Institute of Technology (MIT) Artificial Intelligence Lab with the vision of developing computing platforms. He had served the MIT Lab for a few years until it closed its doors early in 1980 because the propriety software market boomed. The MIT Lab lost many of its talented developers to join privately held technology companies. Stallman believed that customers should know how to work with the software

and be empowered to fix and debug the software themselves (Singh, 2018). Hence, the Free Software Foundation (FSF) was established, allowing users to run, modify, update, and disseminate software in the community (Chopra & Dexter, 2009; McKimmy, 2017).

Moodle as an LMS is an example of open software that offers blended and e-learning opportunities to the world. A study conducted in Turkey explored the benefits and drawbacks of using Open-Source Learning Management Systems and Proprietary Learning Management Systems. It was reported that using an open-source LMS yields great benefits for universities and businesses in terms of security matters as multiple developers are involved in testing the Moodle system (Johnson, 2018; Rymon, 2015; Ulker & Yilmaz, 2016). Consequently, security risks are addressed and resolved swiftly. Despite the growing popularity of Moodle as an LMS and its high acceptance rate amongst course developers, Moodle users must be mindful of the security aspects associated with their use of Moodle (Mudiyanselage & Pan, 2017).

It is, however, unfortunate that active research conducted on the vulnerability of Moodle is primarily applicable to older Moodle versions, such as Moodle 1.9. and 2.6 (Martínez et al., 2013). An exceptional site, "Security Announcements", informs users about security issues in Moodle (Moodle, 2020). The supplier company usually guarantees security related to the vulnerabilities associated with using proprietary software (Melwani, 2019). Furthermore, the loss of data and data leakages are among the severe security vulnerabilities related to proprietary software. Therefore, the reliability and competence of propriety LMS service providers should be analysed when such software is considered an LMS (Ulker & Yilmaz, 2016). Maayan (2019), however, reports that open-source software design is chaotic due to multiple contributors working on it continuously to add new features and improve the software. He further claims that "anybody" is involved in fixing bugs in open sources, while

professional developers are engaged in proprietary software to write the codes according to the organisation's directives.

According to Rymon (2015), open-source developers often release a fix within a day or two in case of severe security issues. On the contrary, commercial vendors rely on fewer people to work on a given project, and thus it takes longer to update cycles. Additionally, commercial vendors attend to software updates based on financial considerations and release cycles that vary between six to twelve months. Consequently, it takes longer for the fixed version to be released into the market. Interestingly, it is claimed that commercial software developers bank on open sources to develop their capabilities. As such, more than 80% of the lines of coding are borrowed from open sources (Synopsys, 2021). Subsequently, the claim that commercial software is prone to open-source vulnerabilities appear to have significant value. Eleven vulnerabilities were reported to be amongst the common types of Moodle vulnerabilities. These are (1) access by unauthenticated and unauthorised users, (2) cross-site request forgery, (3) Structured Query Language (SQL) Injection, (4) cross-site scripting (XSS), (5) loss of data, (6) command-line injection, (7) session fixation, (8) denial of service, (9) brute force login, (10) confidential and configuration information leakage and (11) social engineering (Astra, 2020; Moodle, 2020).

According to Acunetix (2022), the Structured Query Language (SQL) Injection security risk is a high-risk vulnerability that allows attackers to perform SQL queries in Moodle databases due to inadequate sanitisation of data supplied by users. Subsequently, remote attackers can send specific requests to the affected Moodle site to perform capricious SQL commands within the application database.

Suppose the attacker is successful with such infiltration into the application database of the affected system; the attacker can perform any changes in the targeted system, from deleting and reading to modifying data in the database. The attacker would have gained

complete control over the affected application. A range of Moodle versions was affected by this vulnerability, with no official solution to address this security risk. During 2020 the following Moodle versions were at risk: Moodle: 2.7.0, 2.7.1, 2.7.2, 2.7.3, 2.7.4, 2.7.5, 2.7.6, 2.7.7, 2.7.8, 2.7.9, 2.7.10, 2.7.11, 2.7.12, 2.7.13, 2.7.14, 2.7.15, 2.7.16, 2.7.17, 2.7.18, 3.0.0, 3.0.1, 3.0.2, 3.0.3, 3.0.4, 3.0.5, 3.0.6, 3.0.7, 3.0.8, 3.1.0, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.2.0, 3.2.1 (Moodle, 2020). Consequently, the only versions not affected during 2020 by the risks of SQL injections were Moodle versions between the ranges of Moodle 3.2.2 – 3.9.1 (Moodle, 2020).

According to Ciobanu and Ciobanu (2012), the Moodle application is at risk of Cross-Site Scripting (XSS) attacks. XSS attacks are responsible for common application-layer web attacks and target scripts embedded in a page on the client's server. Furthermore, cross-site scripting is caused by internet weaknesses in the client's server due to HTML and JavaScipt languages. Attackers target the Moodle websites with XXS attacks to access sensitive institutional data, engage in identify theft, cause web application vandalism, perform a denial of services and alter browser functionality.

Security Vulnerabilities of Moodle

Table: 1 provides statistics on the security vulnerabilities reported in Moodle between 1999 and 2022.

Table 1

Number of Browse Vulnerabilities of Moodle by Date for the Past 22 years

Year	# of Vulnerabilities												
1999	894	January	February	March	April	May	June	July	August	September	October	November	December
2000	1020	January	February	March	April	May	June	July	August	September	October	November	December
2001	1677	January	February	March	April	May	June	July	August	September	October	November	December
2002	2156	January	February	March	April	May	June	July	August	September	October	November	December
2003	1527	January	February	March	April	May	June	July	August	September	October	November	December
2004	2451	January	February	March	April	May	June	July	August	September	October	November	December
2005	4935	January	February	March	April	May	June	July	August	September	October	November	December
2006	6610	January	February	March	April	May	June	July	August	September	October	November	December
2007	6520	January	February	March	April	May	June	July	August	September	October	November	December
2008	5632	January	February	March	April	May	June	July	August	September	October	November	December
2009	5736	January	February	March	April	May	June	July	August	September	October	November	December
2010	4653	January	February	March	April	May	June	July	August	September	October	November	December
2011	4155	January	February	March	April	May	June	July	August	September	October	November	December
2012	5297	January	February	March	April	May	June	July	August	September	October	November	December
2013	5191	January	February	March	April	May	June	July	August	September	October	November	December
2014	7939	January	February	March	April	May	June	July	August	September	October	November	December
2015	6504	January	February	March	April	May	June	July	August	September	October	November	December
2016	6454	January	February	March	April	May	June	July	August	September	October	November	December
2017	14714	January	February	March	April	May	June	July	August	September	October	November	December
2018	16557	January	February	March	April	May	June	July	August	September	October	November	December
2019	17344	January	February	March	April	May	June	July	August	September	October	November	December
2020	18325	January	February	March	April	May	June	July	August	September	October	November	December
2021	20142	January	February	March	April	May	June	July	August	September	October	November	December
2022	3657	January	February										

Note. The table depicts the number of browse vulnerabilities of Moodle by date for the past 22 years, by VCE Details, 2022 (https://www.cvedetails.com/browse-by-date.php).

Table 1 details the number of vulnerabilities reported by year, over twenty-three years, between 1999 and 2022. In 2019, 122 774 security vulnerabilities were recorded globally for ten years, and 17 344 security vulnerabilities were documented over twelve months. As stated by VLE Details (2020), the three most frequently reported risks prevalent in Moodle are code execution (26.6%), denial of services (19.2%) and cross-scripting (12,5%). However, according to the Moodle project participants, Moodle Head Quarters

remain serious about the security of the Moodle system and developers who work continuously to resolve security issues (Moodle, 2020).

Table 2. provides evidence of the security announcements made on the Moodle website of affected Moodle versions and fixed versions from 18 November 2019 to 23 August 2020 (Moodle, 2020).

Table 2

Security Announcements in Moodle, 18 November 2019 to 23 August 2020

1. Fatal error messages required extra sanitizing to prevent reflected XSS risks on some pages.

Severity/Risk:	**Serious**
Versions affected:	3.7 to 3.7.2, 3.6 to 3.6.6, 3.5 to 3.5.8 and earlier unsupported versions
Versions fixed:	**3.7.3, 3.6.7 and 3.5.9**

2. Tokens used to fetch inline attachments in email notifications were not disabled when a user's account was no longer active. Note: to access files, a user would need to know the file path, and their token.

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.2 and 3.6 to 3.6.6
Versions fixed:	**3.7.3 and 3.6.7**

3. An open redirect existed in the Lesson edit page.

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.2, 3.6 to 3.6.6, 3.5 to 3.5.8 and earlier unsupported versions
Versions fixed:	**3.7.3, 3.6.7 and 3.5.9**

4. User emails required additional sanitizing to prevent blind XSS risk on some pages.

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.2
Versions fixed:	**3.7.3**

5. OAuth 2 providers who do not verify users' email address changes require additional verification during sign-up to reduce the risk of account compromise.

Severity/Risk:	**Serious**
Versions affected:	3.7 to 3.7.2, 3.6 to 3.6.6, 3.5 to 3.5.8 and earlier unsupported versions
Versions fixed:	**3.7.3, 3.6.7 and 3.5.9**

6. When a cohort role assignment was removed, the associated capabilities were not being revoked (where applicable).

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.2, 3.6 to 3.6.6, 3.5 to 3.5.8 and earlier unsupported versions
Versions fixed:	**3.7.3, 3.6.7 and 3.5.9**

7. If a forum's subscription mode was set to "forced subscription", the forum's subscribe link contained an open redirect.

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.1, 3.6 to 3.6.5, 3.5 to 3.5.7 and earlier unsupported versions
Versions fixed:	**3.7.2, 3.6.6 and 3.5.8**

8. The mobile launch endpoint contained an open redirect in some circumstances, which could result in a user's mobile access token being exposed. (**Note:** This does not affect sites with a forced URL scheme configured, mobile service disabled, or where the mobile app login method is "via the app").

Severity/Risk:	**Serious**
Versions affected:	3.7 to 3.7.1, 3.6 to 3.6.5, 3.5 to 3.5.7 and earlier unsupported versions
Versions fixed:	**3.7.2, 3.6.6 and 3.5.8**

9. Activity creation capabilities were not correctly respected when selecting the activity to use for a course in single activity mode.

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.1, 3.6 to 3.6.5, 3.5 to 3.5.7 and earlier unsupported versions
Versions fixed:	**3.7.2, 3.6.6 and 3.5.8**

10. The analytics Python Machine Learning backend has received some security fixes, resulting in the required PIP package version being increased.

Severity/Risk:	**Minor**
Versions affected:	3.7 to 3.7.1, 3.6 to 3.6.5 and 3.5 to 3.5.7 and earlier unsupported versions
Versions fixed:	**3.7.2, 3.6.6 and 3.5.8**

11. yui_combo needed to limit the amount of files it can load to help mitigate the risk of denial of service.

Severity/Risk:	**Serious**
Versions affected:	3.9, 3.8 to 3.8.3, 3.7 to 3.7.6, 3.5 to 3.5.12 and earlier unsupported versions
Versions fixed:	**3.9.1, 3.8.4, 3.7.7 and 3.5.13**

12. Teachers of a course were able to assign themselves the manager role within that course.

Severity/Risk:	**Serious**
Versions affected:	3.9, 3.8 to 3.8.3, 3.7 to 3.7.6, 3.5 to 3.5.12 and earlier unsupported versions
Versions fixed:	**3.9.1, 3.8.4, 3.7.7 and 3.5.13**

13. The filter in the admin task log required extra sanitizing to prevent a reflected XSS risk.

Severity/Risk:	**Serious**
Versions affected:	3.9, 3.8 to 3.8.3 and 3.7 to 3.7.6
Versions fixed:	**3.9.1, 3.8.4 and 3.7.7**

14. The JQuery version used by the H5P library contained a prototype pollution risk, which has now been updated to a patched version.

Severity/Risk:	**Minor**
Versions affected:	3.8 to 3.8.3
Versions fixed:	**3.8.4 and 3.9**

15. It was possible to create a SCORM package in such a way that when added to a course, it could be interacted with via web services in order to achieve remote code execution.

Severity/Risk:	**Serious**
Versions affected:	3.8 to 3.8.2, 3.7 to 3.7.5, 3.6 to 3.6.9, 3.5 to 3.5.11 and earlier unsupported versions

16. MathJax versions 2.7.2 and earlier contain a stored XSS risk. The MathJax URL has been updated to reference a newer version, which has the vulnerability patched.

Severity/Risk:	**Serious**
Versions affected:	3.8 to 3.8.2, 3.7 to 3.7.5, 3.6 to 3.6.9, 3.5 to 3.5.11 and earlier unsupported versions
Versions fixed:	**3.8.3, 3.7.6, 3.6.10 and 3.5.12**

17. Insufficient input escaping was applied to the PHP unit web runner admin tool.

Severity/Risk:	**Minor**
Versions affected:	3.8 to 3.8.1, 3.7 to 3.7.4, 3.6 to 3.6.8, 3.5 to 3.5.10 and earlier unsupported versions
Versions fixed:	**3.8.2, 3.7.5, 3.6.9 and 3.5.11**

18. X-Forwarded-For headers could be used to spoof a user's IP, in order to bypass remote address checks.

Severity/Risk:	**Serious**
Versions affected:	3.8 to 3.8.1, 3.7 to 3.7.4, 3.6 to 3.6.8, 3.5 to 3.5.10 and earlier unsupported versions
Versions fixed:	**3.8.2, 3.7.5, 3.6.9 and 3.5.11**

19. Users viewing the grade history report without the 'access all groups' capability were not restricted to viewing grades of users within their own groups.

Severity/Risk:	**Minor**
Versions affected:	3.8 to 3.8.1, 3.7 to 3.7.4, 3.6 to 3.6.8, 3.5 to 3.5.10 and earlier unsupported versions
Versions fixed:	**3.8.2, 3.7.5, 3.6.9 and 3.5.11**

20. Messages required extra sanitizing before updating the conversation overview, to prevent the risk of stored XSS.

Severity/Risk:	**Serious**
Versions affected:	3.8
Versions fixed:	**3.8.1**

Note. Table 2 presents twenty security threats reported to and announced via the Moodle websites over nine months, of which ten threats were serious, and the remaining ten were of minor severity. From security announcements by Moodle, 2020. (https://moodle.org/security/index.php?o=3&p=8)

Table 3 illustrates seven serious security threats reported by five different developers. These threats were identified as: (1) SQL injection in the code fetching H5P activity user attempts, (2) CSFR risks on the delete related badge feature, (3) reflected XSS risk in the filetype admin tool, (4) a remote execution risk when restoring a malformed backup file, (5) quiz unreleased grade disclose via web service, (6) an arbitrary file could be read the site administrators via LaTeX preamble, (7) authentication bypass risk when using external database authentication. The Moodle versions affected with the above vulnerabilities are reflected in Table 3.

Table 3

Serious Security Announcements in Moodle, 20 September 2021 to 24 January 2022 (4 Months)

CVE identifier:	CVE-2021-40695
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit&s=M 71797
Tracker issue:	MDL-71797 Quiz unreleased grade disclosure via web service

MSA-21-0035: Arbitrary file read by site administrators via LaTeX preamble

by Michael Hawkins -Monday, September 20, 2021, 6:41 PM

Insufficient escaping of the LaTeX preamble made it possible for site administrators to read files available to the HTTP server system account.

Severity/Risk:	**Serious**
Versions affected:	3.11 to 3.11.2, 3.10 to 3.10.6, 3.9 to 3.9.9 and earlier unsupported versions
Versions fixed:	**3.11.3, 3.10.7 and 3.9.10**
Reported by:	raisin_bugbounty
Workaround:	Hard-code the value of the LaTeX preamble into *$CFG->forced_plugin_settings['filter_tex']['latexpreamble']* within the site's *config.php* file.
CVE identifier:	CVE-2021-40694
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit& 71240
Tracker issue:	MDL-71240 Arbitrary file read by site administrators via LaTeX preamble

MSA-21-0034: Authentication bypass risk when using external database authentication

by Michael Hawkins -Monday, September 20, 2021, 6:39 PM

An authentication bypass risk was identified in the external database authentication functionality, due to a type juggling vulnerability.

Severity/Risk: **Serious**

Versions affected:	3.11 to 3.11.2, 3.10 to 3.10.6, 3.9 to 3.9.9 and earlier unsupported versions
Versions fixed:	**3.11.3, 3.10.7 and 3.9.10**
Reported by:	Amit Eyal
CVE identifier:	CVE-2021-40693
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit&s=M 71160
Tracker issue:	MDL-71160 Authentication bypass risk when using external database authentic

MSA-22-0001: SQL injection risk in code fetching h5p activity user attempts

by Michael Hawkins -Monday, January 24, 2022, 2:40 PM

An SQL injection risk was identified in the h5p activity web service responsible for fetching user attempt data.

Severity/Risk:	**Serious**
Versions affected:	3.11 to 3.11.4
Versions fixed:	**3.11.5**
Reported by:	Paul Holden
CVE identifier:	CVE-2022-0332
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit&s= MDL-72573
Tracker issue:	MDL-72573 SQL injection risk in code fetching h5p activity user attempts

CVE identifier:	CVE-2021-40695
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit&s=M 71797
Tracker issue:	MDL-71797 Quiz unreleased grade disclosure via web service

MSA-21-0035: Arbitrary file read by site administrators via LaTeX preamble

by Michael Hawkins -Monday, September 20, 2021, 6:41 PM

Insufficient escaping of the LaTeX preamble made it possible for site administrators to read files available to the HTTP server system account.

Severity/Risk:	**Serious**
Versions affected:	3.11 to 3.11.2, 3.10 to 3.10.6, 3.9 to 3.9.9 and earlier unsupported versions
Versions fixed:	**3.11.3, 3.10.7 and 3.9.10**
Reported by:	raisin_bugbounty
Workaround:	Hard-code the value of the LaTeX preamble into *$CFG->forced_plugin_settings['filter_tex']['latexpreamble']* within the site's *config.php* file.
CVE identifier:	CVE-2021-40694
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit&71240
Tracker issue:	MDL-71240 Arbitrary file read by site administrators via LaTeX preamble

MSA-21-0034: Authentication bypass risk when using external database authentication

by Michael Hawkins -Monday, September 20, 2021, 6:39 PM

An authentication bypass risk was identified in the external database authentication functionality, due to a type juggling vulnerability.

Severity/Risk:	**Serious**
Versions affected:	3.11 to 3.11.2, 3.10 to 3.10.6, 3.9 to 3.9.9 and earlier unsupported versions
Versions fixed:	**3.11.3, 3.10.7 and 3.9.10**
Reported by:	Amit Eyal
CVE identifier:	CVE-2021-40693
Changes (master):	http://git.moodle.org/gw?p=moodle.git&a=search&h=HEAD&st=commit&s=M71160
Tracker issue:	MDL-71160 Authentication bypass risk when using external database authentic

Note. Table 3 presents eight serious security threats reported to and announced via the Moodle websites over four months. Minor risks were excluded in the illustration intentionally. From security announcements by Moodle, 2022. (https://moodle.org/security/index.php?o=3&p=2)

Table 4

General Release Calendar

Release type	Frequency	Months
Major (eg. 3.x)	6 monthly	Second Monday of May and November
Minor (Point) (eg. 3.x.y)	2 monthly	Second Monday of July, September, November, March and May. Third Monday of January.

Note: Table 4 depicts the major releases of Moodle that occur every six months, normally on the second Monday of May and November, whereas minor (point) releases occur on the second Monday of July, September, November, January, March and May, every second month. From Moodle docs by Moodle, 2022. (https://docs.moodle.org/dev/Releases).

According to Table 4, a major Moodle release is indicated as "3. x", and a minor (point) release is displayed as "3. x.y".

Therefore, one can agree with Rymon (2015), who claims that regular Moodle updates can minimise many of the security risks associated with using Moodle as an LMS. The following paragraphs zoom into various ways institutions may consider improving the security of Moodle websites. Literature also confirmed that many organisations that rely on open sources and fail to update such software to the latest versions might be prone to serious software security threats (Acunetix, 2022).

Security measures in Moodle. As agreed by Moodle (2020), the following security measures should be considered by Moodle clients to minimise security vulnerabilities on Moodle websites:

- Moodle administrators should run regular Moodle updates to keep abreast with the minor point releases Moodle offers from time to time, generally after every second month since the upgrade to the first major version release. It has been reported that the major version is not free from bugs and security flaws. Interestingly, Moodle statistics reveal that some

Moodle administrators still use the Moodle 1.9 version. Using such outdated versions of Moodle exposes Moodle users to the risks of numerous security flaws (Moodle, 2020).

- Moodle administrators should keep all Moodle themes and plugins current to eliminate the risk of the backdoor entrance of sites into the Moodle site of the organisation.
- Moodle administrators should uninstall redundant plugins not used by Moodle users. As such, Moodle provides data on the courses about the particular usage of the active activity plugin.
- Implementing a password policy is ideal that requires a mandatory change of passwords for all Moodle users across the institution. The enforcement of a password policy forces all Moodle users to use strong passwords to prevent unauthorised users from accessing the platform.
- Moodle users should be encouraged to change their passwords frequently to ensure the safe usage of the platform.
- Administrators should make it difficult for hackers to access the systems by not choosing "admin" as a username. Administrators and normal Moodle users should use usernames by combining solid characters.
- Login attempts by users should be limited by setting up a threshold limit for the use of incorrect login attempts to prevent distributed denial-of-service (DDoS) attacks. A DDoS attack is a harmful attempt to disturb the regular traffic of a targeted server. The service or network is flooded with internet traffic to crush the targeted server or its surrounding infrastructure.
- It is essential to rely on a robust backup system. Therefore, regular backups should be considered to avoid interference due to hardware issues or security failure.
- The utilisation of the Hypertext Transfer Protocol Secure (HTTPS) for login allows for the encryption of users' login data, which makes it problematic to sniff out users' login

details, such as the username and password. The Moodle administrator can do the enabling of the HTTPS login.

- Permissions for files and folders in the Moodle website should be changed to "specify who and what can read, write, modify and access them". The Moodle administrator should ensure that Moodle directories and subdirectories cannot be configured.
- Site administrators should use the command line to set Cron execution, not the web browser. The Moodle Cron process is a PHP script usually included in a typical Moodle installation. It must be run regularly in the background. The Moodle Cron script performs various activities at different intervals. The reliance on the web browser to set Cron can put the systems at risk, as privileged information can be exposed to anonymous users. The administrator should set a Cron password for remote access to the system.

According to Duque (2021), minor Moodle releases require updates, while major Moodle releases require upgrades. Although implementing every Moodle release may sound ideal, it may not always be feasible technically and logistically. Therefore, it is recommended that Moodle clients consider updating the system every two to three months when a new minor release is available. However, clients should upgrade the system in major system releases, normally after one or two years. Moodle clients may also occasionally consider a plus (+) update to fix bugs and system vulnerabilities.

Summary

In this chapter, a thorough review of the literature was presented. The first section of this chapter provided discourse to evaluate three frameworks useful to guide instructional design considerations in a blended learning setting, emphasising technologies. The three theoretical frameworks that underpinned discussions in the present study were Khan's Octagonal Framework (Khan, 2001), the E-orbital Framework (Elameer & Idrus, 2012) and the Community of Inquiry Theory (Garrison et al., 2000). The chosen frameworks were

sound to support the arguments in the present study and aligned with the study objectives. Furthermore, the chosen theoretical framework provided a scope for the researcher to base arguments, decide on a research design and provide guidance for data analyses.

The second part of this chapter provided an overview of critical constructs associated with blended learning, which include, amongst others, blended learning, blended learning approaches, advantages of blended learning, disadvantages of blending, the concept of e-learning and learning management systems. Literature confirms that Moodle as an LMS has been accepted globally in a record time in educational and commercial markets (Basa, 2019). Several advantages and disadvantages are associated with blended learning, online learning and e-learning (El-Bahsh & Daoud, 2016; Kabassi et al., 2016; Kintu & Zhu, 2016; Ramesh, 2015; Rosenberg, 2005; Yeou, 2016). The advantages of online and e-learning in blended learning settings include flexibility, positive online learning experiences, increased engagement with course material and study participants and better study management. The effective implementation and sustaining of e-learning in blended learning settings require strategic discourse, support and action from management to provide the necessary sustainable institutional infrastructure and the decisions of a suitable LMS (Elameer & Idrus, 2012). Based on empirical evidence, e-learning and blended learning are closely related. Therefore, to ensure successful learning and teaching, students and lecturers need special skills to optimise opportunities associated with the effective use of Moodle as an LMS in blended learning and e-learning settings.

Furthermore, the third part is the discussion was centred on how to use Moodle's main features, followed by a discussion about how responsive course participants are to using the available tools.

Moodle has several communication tools to promote interactivity between student-student and student-lecturer. The announcement tool is the most frequently used (Moodle,

2019; Sathian, 2016). Sufficient training opportunities for Moodle users strengthen the abilities of course participants to use Moodle tools effectively and reduce the level of frustration, and negativity course participants experience due to the complexities associated with using Moodle as an LMS (Winstead, 2020). Access to Moodle does not guarantee an acceptable response level from students and staff to use available tools optimally. Consequently, providing adequate training opportunities for course participants is crucial in blended and online learning settings to secure the effective use of Moodle tools. The lack of training for online instructors and course participants remains challenging in blended learning settings (Mbuva, 2015; Raphael & Mtebe, 2016). It is thus suggested to conduct further research to investigate the main challenges associated with the use of LMSs in a Namibian context. The design and delivery of quality teaching and learning in Moodle is time-consuming. Yet, quality teaching and learning are crucial aspects of using Moodle effectively as an LMS (Estacio, 2017). Successful online learning in blended learning settings is not measured against the number of hours students spend on the online platform but against the quality of teaching and resources offered in online modules (Estacio, 2017).

The above discussion reveals that the longer time spent on the online course does not automatically result in higher course grades. It is thus suggested to conduct future research to investigate the relationship between the time spent on LMS and students' academic performances. Additionally, the availability of quality instruction, quality instructional materials and quality online course design promote the responsiveness of students and lecturers in an online course. Students and faculty members need time to become familiar with the functions and structures of Moodle (Lonn & Teasley). Moodle facilitators need to be aware of the impact of dynamics such as the environment, culture and learning atmosphere, effort expectancy, performance expectancy, facilitating conditions, social

influence and behavioural intention on educators' responsiveness to Moodle (Saleem et al., 2016).

Regarding Moodle adoption, four factors have been highlighted as necessary: gender, age, the voluntariness of usage, and Moodle users' experience. Even though some faculty members did not utilise Moodle at all, users were dubious of Moodle's ability to affect students' academic achievements (Wichadee, 2015). While most students find Moodle useful only to download resources, submit assignments and view course needs, they miss Moodle's opportunities to hone critical thinking skills.

Thus, further exploration is needed to establish why Moodle teachers still opt to use social media platforms to share course content while they have access to an LMS. A matter of concern indicates that both educators and students view Moodle as a complex platform. Consequently, the claim that faculty members view Moodle as an ineffective tool to enhance students' skills could be because of the faculty's experiences with Moodle as a complex platform (Aljeeran, 2016).

As far as Moodle forum functionalities are concerned, Moodle offers four different forum functionalities. Only one of these forum choices allows students to initiate their own choice of topics for online discourse. As such, Moodle teachers have control over the remaining three functionalities, and students are not permitted to add additional threads outside the scope of the original topic initiated by the teacher. Therefore, one may agree that Moodle teachers must choose worthwhile discussion topics that are insightful and interesting to students (Moffat, 2015).

Therefore, ample opportunities should be created for Moodle teachers to up-skill themselves in terms of their level of computer literacy and motivation to use technology. Furthermore, access to the internet, increasing opportunities for online engagement, access to technical support, a high degree of self-discipline, confidence with oral communication

and teaching abilities are indispensable factors in improving the responsiveness of teachers to use Moodle optimally (Damman, 2010; Alshammari et al., 2016). Although the above factors are crucial to increasing the responsiveness of teachers and students in blended learning settings, increased opportunities for online engagement need further exploration.

The fourth part of the chapter explored the signifying factors that affect blended learning in higher education settings. University management, instructional designers and lecturers should be aware of several factors that hinder the successful offering of e-learning in blended learning settings. These factors include e-learning readiness, feelings of isolation, a sense of loss, the absence of online communication abilities of students, challenges with self-regulated learning, challenges with access to the internet and educational resources, and not having access to computer technologies (Bastere & Invala, 2015; Broadbent, 2017; Hamilton, 2010; Kaur & Abas, 2004; Khan, 2016; Mässing, 2017; Vaughan, 2007). Blended and e-learning readiness of students in technology-enabled learning settings is crucial in both developed and developing countries. Studying online or relying on blended learning comes with positive and negative consequences. Students displaying high levels of e-learning readiness tend to be academically stronger than students who struggle to adapt to the demands of blended and e-learning.

However, limited access to the internet and the lack of devices to access course material may constrain successful online learning. Because of their acute knowledge of the use of technology to access information and assure enhanced online connection between classmates and teachers beyond the physical classroom, students in today's classrooms are referred to as "digital natives" (Basitere & Ivala, 2015). The unavailability of devices and internet connectivity issues are critical factors to consider in a blended learning setting (Mässing, 2017). Reports that 25.0% of students at NUST do not have access to learning

devices are cumbersome. It is thus essential to research the psychological impact of online learning on students in the absence of reliable learning technologies.

Residential students are more engaged with course content due to unlimited access to on-campus resources. However, when it comes to the actual writing of online tests, students may cheat, as it was reported that off-campus students rely on the assistance of campus students to do well on tests (Panyajamorn et al., 2018).

Despite contradictory evidence of online isolation, many scholars agree on the psychological impact online learning may cause (Cook, 2007; Liu et al., 2016; Wojciechowski & Palmer, 2005). The introduction of blended learning in higher education institutions increases the learning experiences of course participants, as facilitators can integrate multi-modalities, multimedia and hypermedia in their courses (Darling-Hammond et al., 2020; Khan, 2016). A gap has been identified in addressing the technological needs of Namibian students at both public higher education institutions for the successful integration of technology-enabled learning (Mässing, 2017).

Additionally, the fifth part of this chapter explored literature on the use of Moodle towards increased students' course engagement, communication and development of problem-solving skills. According to Ding et al. (2017), online forums are potentially effective in various learning situations and play a vital role in forming a feeling of community by allowing learners to exchange knowledge that contributes to the development of critical thinking. Furthermore, student participation in forum discussions encourages active online learning, which leads to higher student engagement. Teachers use direct communication in conventional classrooms to promote communication between the teacher and students. However, teachers require skills to create meaningful communication opportunities consciously selected to suit the purpose of augmenting effective communication in Moodle. Moodle offers various tools to promote communication, but

without stable internet connectivity, Moodle users may not use the available tools effectively (Cleveland-Innes & Wilton, 2018; Fry et al., 2009).

Moodle offers different approaches to promote critical thinking opportunities in blended or online learning situations. Still, teachers must make special efforts to create opportunities for students to engage in meaningful discussion forums, Moodle assignments, blogs and wikis. The availability of several communication tools for problem-solving skills does not serve its purpose unless the teacher utilises such tools. Therefore, with blended learning, students get the opportunity in both face-to-face engagements and online engagements to augment critical skills development, which leads to the ability to solve problems. Therefore, Moodle teachers should offer opportunities for online course participants to solve authentic problems (Al-Husban, 2020; Foo & Quek, 2019). Another area for investigation would be to examine the strategies Namibian universities use to augment problem-solving skills using Moodle as an LMS.

The sixth and final part of this chapter reviewed the literature on the effective and safe use of Moodle as an open source. Open-source and proprietary LMSs are prone to security risks, as developers of close source LMSs borrow many command lines from open sources. Code execution, denial of services and cross-scripting resort amongst the commonly reported security risks Moodle users face (VCE Details, 2020). As multiple developers assist in fixing security issues in Moodle, vulnerabilities are resolved quickly. However, the latter is not the case with close source LMSs, as the supplier of the proprietary software is responsible for attending to fixes; it may take several months to resolve bugs on the LMS. Frequent Moodle updates minimise the many security vulnerabilities Moodle users are exposed to daily (Duque, 2021; Moodle, 2020). Thus, staying abreast with the latest version of Moodle may reduce the security vulnerabilities associated with the use of Moodle.

CHAPTER 3: RESEARCH METHODS AND DATA COLLECTION

The 21st century, shaped by the Fourth Industrial Revolution, requires tertiary institutions to use available technologies optimally to enhance student learning experiences and performances. Learning institutions use blended learning by integrating traditional teaching practices with modern educational technologies to improve student productivity. Technologies facilitate learning, provide conveniences and promote the interactive nature of learning (Trines, 2018). There are various technologies available for use in teaching and learning, among others, Moodle. The effective use of Moodle ensures optimum teaching and learning, which culminates in high student achievements, producing the needed human capital required to propel national economies (Aristovnik et al., 2017; Francescucci & Rohani, 2018).

Despite the realisation that the effective use of educational technologies yields high student achievements, NUST has yet to reap the full benefits of Moodle as a learning management system that the university uses for online teaching-learning. The university implemented the learning management system Moodle in 2011. Yet, students' performance levels have not improved as anticipated, despite the assertion that educational technologies in teaching and learning improve students' performance significantly (Mulhayatiah et al., 2019). Given the students' performance not being impressive, despite the university using Moodle, this study sought to explain the challenges facing the implementation of Moodle at NUST, with the view of designing measures on how the identified challenges can be addressed. This will help ensure that the University optimally uses Moodle as a learning management system to maximise students' performances as an outcome of teaching and learning through effective course engagement, communication and problem-solving opportunities.

The purpose of this mixed-methods case study was to investigate the effective use of Moodle as an LMS at NUST, a public, non-profit university offering full-time, part-time and distance education learning opportunities through blended and full-fledged online learning.

This study was conducted at the NUST main campus from April 2021 to August 2021. Three different sample populations were included in this study drawn from students, lecturers and knowledgeable key support staff regarding the use of Moodle as an LMS in higher education. Probability sampling was used to draw two representative samples. Anonymous web-based survey questionnaires were administered to students and lecturers. Non-probability sampling was used to select a third sample which was drawn purposively from the population. Quantitative data were collected through in-depth interviewing as a qualitative data collection instrument. Data were coded and analysed through relevant computer software packages. Quantitative and qualitative data were collected concurrently but analysed separately. Numerical and textual data were integrated to derive at findings that answered the research questions. Study findings were integrated with related literature to develop a strategy for the effective use of Moodle as an LMS in higher education settings in a Namibian context.

The following questions guided the study:

RQ1. What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

RQ2. What signifying factors affect blended learning using Moodle in higher education?

RQ3 What impact does the use of Moodle have on students' course engagement?

RQ4 What impact does the use of Moodle have on students' communication?

RQ5 What impact does the use of Moodle have on the development of students' problem-solving skills?

RQ6 Which strategies can be adopted by NUST to increase the effective and safe use of Moodle as an LMS?

Furthermore, the study is grounded on three theoretical models, the Orbital E-education Framework (Elameer, 2012), The Community of Inquiry (CoI) Framework (Garrison et al.,

2000) and Khan's Octagonal Framework (Khan, 2010). The study aimed to develop a strategy to increase student and lecturer responsiveness in using Moodle tools at NUST to capitalise optimally on the benefits of using Moodle as an LMS. In this way, students' learning experiences may increase, and operational costs at NUST institutional-wide may be slashed.

This chapter explains the methodological considerations that underpinned this investigation. Sarantakos (2013) defines the methodology in research as the strategy used by researchers to communicate their ontological and epistemological principles to provide a guideline on how empirical studies should be conducted. On the other hand, a strategy refers to the skills, assumptions, and practices inquirers employ to conduct empirical investigations (Denzin & Lincoln, 2013).

Firstly, the chapter provides a synopsis of the philosophical assumptions of the present investigation, supported by the research approach and research design employed in this investigation. Secondly, the chapter discusses the strategies employed to select the participants of this study. Thirdly, details are provided relating to data collection methods and the analysis of the collected data. Fourthly, the research findings' reliability, validity and trustworthiness are discussed. The chapter concludes with a discussion of the ethical considerations fundamental to this investigation.

Decisions regarding the choice of the inquiry and research methods deemed appropriate for this inquiry were informed by the underlying philosophical assumptions of the inquirer. The research approach and design for this study is discussed next.

3.1 Research Approach and Design

The construct 'paradigm' was first described as an essential ingredient of scientific research, with the claim that it is impossible to interpret natural history without at least some implicit body of intermingled theoretical and methodological belief to permit the selection, evaluation and criticism of the inquiry (Kuhn, 1962). According to Okeke and van Wyk (2015),

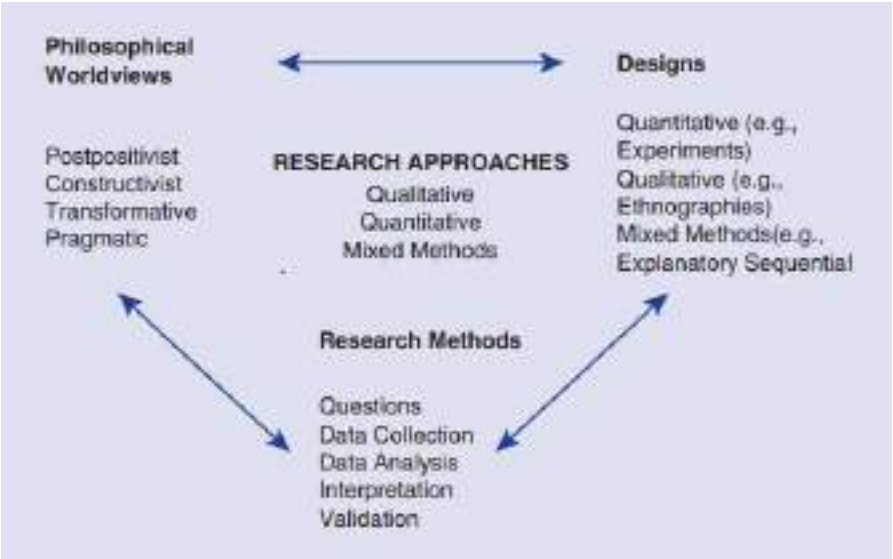
a research paradigm is associated with a ‘camp’, to which a researcher belongs, informed by certain assumptions, propositions, rationale and approaches to research. It is further argued that research paradigms provide philosophical substance that guides researchers regarding their decision about the nature of the study and the type of methodology to employ when conducting research. Lincoln and Guba (1985); Creswell (2003, 2014) emphasise five philosophical elements, referred to as:

- ontology (what is knowledge?),
- epistemology (how do we know what we know?),
- axiology (what elements contribute to its values?),
- rhetoric (how we write about it?), and
- methodology (the process for studying it).

Despite the concealed nature of researchers' philosophical underpinnings, such beliefs influence how research is conducted (Slife & Williams, 1995). As presented by Creswell (2014), the framework for research illustrates the interconnectedness of philosophical worldviews, research approaches, designs and research methods, as shown in Figure 8.

Figure 8

A Framework for Research - The Interconnection of Worldviews, Design



Note. This image depicts A Framework for Research - The Interconnection of Worldviews, Design [Image], by J. W. Creswell, 2014.

The choice of a specific research paradigm inquiry depends on the philosophical beliefs of the investigator based on the perception of reality, nature, and the ability to be believed. Moreover, the choice of a specific paradigm offers a holistic perception of how the researcher perceives the world (Creswell & Creswell, 2018). The researcher's worldview predominantly depends on the discipline area of the researcher, beliefs and experiences. The present study was primarily influenced by several factors driven by the ontological and epistemological assumptions of the inquirer, her interest and urge to find a solution to an issue she observed over several years. Other factors that inspired the researcher to engage in the present investigation relate to the wealth of experience she had acquired over more than two decades in an educational environment, her interest in the focal area of this investigation, and her position as an instructional designer in a higher education setting. The next section discusses the positivist/post-positivist, constructivist, transformative and pragmatic paradigms as the dominant worldview or approach considered to be scientifically and objectively most viable in the 21st century.

Positivist/Post-Positivist Paradigm

The positivist paradigm is the worldview grounded on the scientific method of inquiry. This paradigm was initially proposed by Auguste Comte, a French philosopher during the period 1798 to 1857. Thus, positivists rely on scientific procedures, including experimentation to answer questions and observational discovery. Furthermore, positivists are concerned with testing for cause-and-effect relationships in nature. Fadhel (2002) argues that the positivistic paradigm aims to interpret observations based on facts or through measurable objects. Researchers who belong to this school of thought rely on deductive reasoning to formulate and test hypotheses, operational definitions, scientific equations, extrapolations and expressions to

conclude. Positivistic philosophers offer justifications and estimates that are informed by measurable outcomes based on determinism, empiricism, parsimony and generalisability (Cohen et al., 2007).

Consequently, the positivist paradigm supports quantitative research methods. Still, researchers need to be exact when describing the limitations and measurements for data collection, analysis and interpretation to comprehend the relationships embedded in the data (Onghena et al., 2018).

The positivist epistemology is based on objectivism and relies heavily on experimental technique to provide axiology of beneficence (Cohen et al., 2007). The positivist worldview is the traditional practice of research, strictly associated with quantitative research (Creswell & Creswell, 2018). However, Phillips and Burbules (2000) argue that post-positivists challenge the traditional idea of the absolute truth, based on the assumption that researchers cannot be unequivocally positive about the claims they make when studying human behaviour. As a result, the post-positivist paradigm (Smith, 1983), based on the deterministic concept of control outcomes, has existed since the nineteenth century. Post-positivism is referred to by various terms, including empirical science positivist/post-positivist research. Objectivity is at the heart of postpositivist knowledge, attained by careful observation and measurement of reality (Cohen et al., 2007; Creswell & Creswell, 2018). Therefore, post-positivist researchers conduct research that starts with a theory, followed by data collection and analysis to obtain results that either support or refute the theory.

Additionally, post-positivist theorists make the required amendments to theory and conduct additional tests. Both positivists and post-positivists rely on the objectivity of reality and the application of scientific procedures to obtain knowledge; hence their worldviews are intertwined. However, post-positivistic researchers criticise conclusions of scientific methods to strengthen objectivity and avert human biases (Onghena et al., 2018). Although the positivist

and post-positivist worldviews are frequently considered intertwined, academics struggle to comprehend why many of positivism's qualities are not fully applicable in situations involving people. As a result, the social world is examined differently than the natural world.

Consequently, the argument that the social world is not value-free and not likely to offer elucidations of a causal nature resulted in adjustments to the traditional positivistic paradigm to lessen some of the philosophical underpinnings of positivism (Baškarada & Koronios, 2018). Subsequently, the post-positivist paradigm arose to accommodate the imperfect nature of reality and further strengthen the belief that truth is not absolute but rather probable. Philosophical underpinnings of post-positivism permit observations to be conducted that are not subjected to experimentation or to formulate the hypothesis that needs testing. Guba (1990) states that the positivist paradigm researchers strongly believe in investigating and understanding reality "out there". Researchers from the post-positivist paradigm admit that truth can only be approximated and never be comprehended completely.

Although this study underpins the pragmatic worldview, the post-positivist research paradigm is also relevant to this study, based on the philosophical conviction of the researcher that reality can never be fully understood but only be approximated. The researcher agrees with the positivist/post-positivist view that social context elements maintain a high degree of consistency over time and space. Additionally, positivistic studies comprise specific elements that place a high premium on applying available statistical techniques to study large sample populations. Hence, the assumptions mentioned above are significantly applicable to the current study. This inquiry relied on a large sample size to collect quantitative data and applied statistical methods to analyse that data. Although this study adopted a pragmatic paradigm, the quantitative character of the study is associated with a positivist/postpositivist research design.

The reality of the effective use of Moodle as an LMS at the research site was discovered by administering survey questionnaires to the participants to seek answers to the research

questions and issues under inquiry. These realities were based on the participant's perceptions; therefore, the truth discovered depended on human responsiveness and reasoning. However, to address the research questions fully in this study, the study could not be detached entirely from a positivism/post-positivism research paradigm but rather a mixed-methods research approach, which a full discussion will follow later in this section. Next, an outline of the constructivist/interpretivist paradigm is offered, along with reasoning about the applicability of the constructivist paradigm to this study.

The Constructivist/Interpretivist Paradigm

The constructivist paradigm aligns with qualitative research methodologies to collect and analyse data. It is argued that interpretivists believe that individuals develop subjective meaning based on personal experiences. Thus, researchers from this school of thought rely on participants' perceptions to make sense of the phenomenon being studied (Crotty, 1998; Lincoln & Guba, 1985; Mertens, 2010). Some of the assumptions used to explain constructivism are outlined below.

Humans are said to create meaning through their interactions with the world. To obtain information, interpretivist researchers personally connect with the natural surroundings of the subjects. The background and personal experiences of researchers shape the interpretation of phenomena. Researchers in the interpretivist paradigm may choose qualitative data gathering methods, such as the grounded theory approach to capture real-life occurrences. Regarding the relativist ontological assumptions of interpretivists, phenomena studied have multiple realities. Chalmers et al. (2005) agree that interpretivists believe that various realities can be explored and reconstructed to make sense of situations. This is accomplished through human interaction between the researcher and the research subjects and among the research participants (Chalmers et al., 2005). Furthermore, interpretivists collect data in a social context using

naturalistic methodologies, such as interviews, reflective sessions, text messages and discourses (Carr & Kemmis, 1986).

For this study, an interpretivist paradigm was relevant since the study relied on the subjective experiences of study participants. These include the experiences of a wide range of Moodle users at the research site to offer direction to craft a plan for the university to ensure the effective and safe use of Moodle as an LMS, which could increase student academic achievements. The interpretive paradigm's basic assumptions are rooted in the belief that knowledge is created in a social context by people who are actively involved in the research process, necessitating researchers to try to comprehend the "complex world of lived experience from the perspective of those who live it" (Mertens, 2010). Hence, considering the above assumptions of the interpretive paradigm, the researcher could look further than quantitative data, which strengthened the reliability and credibility of the evidence. Next, a discussion is presented on the critical paradigm/transformative paradigm.

The Critical Paradigm/Transformative Paradigm

The transformative paradigm arose in the 1980 and 1990s and presented the philosophical assumptions of researchers that belong to the 'camp' that position themselves to seek answers to social justice matters, among other things, to address the political, social and economic issues (Creswell & Creswell, 2018). The latter problems are central to social oppression, struggle, power structures and conflict at various levels. The philosophical underpinnings of the transformative paradigm are aimed at changing politics, confronting social oppression and improving social justice in a given situation. The researcher and participants have a close relationship, which accounts for the transactional epistemology associated with this paradigm. Additionally, transformative paradigms relate to oppression, defined as a dialogic methodology coupled with axiology that respects cultural norms (Mertens, 2003). Informed by the topic, research questions, and audience, this study did not consider the

transformative paradigm. The following section discusses the pragmatic paradigm as the preferred approach for this study.

Pragmatism as a Paradigm

Tashakkori and Teddlie (2003) believe that pragmatism, as a research paradigm, is grounded on the conjecture that investigators ought to use the philosophical and/or methodological approach that best addresses the particular phenomenon under inquiry. This paradigm is frequently associated with the use of mixed-methods or multiple-methods research in which the findings and research questions receive more attention than the methods used to conduct the study (Biesta 2010; Creswell & Creswell, 2018; Creswell & Clark 2011; Teddlie & Tashakkori, 2009). Moreover, Creswell and Clark (2011) confirm that studies grounded on pragmatic philosophies may involve formal and informal rhetoric. Hence, many researchers rely on pragmatism as it is less concerned with assumptions about reality and more focused on solving practical research problems (Baškarada & Koronios, 2018, Johnson & Onwuegbuzie, 2004). This study adopted a pragmatic worldview, allowing the researcher to include qualitative and quantitative approaches to seek answers to the problem under inquiry (Rossman & Wilson, 1985). Creswell and Creswell (2018) agree that studies underpinned by the pragmatic worldview allow researchers the liberty to select the most appropriate methods, techniques and research procedures aligned with the study's needs and purposes. In the next section, a discussion is presented on research design.

Research Design

Yin (2015) refers to a research design as a logical plan that can be followed to move from ‘here’ to ‘there’. In this definition, ‘here’ represents the initial set of questions that need exploration and ‘there’ represents the conclusions drawn from the inquiry. Furthermore, theorists agree that research designs are customised to align with the scope of the study and match the objectives of studies to answer the research questions (Creswell & Creswell, 2018).

A sequential explanatory evaluation study design was chosen as part of a mixed methods approach to evaluate the effective use of Moodle as a learning management system at NUST. The research design secures the framework for the research and offers a roadmap to answer the issue under investigation.

Furthermore, it informs researchers about the types of data to be gathered, how to analyse the data, and sheds light on any limits to be placed on the findings (Creswell & Creswell, 2015). According to Babbie (2016), the research design requires researchers to think deeply about a particular topic, population, type and purpose of research methods to employ for any study. Informed by the research question(s), coupled with examining existing literature, one has to choose an appropriate research design to conduct research successfully. According to Creswell and Creswell (2018), the decision that informs a specific design is also governed by the inquirer's interest. Empirical research involves the engagement in studies to collect and present original evidence or data to support claims in a study (Yin, 2018).

Therefore, empirical research may include both qualitative and quantitative studies. According to Creswell and Creswell (2018), conducting a qualitative empirical study allows researchers to understand complex problems better, empower individuals to express their opinions, and guide decisions in developing theories when existing ones are unfit to address the problem under investigation. This study adopted a pragmatic worldview that includes qualitative and quantitative approaches to seek answers to the issue under inquiry (Rossman & Wilson, 1985). Creswell and Creswell (2018) agree that pragmatism entails mixed methods research, whereby researchers rely on a combination of qualitative and quantitative data to seek answers to research questions. Studies underpinned by the pragmatic worldview allow individual researchers the liberty to choose the most appropriate methods, techniques and research procedures that match best with the study's needs and purposes. In the context of this study, the researcher sought to address six research questions informed by the topic, problem

statement and objectives of this study. Both quantitative and qualitative data were collected, analysed, and interpreted to address the study questions adequately.

Mouton (2011) states that a research design can be separated into empirical and non-empirical data. In the context of this study, the researcher conducted an extensive literature review informed by the research objectives and questions. Considering the ethical issues, which will be explored later in the chapter. Empirical data for the current study were gathered using both quantitative and qualitative data collection tools. Quantitative data was gathered in this study by distributing survey questionnaires to study participants for completion. These questionnaires contained both closed and open-ended questions. The quantitative data collection was followed by the qualitative data collection process, in which in-depth interviews were conducted with instructional designers, academics, academic support coordinators, and the Moodle systems analyst at the research site. The non-empirical data used in this study enabled the researcher to set the scope for the study informed by the research questions and the purpose of the inquiry to conduct an extensive literature review. The study's primary purpose was to investigate the effective use of Moodle as an LMS at NUST, a public, non-profit university that offers full-time, part-time and distance education opportunities through blended and full-fledged online learning. The researcher engaged in an extensive literature review that included seminal, peer-reviewed publications and eBooks from various electronic databases ranging from 2000 to 2020. Related electronic literary sources consulted align with the focal area of the study.

Furthermore, various electronic searches were conducted to address the research questions. A few examples of electronic searches performed involved the:

- responsiveness of course participants to use Moodle features,
- the use of a learning management system for increased course engagement,
- using Moodle to augment communication,

- using Moodle for the development of critical thinking and problem-solving skills in blended learning settings, and
- safety vulnerabilities in Moodle as an open source.

All the searches conducted were thoughtfully done and showed alignment with the research questions. The researcher was convinced that the combination of quantitative and qualitative methodologies could offer a suitable research plan to gather data that could shed light on the research questions of this study. Consequently, selecting an appropriate design for the study was guided by the researcher's worldview, the problem definition, research objectives, the extent or rigour desired for this study and cost considerations. The mixed-methods approach enabled the researcher to triangulate textual data with numerical data to thoroughly understand the phenomena under investigation (Creswell, 2014). Both positivist and interpretive research methods were employed in this study for two reasons. Firstly, the study relied on the objective facts provided by students and academics. Therefore, a quantitative approach was deemed fit to investigate the accurate views of study participants. Secondly, the study relied on the qualitative approach to collect qualitative data. The personally lived experiences of students, academics, instructional designers, Moodle support staff and the systems analyst could be accounted for through open-ended questionnaires and in-depth interviews.

The Sequential Explanatory Mixed-Methods Research Design

The present case study adopted an explanatory sequential research design. It is a two-phase mixed-methods design where quantitative data are first gathered and analysed in this design. The next step is the gathering and analysis of qualitative data after the initial phase. The study's second qualitative phase is structured to build on (or relate to) the findings of the first quantitative phase (Creswell and Creswell, 2018).

Because this strategy starts quantitatively, researchers frequently give quantitative methods more weight than qualitative methods. Researchers who need qualitative information to supplement or explain quantitative findings turn to the follow-up explanations model (Creswell, Plano Clark, et al., 2003). In this paradigm, the researcher selected particular quantitative results that require further explanation, such as statistical discrepancies between groups, people who scored at the highest or lowest levels, or unexpected outcomes. After that, the researcher gathered qualitative information from participants who are best able to explain these results. In this model, the quantitative elements were typically given the most weight.

Adopting an explanatory sequential research design enabled the researcher to rely on both quantitative and qualitative data collection tools. Quantitative data from students and academics using Moodle as an LMS were gathered with the use of survey questionnaires. Informed by the results of the quantitative data, qualitative data were collected and analysed, which helped the researcher to get a deeper understanding of the challenges faced by NUST to use Moodle effectively. Thus, suggestions could be made to solve a real-life problem at NUST. Hence, the adoption of an explanatory sequential research design provided a complete understanding of the effective use of Moodle as an LMS at the chosen research site, as this inquiry provided answers to the research questions.

The researcher could collect and integrate quantitative and qualitative data to establish the level of responsiveness of NUST students and lecturers to capitalise optimally on the existing features of Moodle – the first research question. Participants in the study were required to complete questionnaires that included closed and open-ended questions to answer the latter research topic. The second research question explored the signifying factors that affect blended learning in higher education. Data collected via the survey questionnaires and the facilitation of in-depth interviews with instructional designers, academic support coordinators, student support coordinators, faculty coordinators and the Moodle site administrator provided answers

to the second research question. The third research question evaluated whether using Moodle has led to increased course engagement among students. The fourth research question assessed whether the use of Moodle has led to improved student communication and the fifth research question evaluated whether the use of Moodle has increased student problem-solving skills. Research questions three to five were answered through data obtained from the survey questionnaire and in-depth interviews. The sixth research question required the development of a strategy for NUST to provide details on possible approaches that could be employed to capitalise on the effective and safe use of Moodle. This research question was answered with data collected mainly via in-depth interviews, the open-ended response in both questionnaires, and non-empirical data from the literature review. It is believed that using a sequential explanatory mixed-methods research design research design strengthens the study's focal area and instructs the researcher on how to analyse data. Hence, the researcher concurs that a case study aims to describe and analyse occurrences of social units in the context of an individual, institution, group or community (Merriam, 1998). The latter definition links to the choice of the focal areas of the inquiry (Stake, 2005) to strengthen the parameters of this investigation.

This mixed-method single case evaluated the effective use of Moodle as an LMS, which is in line with Yin's (2018) and Schumacher and McMillan's (2010) views, which affirm that a case study involves the study of a case within the natural setting or authentic context. Researchers working on case studies can utilise various ways to collect and analyse data, whether statistically, qualitatively or using a combination of quantitative and qualitative methods (Creswell & Creswell, 2018).

Pilot Study

A pilot study is a small investigation to test the feasibility and validity of procedures and collect information before the primary research is conducted (Okeke & van Wyk, 2015). The main study in this investigation was preceded by a pilot study, which allowed the

researcher to rectify any weaknesses in the research instrument before carrying out the full-scale research. A pilot study was conducted with fifteen students and twelve lecturing staff members in the Management Sciences Faculty. The design and question formulation of questionnaires were tested, after which the researcher made necessary changes to eliminate errors. Creswell and Creswell (2018) agree that conducting a pilot study in research adds value to the validity and credibility of the questions and provides answers to the research questions.

Research Setting

This study was conducted at NUST, a public tertiary institution in Windhoek, the capital city of Namibia. As a public tertiary institution, it offers a range of undergraduate and postgraduate professional and academic programmes to both national and international students. During the 2020 academic year, the institution provided study opportunities to over 12 500 students across six faculties – Computing and Informatics, Engineering, Management Sciences, Human Sciences, Health and Applied Sciences, and Natural Resources and Spatial Sciences (NUST, 2020). The Faculty of Human Sciences is the second largest of the six faculties and recorded a staff complement of seventy-seven academics in 2020. The faculty comprises three departments: the Department of Communication, Social Sciences, and Vocational and Educational Training.

As study participants in this mixed-method case study, students and lecturing staff were selected based on their first-hand experiences using Moodle as an LMS at the chosen institution. The study participants in the in-depth interviews were selected based on their close involvement in working on Moodle to offer technical and academic support services to faculty members and students. The voluntary participation of faculty coordinators interviewed in this study was considered based on their personal experiences using Moodle and the participants' role in promoting sustainable full-fledged online learning experiences amongst fellow faculty members and students in the chosen department. The researcher found and selected study

participants and groups of individuals who were highly conversant about and experienced a phenomenon of interest, as described by Creswell and Clark (2011). Additionally, an agreement exists regarding the crucial importance of the availability and willingness of participants to be included in the research and their ability to communicate their experiences and opinions in an articulate, sensitive and thoughtful manner (Bernard, 2002; Spradley, 2016).

The study included study participants (students) from six faculties at the research site: Faculties of Human Sciences, Engineering, Natural and Spatial Sciences, Health and Applied Sciences, Management Sciences and Human Sciences. In addition to the faculties mentioned above, the study also included participants from The Centre for Open and Lifelong Learning (COLL), the Teaching and Learning Unit (TLU) and the Department of Information Communications and Technology (DICT). The decision to involve the COLL and TLU in this study was based on their shared responsibility to offer online support to students and faculty members at the institution. While COLL offers e-learning support to distance students, the TLU offers e-learning support to lecturers. DICT was included in the study based on their responsibility of hosting and maintaining Moodle. Thus, full-time and part-time students are confused about whom to consult if e-learning support services are required. This approach has crippled the online learning experiences of full-time and part-time students across the institution, particularly regarding technical support services. In most cases, students rely on faculty expertise to provide technical and academic support in the absence of a designated unit to offer e-learning support to full-time and part-time students at NUST. On this basis, this empirical investigation was confined to the Faculty of Human Sciences, where students have been exposed to blended learning and to a great extent, full-fledged online modules.

Following approval from the Unicaf Research Ethical Committee (UREC) for this study to be conducted at NUST, a written request was sent to the Department of Institutional Planning to request a spreadsheet containing the names and contact information of students and

staff members from (1) The Faculty of Human Sciences; (2) The COLL; and (3) The TLU. The dean and sectional heads in the Faculty of Human Sciences were informed via email that the study would be conducted in the faculty.

3.2 Population and Sample of the Research Study

A population is described as the aggregate of all the elements that conform to a set of research specifications (Polit & Hungler, 2004). In contrast, a sample is defined as the technique researchers use to select a population quota to represent the whole population (LoBiondo-Wood & Haber, 2018). Furthermore, because not every member of a target population can be included as a participant in a study due to limits and delimitations influencing the study, Ranjit (2011) defines a sample as the subsets to be included in an empirical investigation. The population of this study comprises lecturers, students and administrative staff at a public university in the capital city of Namibia, Windhoek. The student population includes a blend of distance education, full-time and part-time undergraduate students in the Faculty of Human Sciences at NUST. This study, furthermore, included only second-year and third-year students attached to six faculties at the research site. The second sample consisted solely of full-time lecturers.

Sampling is defined as a technique to select a sample from an individual or a large group population for a specific kind of research purpose (Bhardwaj, 2019). Hence, a sample refers to a group of study participants, objects, or items, drawn from a population of interest to form a research study. Sampling is an essential tool in research, especially when the population is large. This technique involves selecting the subsets to be included within a research project from a defined population (Guest et al., 2013).

Furthermore, Sarantakos (2013) alludes that sampling aims at selecting appropriate study participants who hold the traits, roles, views, knowledge, thoughts, and experiences relevant to the study. Probability and non-probability sampling are two major sampling types

used in research. Probability sampling was used to draw the participants included in this empirical investigation for the collections of quantitative data. Researchers can select samples from a broader population using the probability sampling technique, which uses probability theory to ensure that every community member has an equal chance of being included in the study. Probability sampling is associated with quantitative research and provides an equal opportunity for each subset to be selected as study participants. The outcomes of studies in this area can be extrapolated from the sample to the population (Gibson & Brown, 2009). Simple random sampling, cluster sampling, systematic sampling, and stratified random sampling are four types of probability sampling often used in empirical research (Ciromo, 2009).

In non-probability sampling, randomisation is insignificant for selecting a sample from the population of interest (Sarantakos, 2013). As a result, non-probability sampling refers to a sampling method in which the sample is drawn in a way that does not give all population members an equal chance of being included in the study. Purposive, snowball, quota, and convenience sampling are examples of non-probability sampling (Bhardwa, 2019; Chiromo, 2009). For the present study, purposive sampling was employed to draw a small sample of twelve participants for the collection of qualitative data.

Sample Frame

For this mixed-method case study, three different samples were required. Samples one and two were selected to collect quantitative data from students and lecturers in the Department of Human Sciences and Management Sciences at NUST. Sample three was chosen to collect qualitative data from participants. The following paragraphs summarise the population composition and sampling techniques applied to select the desired three samples. The population for this study was finite and consisted of 1,092 participants. A total of ten data sets were used to determine three different samples from the target population.

The student sample included second and third-year students from the Faculty of Human Sciences as a target population, consisting of 1,001 students, 580 females and 421 males. Stratified simple random sampling was used to draw a representative sample of 278 students, comprising 162 females and 116 males. The stratified sampling technique was employed to select a proportionate sample size of each stratum equivalent to the stratum's population size (Taherdoost, 2016). According to Salkind (2017), proportional sampling is a technique to divide a finite population into subpopulations. Subsequently, random sampling techniques were employed to draw a representative sample from each subpopulation. This study's random selection of participants was performed electronically with the help of Microsoft Excel. Gall et al. (2007) highlight the benefit of randomisation as a sampling approach for generating data that may be generalised to a broader population. Next, a discussion is presented on the sampling proportions employed to draw study participants from three different subsets in the Human Sciences Department.

Six data subsets were proportionally chosen, using stratified sampling to select a representative student sample of six faculties at NUST.

Sample Size

For the calculation of the sample size of the students (Sample 1), the following assumptions were taken into consideration:

Where:

n = sample size required

e = Margin of error = (0.05)

P = Population Proportion = 0.5

N = Number of people in population = 1,001

At 95% confidence level with degree of freedom 1, the chi-square value is (x2) = 3.841

The following formulae were used to calculate the sample.

$$n = \frac{x^2 N\ P\ (1 - P)}{e^2(\mathrm{N} - 1) + x^2\mathrm{P}(1 - \mathrm{P})}$$

$$x^2 = 3.841$$

$$\mathrm{P} = 1{,}001$$

$$\mathrm{e} = 0.05$$

$$n = \frac{x^2 NP\ (1 - P)}{e^2(\mathrm{N} - 1) + x^2\mathrm{P}(1 - \mathrm{P})}$$

$$n = \frac{3.841 * 1001 * 0.5 * 0.5}{((0.05)^2 * (1001 - 1)) + (3.841 * 0.5 * 0.5)}$$

$$n = 278\ Units$$

As a result, the students' sample population consisted of 278 units that were sampled for the student population.

Sampling Frame of Lectures

A second sample was drawn, also using stratified random sampling. Two data sets were used to calculate the sample with a target population of 77 participants comprised of 40 females and 37 males. For the calculation of the sample size of the lecturing staff (Sample 2), the following assumptions were applied:

Where:

$$x^2 = 3.841$$

$$\mathrm{P} = 77$$

$$\mathrm{e} = 0.05$$

$$n = \frac{3.841 * 77 * 0.5 * 0.5}{((0.05)^2 * (77 - 1)) + (3.841 * 0.5 * 0.5)}$$

$$n = 64\ Units$$

As a result, the lecturers' sample population consisted of 64 units that were sampled for data collected from teaching staff using an anonymous web-based Google Forms survey following reliability and validity standards, which will be discussed later in this chapter. The web-based survey questionnaires were adapted from existing data collection tools used in related studies to produce data collection tools that address the purpose of this study.

Sample Selected to Gather Qualitative Data

Participants for the third sample were drawn purposely as a type of non-probability sampling. This data set consisted of the COLL, the TLU, the Faculty of Human Sciences, and the Faculty of Management Sciences. The target population for the third sample recorded a staff total of twelve participants drawn purposely, consisting of nine females and three males. In-depth face-to-face interviews were conducted with the third sample. According to Patton (2014), purposive sampling is extensively employed in qualitative research to locate and choose data-rich cases to make the most use of limited resources. Purposive sampling was chosen for the third sample because it best suited the specific aims connected with answering the research questions (Babbie, 2016; Teddlie & Yu, 2007). Furthermore, purposive sampling aided the researcher in concentrating on key informants who were exceptionally knowledgeable of the phenomenon under investigation to provide in-depth findings of the inquiry (Anney, 2014). In agreement with Bhardwaj (2019), purposive sampling is the best sample technique to use when dealing with a small population in which the researcher is confident that the target population fulfils the demands of the inquiry.

The anonymous web-based surveys, built with Google forms and featuring both closed and open-ended questions, were completed by students and lecturers in samples one and two, which will be detailed in the next section.

3.3 Materials/Instrumentation of Research Tools

This section discusses the research tools used in this study, which consisted of two different sets of survey questionnaires and the facilitation of in-depth interviews. This section also provides discourse on the validity and reliability of the data collection tools and the pilot study. As mentioned in Chapter 1, this single case study adopted a mixed-methods research design. Therefore, the combination of quantitative and qualitative dimensions formed part of this study. Two survey questionnaires were prepared and administered to lecturing staff and students as research participants in this investigation to accommodate the quantitative character of this study.

Design and Development of Web-Based Questionnaires

Web-based survey questionnaires are convenient to use, easy to design, cost-effective to use, provide real-time access to participants and increase the response rate of participants (Howard, 2019). The present study used anonymous web-based survey questions created with the Google Forms tool to collect quantitative data. The participants could complete the survey at their leisure using the Google Forms application. There was no time constraint attached to completing the survey form. The software is free to use if the researcher (designer) has a Google account. Initially, the questionnaires were developed in MS Word and populated into Google Forms. The Google Forms template produces a user-friendly web interface to design and develop web-based survey questionnaires that look professional. Various data capturing options are available in Google Forms to allow the design of Lickert scale-type questionnaires to cater to multiple survey responses. Furthermore, using the Google Forms template enabled the researcher to set up the exact number of questions to collect data from participants. It also allowed for selecting a theme of preference and various colour schemes to improve the appearance of the design.

Before developing the data collection instruments, the researcher reviewed existing tools and created a preliminary list of items in conformity with the study design and in alignment with the research objectives and questions. Thus, the web-based survey questionnaires were designed to answer the research objectives and questions. To increase data reliability, Saunders et al. (2019) suggest researchers may adopt or adapt existing questionnaires to ensure that studies are replicated or compared with findings of existing studies. The researcher adapted existing Adapting data collection tools to design survey questionnaires that consisted of questions that collected demographic data, 5-point Likert scale questions and yes/no responses for the present study. All survey items were linked to the literature review of relevant theoretical models that fit this study. Survey questionnaire questions were adapted from the Blended E-learning Model (Ozkan & Koseler, 2009), a Learning Design Methodology (Antonis et al., 2011), Khan's Octagonal Framework (Khan, 2010), Orbital E-education Framework (Elameer & Idrus, 2012), and The Community of Inquiry Framework (Garrison et al., 2009). Adapting existing data collection tools linked to the purpose, objectives, and research questions fundamental to this inquiry. The survey questionnaires administered to the lectures contained forty-three questions. The questionnaire consisted of forty-two 5-point Likert scale-type questions and one open-ended question. Furthermore, the researcher used a panel of online tutors, instructional designers and senior lecturers in the Department of Human Sciences to secure the validity of the content included in both survey items.

According to Allan (2017), researchers gather background information from their respondents by incorporating demographic questions in a survey questionnaire. Questions on the demographic characteristics of respondents provide context for collecting survey data, which offers substance to researchers to describe the participants and analyse their data.

The survey questionnaires administered to the students comprised seven sections labelled A to G and contained 47 questions. Students were required to answer predominantly 5-point Likert scale-type responses and one open-ended question. Section A had five questions to collect demographic information on the gender, study mode, study programme and year of study programme registered for and age of students. Section B measured students' responsiveness in utilising the basic features in Moodle and contained six questions. Question 9 of Section B had four sub-questions, while Questions 10 and 11 consisted of five sub-questions each. Section C focused on the factors affecting blended learning at NUST and included eleven questions (Questions 12-22). Section D focused on using Moodle to increase students' course engagement and contained six questions (Questions 23-28). Section E concentrated on using Moodle for improved communication and included six questions (Questions 29-34). Section F focused on using Moodle to develop problem-solving skills and had ten questions (Questions 35-44). Section G evaluated the current use of Moodle based on students' experiences (Questions 45-46). The final question required an open-ended response to obtain ideas from students to augment Moodle's effective and safe use at NUST (Question 47).

The survey questionnaires administered to the lecturing staff consisted of six sections, labelled Section A to F, consisting of 43 questions. Section A focused on the demographic details of study participants. In this study, the lecturing staff's demographic characteristics included gender, age, years of teaching experience in a higher education environment and years of teaching experience using the NUST Moodle platform – MyNUST (Questions 1 – 4). Section B contained nine questions and required specific responses regarding the responsiveness of lecturing staff to use Moodle tools on the MyNUST e-learning platform (Questions 5 – 13). Respondents were required to rate statements to indicate how frequently they use some basic Moodle tools in blended learning. Options included in the rating scale to

show the frequency of use of the basic Moodle tools were: Never, Almost never, Sometimes/Occasionally, Almost every time, and Every time. Section C (Questions 14–26) includes thirteen questions focusing on the elements affecting blended learning at NUST. Section D contained five questions centred on using Moodle to increase communication (Questions 27 - 31). Section E had eleven questions (Questions 32–42) that focused on developing problem-solving skills through the use of Moodle. Section F included one open-ended question to elicit recommendations for the effective and safe use of Moodle as an LMS (Question 43).

Interview Design

In-depth interviews were conducted with selected participants to collect qualitative data. Reddy (2016) describes an interview as a qualitative research technique employed to collect data by facilitating participants' interviews. In this study, semi-structured interview questionnaires were designed, consisting of three sections labelled A, B, and C. Section A was designed to collect data on the demographic characteristics of participants. Section B, comprised of eleven open-ended questions, collected data on the factors that affect blended learning to evaluate the effective use of Moodle as an LMS at NUST. Section C contained one open-ended question designed to provide recommendations to promote the effective and safe use of the MyNUST e-learning platform/Moodle at NUST.

Validity of Data Collection Tools

Creswell and Poth (2018) describe validity as a data collection instrument's ability to measure what it is supposed to measure precisely. Researchers commonly rely on the content and construct validity to ensure the validity of the data collection tools. Content validity examines how the questionnaire includes all the essential elements relevant to the construct being measured. The web-based survey questionnaires used for this empirical investigation contained items aligned with the purpose and direction of the study to evaluate the effective

use of Moodle as an LMS. The involvement of several parties to scrutinise questions ensured content validity for the present study. Contributions from a panel of Moodle experts at NUST increased the validity of data collection tools. The investigation overseeing body, Unicaf Research Ethical Committee (UREC) and the research supervisor approved the data collection tools. In addition to a panel of Moodle experts to validate the questionnaires, a pilot study was conducted as a pre-test to ensure the validity of the survey tools. The Management faculty's head of department (HOD) granted permission to conduct a pilot study. This pilot study included fifteen students and twelve lecturing staff members. Two pilot interviews were conducted in the end. Both sets of survey questionnaires and the questions in the interview guide were updated to reduce misunderstanding based on the results and suggested pilot research. Thus, results from the pilot study confirmed the validity of both quantitative and qualitative data collection tools.

Reliability of Data Collection Tools

The reliability of data collection tools refers to how such instruments represent the consistency of the measures acquired of the characteristics if used in repeated trials (Grove et al., 2013). For this investigation, the reliability of all survey questionnaires and the questions included in the interview guide were confirmed in a lengthy process by a panel of Moodle experts and senior lecturing staff members. It was determined that both sets of web-based questions were reliable after extensive email correspondence and follow-up virtual sessions. The interview questions presented in the interview were reviewed several tim to be appropriate. The details of the pilot are be discussed later in this section.

Refinement of the Research Instruments

Instruments for both quantitative and qualitative research have been improved. Collaborations with diverse team members were used to fine-tune the quantitative research instruments. Some helpful recommendations were made and implemented to address grammar

issues, layout and appropriateness of items included in both instruments. Special attention was given to the design of the questionnaires to present a logical presentation of questions. Questions were grouped according to specific themes, and the formulation of several statements was improved.

Pilot testing of the Research Instruments

Pilot studies are crucial and are highly recommended (Vogel & Draper-Rodi, 2017). All collected data should be piloted to confirm a clear presentation of all questions and instructions and remove any items that do not yield usable data (Bell, 2005). Researchers must perform pilot studies to ensure the correctness of the format of the tool before implementing the main instrument(s). A pilot study was administered to eliminate any ambiguities of items in the survey questionnaires. This was necessary to ensure that tools are suitable to elicit the desired type of data the researcher expects from participants to answer what is meant to be answered. It also confirmed that collected data were analysed meaningfully to address the study objectives and provide answers to the investigation inquiry. The pilot study consisted of fifteen students and twelve lecturers, randomly selected from the Faculty of Management Sciences at NUST. It was determined that the time given to participants to complete the form was insufficient. Data collected during the pilot study was collected using Google Forms. A spreadsheet was downloaded in the format of an Excel spreadsheet. Statistical Package for Social Science (SPSS) version 27 was used to code the data and run the Cronbach alpha test to evaluate the inter-item consistency reliability of the survey questionnaire items. The most common method for evaluating inter-item consistency dependability is the Cronbach's alpha coefficient (Sekaran & Bougie, 2010). Frequency in using Moodle tools' subscale consisted of 16 items ($\alpha = .77$), the factors affecting the blended learning subscale consisted of 11 items ($\alpha = .90$), and the course engagement subscale consisted of 7 items ($\alpha = .74$). Cronbach's alphas for the six communication and thirteen problem-solving skill development items were .78 and

.91, respectively. The internal consistency is expressed on a scale between 0 and 1. Typically, a value of .07 or higher is acceptable (Stark & Roberts, 1998). Figure 9 presents the Cronbach alpha measures of the students' survey questionnaires, and Figure 10 depicts the Cronbach alpha measures of lecturers' survey questionnaires as a result of the pilot study.

Figure 9

Internal Consistency of Students' Questionnaires

Internal Consistency of Students' questionnaires	
RQ1: Responsiveness of NUST's student in using the tools of Moodle	
Number of participants	15
Sum of the item variances	14.02666667
Variance of total score	49.71555556
Cronbach's alpha	0.77
RQ2: Signifying factors that affect blended learning	
Number of participants	15
Sum of the item variances	14.34667
Variance of total score	88.72025
Cronbach's alpha	0.90
RQ3: Increased course engagement using Moodle as an LMS	
Number of participants	15
Sum of the item variances	5.715556
Variance of total score	18.22222
Cronbach's alpha	0.74
RQ4: Communication between course participants using Moodle as an LMS	
Number of participants	15
Sum of the item variances	8.088889
Variance of total score	30.14277
Cronbach's alpha	0.78
RQ5: Development of problem solving skills using Moodle as an LMS	
Number of participants	15
Sum of the item variances	4.06222222
Variance of total score	26.6933333
Cronbach's alpha	0.91

Note. Cronbach alpha's internal consistency measures of the students' survey questionnaire items.

Figure 10

Internal Consistency of Lecturers' Questionnaires

Internal Consistency of Lecturers' questionnaires	
RQ1: Frequent use of Moodle tools	
Number of participants	12
Sum of the item variances	24.9375
Variance of total score	310.6875
Cronbach's alpha	1.00
RQ2: Factors affecting blended learning	
Number of participants	12
Sum of the item variances	6.375
Variance of total score	17.25
Cronbach's alpha	0.69
RQ4: Increased communication through the use of Moodle	
Number of participants	12
Sum of the item variances	8.576388889
Variance of total score	22.07638889
Cronbach's alpha	0.67
RQ5: Development of Problem solving skills	
Number of participants	12
Sum of the item variances	0.1875
Variance of total score	0.576388889
Cronbach's alpha	0.74

Note. Cronbach alpha's internal consistency measures of the lecturers' survey questionnaire items.

Results of the Pilot Study

The pilot study outcomes revealed that the instruments were appropriate and valid for the main study. However, several adjustments had to be made to initial data collection tools regarding the time allocated for completing the survey questionnaires and the structure of the survey items. The time limit for lecturing staff and students to complete the survey surveys has been reduced to 15 minutes. During the pilot trial, several instructors and students found that certain questions were not adequately grasped. The usage of Moodle wikis, choices, chats, and

blogs caused difficulty because lecturing staff and students did not completely understand these components. The student questionnaires were stripped of statements about wikis, choices and blogs. However, these items remained in the lecturer survey since each construct provided an explanation to ease the understanding of statements containing technical terms. Participants did not understand the clause, 'I feel lost studying online'. This clause was changed to 'I feel lost and unsure about my ability to manage online learning'. Amendments to some of the statements included in the survey questionnaires were needed.

Section B contained statements to evaluate the responsiveness to using the features of Moodle by students and lecturing staff. Instead of gauging how frequently certain Moodle tools were used, the confidence level in utilizing the tool was measured. The order of items was rearranged and grouped to ensure items included in the study addressed the research questions logically.

After the pilot study was conducted, the student survey questionnaire was adapted based on the suggestions collected from participants involved in the pilot study. The student questionnaire consisted of five dimensions. Section A collected data on the demographic characteristics of the participants. Section B was labelled "Students' responsiveness in using the My NUST e-learning platform (Moodle)" and yielded data to answer the first research question - What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle? Section C of the student questionnaire focused on the factors that affect blended learning at NUST and yielded data to answer the second research question - What are the signifying factors that affect blended learning at NUST? Section D of the student survey questionnaire focused on the use of Moodle for increased student course engagement, which yielded data to answer the third research question - What impact does the use of Moodle at NUST have on students' course engagement? Section E focused on the use of Moodle for improved communication. This section gathered data that answered the fourth

research question - What impact does the use of Moodle at NUSt have on students' communication? Section F focussed on the use of Moodle to develop problem-solving skills. This section collected data that answered the fifth research question - What impact does the use of Moodle at NUST have on the development of students' problem-solving skills?

No costs were involved in conducting interviews during the pilot study, as both participants interviewed during the pilot study were based on the main campus in Windhoek. The researcher contacted the two participants via email to confirm their participation in the pilot interviews. The interviewing process of the pilot study took approximately two hours. It was intended to complete each interview within 45 minutes. The researcher re-examined the interview guide and consequently removed three questions that did not add value to the study to minimise the risk that participants become sceptical in an interview that could last two hours. There was a need to rearrange some questions in the interview guide to ensure a logical flow of responses aligned with the research questions and objectives.

3.4 Operational Definitions of Variables

The variables within the sample relevant to this investigation exhibited specific variables particularly significant to the literature in related studies and the theories underpinning this research. This section provides details on the presence of those variables. More particularly, the variables presented in this sample were chosen from several related studies (Broadbent, 2017; Cleveland-Innes et al., 2011; Elameer & Indrus, 2012; Fettahlıoğlu & Kaleci, 2018; Garrison et al., 2000; Giraldo-García et al., 2015, Gomez, 2015; Hartman et al., 2019; Kabassi et al., 2018 Khan, 2010; Khan & Smith, 2007; Kiget et al., 2014; Liu et al., 2016; Oblender, 2002; Sanchez-Gordon & Luján-Mora, 2014, Wojciechowski & Palmer, 2005).

Section A was designed to collect demographic data from participants in both survey questionnaires. The survey questionnaire contains 5-point Likert scale-type questions, and

variables were measured as explained in the following section. Demographic information of each data set was presented separately in frequency tables. Descriptive analyses, frequencies and percentages were used to compare the proportions of subjects who responded in different directions. Spearman's correlation coefficient (r_s) was used to establish whether two variables are correlated, i.e. related to each other.

Demographic Characteristics of Students and Lecturers

All sections in the web-based survey questionnaire relied on a 5-point Likert scale to present variables linked to specific semantic scales to best measure what was supposed to be measured and provided answers to the research questions. Outcomes were presented in frequency tables and graphs.

Variable 1: Gender

The variable of gender is an independent variable. Both the lecturer and student survey questionnaires provided gender as a nominal dichotomous variable. Participants were required to choose between Male and Female.

Variable 2: Study Mode

The independent variable, study mode, is a nominal variable which is categorised as full-time, part-time, and distance and displayed in frequency tables.

Variable 3: Current Year of Study

The student questionnaire contained the independent variable, the current year of the study programme, which is a dichotomous variable, categorised as the second year and the third year of study.

Variable 4: Faculty

The six faculties at NUST at the time the study was conducted made up the nominal independent variable 'study program', which was used in the analysis.

Variable 5: Department

Students were asked to choose the department they belonged to while filling out the 'Department' variable on both sets of questionnaires, which is an independent nominal variable.

Variable 6: Age

Respondents were prompted to provide their exact age and the exact number of teaching experiences in years. The participants who had teaching experience of less than one year could choose the option, less than one year of teaching experience.

Variable 7: Number of years of Experience Teaching with Moodle

The variable, 'years of experience teaching on Moodle,' also required lecturers to provide the exact number of years they taught with Moodle. Alternatively, participants with less than one year could choose the option 'less than one year.' This concludes the variables in Section A. The variables in Section B are presented next.

3.5 Lecturer Questionnaire

Section B of the lecturers' survey questionnaire measured the responsiveness of lecturers in using Moodle tools using a 5-point Likert scale.

Variable 1: Frequent use of Moodle tools.

This is a dependent variable chunked in the following variables presented in a 5-point Likert scale consisting of six dimensions to measure the level of frequency in the use of Moodle tools, measuring eight items, namely: (1) upload resources (file, folder, and videos), (2) create activities (Chat, Forum, Quiz, Assignments, Feedback, Moodle workshop tool, Glossary), (3) communicate (Announcements/News tool), (4) promote interactivity (Lesson, Wiki, Choice, Shareable Content Object Reference Model (SCORM), Survey feature, H5P), (5) engage in online grading of tasks, (6) provide feedback, (7) allow resubmission opportunities and (8) access the e-learning platform in general. Dimensions one to seven were chunked in different ordinal variables and presented with the following semantic scale: Never, Almost never, Occasionally/Sometimes, and Almost every time.

Variable 2: Access to Moodle.

This dependent variable was measured as an ordinal variable, categorised as follows: I do not use the MyNUST e-learning platform, Once a month, Once a week, or daily.

Variable 3: Access to Moodle Training.

This is a dependent variable; four items were measured that required 'Yes' or 'No' responses from participants. These are dichotomous, nominal variables to assess the type of training opportunities offered by the department during the last 12 months. The four dimensions used to measure efforts made by the faculty to provide training were: I attended training workshops, I was part of a small group session (10 or fewer participants), I received one-on-one training, and I was assigned to a mentor by the institution. This concludes the

variables in Section B of the lecturer survey questionnaire. The variables in Section C of the lecturer survey questionnaires are presented next.

Variable 4: Factors affecting blended learning.

Section C of the survey questionnaire focused on the factors that affect blended learning at NUST and contained thirteen items/variables (Questions 14 – 26). Lecturing staff were asked to rate their level of agreement or disagreement with the statements that followed. Items 14 to 26 are ordinal variables chucked to present the following thirteen items: open access to reliable internet at home, motivation to teach online, readiness to teach online, challenges to adapt to online teaching, opportunities to communicate with course participants via Moodle, a certain level of computer literacy needed, self-directed learning, submission of assignments after the due date with permission, take ownership of course, better course management, feel lost and unsure, more training to improve confidence, heavy workload. The items mentioned above were measured using a 5-point Likert scale response as ordinal variables, measured as Strongly disagree, Disagree, Uncertain, Agree and Strongly agree. The variables of Section D in the lecturer survey questionnaire are presented next.

Variable 5: Students' Level of Communication via Moodle.

This is a dependent variable. Section D of the survey questionnaire contains eleven items/variables and focuses on 'the use of Moodle for increased communication.' Participants were asked to rate their level of agreement or disagreement with the statements to follow, which were presented in dimensions to evaluate student levels of communication.

Variable 6: Tools Used to Communicate in a Blended Learning Environment.

Communication tools used in blended learning included eight-item/variables (a) WhatsApp, (b) Short message service (SMSes) – Mobile phones, (c) Moodle messaging tool (MyNUST e-learning Platform), (d) Email communication, (e) Microsoft (MS) Teams chat tool, (f) MS Teams call tool, (g) Personal phone calls, (h) Facebook. The items above are

ordinal variables and are presented on a 5-point Likert scale. The following semantic scales were applied: Strongly disagree, Disagree, Uncertain, Agree and Strongly agree.

Variable 7: The Extent to which the Use of Moodle Led to Increased Communication Opportunities.

This variable was measured on a 5-point Likert scale, and the following semantic scales were applied: Very small extent, Poor extent, Satisfactorily extent, Great extent, and Excellent extent.

The development of problem-solving skills was the emphasis of Section E of the lecturer questionnaire, and respondents were asked to score their level of agreement with the statements provided.

Variable 8: Problem-solving Skill Development.

This section allowed respondents to evaluate the effect of problem-solving skills using Moodle. It included ten items presented as (1) Promote student rational thinking, (2) Promote independent thinking of student rational thinking, (3) Students seek multiple paths to analyse problems, (4) Develop their ability to think critically, (5) Students use quick messaging tool to share some thoughts and perspectives, (6) Able to solve authentic workplace-related issues, (7) Promote real-time problem-solving based on particular units, (8) Videos related to real-life scenarios to develop problem-solving skills amongst students, (9) Web links to articles which are related to real-life scenarios to engage students in solving problems, (10) PowerPoint presentations related to real-life scenarios to engage students in solving problems. These variables were measured in a 5-point Likert scale as ordinal variables, and the following semantic scales were applied: Strongly disagree, Disagree, Uncertain, Agree and Strongly agree.

Variable 9: The extend to which the use of Moodle led to the development of problem-solving skills.

Variable 9 was a dependent variable, and the following semantic scales in the 5-point Likert scale were applied: Very small extent, Poor extent, Satisfactorily extent, Great extent and Excellent extent. This concludes the variables in the Lecturer survey questionnaire. The variables in Section B of the student survey follow in the next section.

3.6 Student Questionnaire

Regarding the student survey questionnaires, Section B contained three behavioural dimensions, which included (a) Student responsiveness in using Moodle tools, (b) The tools used to access the platform and (c) the frequent use of Moodle.

Variable 1: Students' Responsiveness in Using Moodle Tools.

Several dimensions were created to measure student responsiveness in using Moodle, such as (a) Awareness of Moodle, a nominal variable measured as Course Lecturer, Friend, Moodle orientation session and Uncertain.

Variable 2: Devices Used to Access Moodle.

These nominal variables were presented in the form of multiple-choice questions, which required one answer and were measured as a device used to access the platform. The variables included: own Computer/laptop, mobile phone, iPad, Android tablet, I use a computer at the library/ lab/regional centre.

Variable 3: Frequent Use of Moodle.

This is a dependent variable, and the following items/variables were measured: (1) View course announcements/News, (2) View course syllabus, (3) Download assignments, (4) Taking Moodle quizzes, (5) Writing an online test, (6) Using the Workshop feature for peer assessment, (7) Participate in an online forum and (8) Submit assignments on the e-learning platform. The variable in this category was measured through a 5-point Likert scale, and the

following semantic scales were applied: Never, Almost never, Occasionally/Sometimes, Almost every time and Every time.

Variable 4: Factors Affecting Blended Learning at NUST.

Section C included eleven items/variables to measure the factors affecting blended learning at NUST, including (1) Off-campus access to the internet, (2) E-learning readiness, (3) Adaptation challenges, (4) Level of computer literacy, (5) Ample time to complete tasks, (6) Opportunity to take ownership of studies, (7) Promote self-directed learning, (8) Better management of studies, (9) Take ownership of studies, (10) Feeling of isolation from my peers and (11) Doubt in the ability to manage online learning. These items were measured in the 5-point Likert scale as ordinal variables, and the following semantic scales were applied: Strongly disagree, Disagree, Uncertain, Agree, and Strongly agree.

Variable 5: Increase Course Engagement.

Section D contained six items and evaluated the level of student course engagement and consisted of the following: (1) Engagement in online forum discussions, (2) Interesting Topics for forum discussions, (3) Timely feedback for forum discussions, (4) Ability to use ePortfolio, (5) Adequate reading materials (6) Increased course engagement. The semantic scales used to measure the above variables were: Strongly disagree, Disagree, Uncertain, Agree, and Strongly agree. This concludes Section C of the students' questionnaires. Next, the variables in Section D are presented.

Variable 6: Level of Communication.

Section D evaluated the students' level of communication as follows: (1) Ease communication with lecturers (2) Contact lectures through Moodle (3) Open communication (4) Use upcoming events feature to get information about scheduled offline tasks (5) Use upcoming events feature to get information of scheduled online tasks. The 5-point Likert scale

was used to present ordinal variables, and the following semantic scales were applied: Strongly disagree, Disagree, Uncertain, Agree and Strongly agree.

Variable 7: Problem-Solving Skill Development.

Section E of the student questionnaires evaluated whether the use of Moodle has led to increased problem-solving abilities. The following variables were measured (1) Provide solutions to real-life problems, (2) Promote problem-solving skills development, (3) Promote rational thinking, (4) Promote independent thinking, (5) Provide multiple paths to solve problems, (6) Assist with the development of critical thinking skills, (7) Discussion forums require the application of critical thinking skills, (8) Sharing thoughts with the quick messaging tool, (9) Engagement of Additional tasks on real-time issues, (10) Quality Assignment feedback, (11) Increase abilities to solve problems through engagement. The 5-point Likert scale was used to present ordinal variables, and the following semantic scales were applied: Strongly disagree, Disagree, Uncertain, Agree, and Strongly agree.

Variable 8: The extent to which the use of Moodle increased students' problem-solving skills.

Students were asked to rate the question on the 5-point Likert scale, and the following semantic scales were applied: Very small extent, Poor extent, Satisfactorily extent, Great extent and Excellent extent.

Students were asked to choose between ‘Yes’ and ‘No,’ which are ordinal dichotomous variables, to rate their responses to the items in Section F in the students’ survey questionnaire. Section F was designed to rate the effective use of Moodle at NUST. The last two items in the survey questionnaire measured (1) secure access to Moodle and (2) illegal access to the platform.

Variable 9: Secure Access to Moodle.

This dependent variable is measured on a 5-point Likert scale as ordinal dichotomous variables, requiring a 'Yes' or 'No' response from students.

Variable 10: Illegal Access to the Platform.

This dependent variable was measured in the 5-point Likert scale as a nominal dichotomous variable, requiring a 'Yes' or 'No' response from students. This concludes the discussion on variables. The study procedures and ethical assurances related to this study are explored next.

3.7 Study Procedures and Ethical Assurances

On 8 December 2020, the study received approval from the ethical research committee at NUST. Approval from UREC was received on 8 March 2021. Once these necessary permissions were granted to conduct the study, the pilot study was conducted between 12 March 2021 and 20 March 2021. The main research was conducted between 1st April 2021 and 31st August 2021 in the Faculty of Human Sciences, Faculty of Management Sciences, COLL and TLU.

Ethical Assurances

Including human subjects as research participants in any research requires researchers to adhere to ethical codes. This process involves obtaining permission to conduct research and adhering to ethical principles (Yin, 2018). To protect each participant's dignity, rights and welfare, the researcher complied with all ethical standards stipulated by Unicaf University, Zambia, as the overseeing body of this study, as explained in the following paragraphs. Permission was granted by the Research Board of Unicaf University, Zambia, involving a written ethical clearance and approval application.

Beneficence and Non-Maleficence

All participants were treated according to the ethical standards of beneficence and non-maleficence (Benatar & Singer, 2010). These ethical standards include, amongst others, a critical consideration to respect the dignity of all subjects and focus on the best interest of all participants in this study (Flick, 2016). The researcher has a moral obligation to the human subjects who participated in the study, based on the principles of beneficence and non-maleficence. Consequently, assurance was provided that nobody would be harmed in any way during the period of gathering data for the study and that assurance was provided to protect participants at all times (American Psychological Association (APA), 2017).

Accessibility of the Research Site

Additional approval was obtained from the research board of NUST through the registrar's office for this study to be conducted at the main campus of NUST in Windhoek, the capital city of Namibia. After receiving approval for this inquiry to be carried out at the research site, the department heads in the faculty of human sciences were contacted through email. They received written explanations of the investigation's purpose and specifics. Replies from the departmental heads provided all faculty members' email addresses to share the study's full details with the participant of this study via the NUST webmail services.

Informed Consent

Informed consent refers to the permission obtained from participants to participate in a study before participating. This permission requires participants to sign an agreement in which the researcher declares that participants' rights will be protected during data collection (Creswell & Creswell, 2018; Sarantakos, 2013). Each participant received an informed consent letter in the form of an email that contained detailed information about the researcher and the study. Each participant was required to complete and sign a letter of informed consent to ensure that their rights would be upheld at all times and as a condition of their voluntary participation in

the study. As confirmation that the interviewees agreed to participate in the study, the researcher preserved a copy of the informed consent signed by the research participants.

Voluntary Inclusion in the Research

Participants were informed that participation in the study was optional and required to complete an informed consent document before participating in the study. Participants were invited to participate in an anonymous web-based survey designed and administered through Google Forms. The study did not require participants to provide personal details, such as email addresses, names or surnames. Furthermore, during the data gathering and analysis processes, no IP addresses were recorded, and the anonymity of every participant was maintained. No participants in the research suffered any harm while the study was performed. Participants in this study were adults and intellectually capable of reading and understanding the informed consent letters. All participants agreed voluntarily to be included in the research. The initial email to participants was an invitation to participate in the study. Details were provided regarding the anonymous nature of the web-based survey questionnaire, the number of questions included, and the time needed to complete the questionnaire.

Separate emails were forwarded to the participants who were purposefully chosen to acquire qualitative data. These study participants were invited to take part in an in-depth interview. This sample consisted of twelve respondents, including four instructional designers, two academic support coordinators, two student support coordinators, three faculty coordinators and the Moodle site administrator.

The Right to Withdraw from the Study

The right of participants to withdraw from this study at any time was communicated clearly in the invitation email sent to interviewees and explained in the letter of informed consent. Each participant agreed to participate in the web-based survey questionnaires voluntarily, as it included a paragraph to emphasise the voluntary nature of the participation of

participants, and the option to withdraw from the study, should any doubts about participating in the study exist. Before the in-depth interview was conducted, each participant was reminded about their right to withdraw from the study at any time (Cohen et al., 2009).

The Principle of Transparency

The researcher adhered to the principle of transparency. Participants enjoyed the right to access the data provided, rectify inaccurate data, and restrict the provided data processing. The informed consent letter captured all information regarding participants' right to access collected data. Participants were provided with the researcher's contact details to secure access to the data provided to the researcher.

Protection of Collected Data

A secure folder was used to store both quantitative and qualitative data on the researcher's personal computer. As such, access to data was restricted to the researcher exclusively. Quantitative data and qualitative data were stored in separate folders, labelled uniquely. Both the audio recordings and the transcriptions were stored separately in the secured folders on the researcher's personal computer in the researcher's office. Participants were informed that all data collected via in-depth interviews would be stored for a period of five years. After five years, the stored data will be deleted from various storage devices.

The Principle of Confidentiality

During the first email communication, participants were ensured that data collected in this study would be treated confidentially and used for this study exclusively. Web-based survey questions were completed by study participants voluntarily, which did not collect data regarding participants' details, such as name and surname, email addresses or IP details.

The principle of Anonymity

The researcher ensured the anonymity of participants during all the stages of recruitment, the initial collection of data, analysis of the collected data, dissemination of

findings, storage and retention of data, and disposal of records by giving serious attention to the measures to follow. The following measures were applied to ensure the anonymity of data collected during the in-depth interviews. Voice recordings were transcribed as soon as possible and stored in a de-identified format. A pseudonym (fake name) was linked to separate transcribed interviews to protect the identity of the interviewees. Transcribed interviews were availed to interviewees via e-mail for approval using password-protected files.

At the research location, in-depth interviews were performed virtually via Zoom and MS Teams. An agreement was reached via email regarding an appropriate time to conduct the in-depth interviews based on the availability of participants for the interview. Before beginning an interview, the researcher confirmed that the interview would be recorded, and the informed consent form was signed. All participants agreed that interviews could be audio recorded. Participants confirmed that the most suitable time to conduct the interviews would be after 14h00. As soon as the interview was completed, audio-visual recordings were downloaded and stored on the researcher's personal computer. A separate backup folder was created to store all audio-visual recordings on an external hard drive, which was locked in a steel cabinet in the researcher's office. A secured sub-folder was created and marked "Voice_recordings_NUST" to store the original version of the voice recording on the hard drive of the personal computer of the researcher. Unauthorised access to stored data was prohibited due to strict security measures. Reliance on a computer-protected password and firewall software installed on the researcher's computer prevented any unauthorised access from a private network. Through the use of updated anti-virus software installed on the researcher's computer, malicious cyber-attacks were curbed. A secured subfolder was created to store the raw data obtained from students who participated in the web-based survey questionnaires. Spreadsheets were downloaded in MS Excel and stored in a password-protected folder labelled

"Raw_data_students," and a separate folder was created to keep the raw data from lecturers labelled "Raw_data_lecturers."

3.8 Data Collection

The data collection techniques used to complete this study are presented in this section. The discussion is presented in two parts, namely, the collection of quantitative data followed by the collection of qualitative data.

Collection of Quantitative Data

After completing the pilot study, both sets of questionnaires were adapted to enhance the suitability of the primary research. Quantitative data were collected from lecturers and students from the Faculty of Human Sciences. This faculty is made up of three different departments. Study participants were invited via email to explain why they were selected to participate in the survey adhering to all ethical considerations. Informed consent letters were emailed to each participant included in the sample population. Each participant was invited via email to participate in the anonymous web-based survey. Weblinks to both survey questionnaires were generated and emailed to each participant. A week after the initial invitation, a second email was sent to participants as a reminder to complete the survey questionnaire. During the initial communication, participants in the study were ensured about the anonymous nature of the web-based survey questionnaires and that their identities would be kept private during the data collection and analysis phases.

Regarding the confidentiality of data, all study participants were ensured that all data would be protected throughout the data collection and analysis process. Assurance was given that the data gathered during this study would solely be used for the purpose of the study. Quantitative data was collected anonymously via web-based surveys and distributed to students and instructors via the computer software Google forms between the 15th and 31st of August 2021. All ethical rules and principles were adhered to during the data collection phase.

Quantitative data collected via Google Forms were downloaded and exported to SPSS for further analysis.

Collection of Qualitative Data

One-on-one in-depth interviews were conducted virtually with seven participants to collect qualitative data. Semi-structured in-depth interviews with two instructional designers, two administrative support coordinators, two lecturers and the Moodle systems analyst allowed the researcher to understand the research problem more deeply. Interview questions to all interviewees were similar due to participants' shared responsibility to enhance the effective use of Moodle as an LMS at NUST (Appendix C). An initial email was sent to each study participant sampled to be included in the in-depth interviews. The choice of one-on-one in-depth interviews with selected participants enabled the researcher to understand the research problem better. All participants were required to sign an informed consent form before the data collection commenced. The informed consent form included permission to record the virtual interviews with selected study participants. Participants granted permission to the researcher to audio record all interviews. Boyce and Neale (2006) highlight the value of individual interviewing as it enables the researcher to understand individual experiences and expectations related to the phenomenon of study.

The researcher recruited the participants included in the in-depth interviews without difficulty. Although twelve participants were sampled to participate in the interviews, only seven were available to be included in the one-on-one interviews, which enabled the researcher to conduct interviews over eight weeks. Conducting semi-structured one-on-one interviews with study participants allowed the researcher to collect rich data to develop insight to evaluate the effective use of Moodle as an LMS in the Faculty of Human Sciences at NUST, the Faculty of Management Sciences, the COLL and the TLU. The researcher was also able to collect valuable data to assist with designing a strategy to improve Moodle's effective and safe use at

NUST. Direct virtual interaction with the respondents was enhanced, as one-on-one in-depth interviews do not allow group interaction. Respondents could freely comment on the availability of human capital to offer timely technical support at NUST. Respondents could honestly respond to the strategies to provide quality online teaching for all online courses, as all key stakeholders formed part of one-on-one virtual interviews.

Respondents explored the given topic and suggested ideas to address the identified problems. In-depth interviews with respondents were conducted in a relaxed virtual atmosphere, and respondents could easily and comfortably engage in a one-on-one conversation. Respondents could share their views honestly, which allowed the researcher to obtain high-quality data without possibly being influenced by other participants. Finally, conducting in-depth interviews was a flexible and cost-effective manner of collecting data (Reddy, 2016).

In view of Mack et al. (2005), the researcher could listen attentively to the views of individual respondents. Thus, the one-on-one virtual engagement allowed the researcher to engage with each participant, following their personality without interruptions, as may be the case in group interviewing. The researcher also encouraged the interviewees to elaborate on specific topics by eliciting detailed responses and asking follow-up questions. As Driscoll (2011) suggested, one-on-one interviewing was deemed a fit approach to collect expert knowledge by interviewing experienced team players within the field who are knowledgeable about the central focus of the study.

The one-on-one in-depth virtual interviewing sessions gave respondents the freedom to speak freely, without anybody to correct them or debate the phenomena, as is the case with focus group interviews, respondents can be biased in their answers. Individual in-depth interviews might not be suitable for people who prefer to voice their opinions in a group setting. The amount of information the researcher obtain through one-on-one in-depth interviews may

be constrained by the group's encouragement of individuals to express their unique viewpoints. Despite the restrictions above, data gathered through the one-on-one in-depth interviewing was valuable and appropriate to meet the current study's objectives and address the research questions. Personal views from participants working in different units or departments allowed the researcher to find answers to the research questions and develop a strategy characterised by a short, medium and long-term vision. Masadeh (2012) suggests that researchers should employ multiple data collection tools to complement each other. As a result, the qualitative and quantitative data were triangulated by utilizing a variety of research techniques and theoretical frameworks, which are covered in more depth under the section "Triangulation".

The availability of an interview guide ensured that discussions remained relevant and focused (Hancock et al., 2016). Data obtained using the one-on-one interviewing method allowed the researcher to gain a better grasp of how NUST used Moodle of as an LMS. Because the interview questions were semi-structured, the researcher was able to gather information on the participants' perspectives on the study's main topic (Moriarty, 2011). In addition, open-ended inquiries in the semi-structured approach stimulated explanations from interviewees (Hancock et al., 2016). The open-ended nature of the questions gave the researcher and participants the chance to debate certain subjects thoroughly. A suggestion and encouragement to think about the subject from a new angle and comment on enhanced clarity might be given to participants who had trouble answering questions or gave only a quick response. Consistent with the findings of Bertram and Christiansen (2014) and Gall et al. (2007), the researcher capitalised on the benefits of the mixed methods research approach by triangulating quantitative and qualitative data to address the study questions and objectives. Furthermore, triangulating three theories led to an increased understanding of the research questions.

3.9 Data Analysis

Faryadi (2019) refers to data analysis as a systematic approach characterised by the logical techniques and statistical tools researchers apply to give meaning to the collected data. Additionally, this process assists researchers in interpreting collected data. Data analysis was done using IBM Statistical Package for Social Sciences (SPSS) version 27. In this study, quantitative data collected from students and instructors were collected using the Google Forms template to design and present closed and open-ended questions. During the first phase of data analysis, variables were presented in tables and graphics through the use of descriptive statistics.

Statistical Package for the Social Sciences (SPSS)

First, collected data were downloaded in a Google forms spreadsheet, and second, the Google spreadsheet was downloaded as an Excel spreadsheet. Ordinal data were collected on a 5-point Likert scale and coded in the Excel spreadsheet.

Descriptive Analysis and Inferential Statistics

Descriptive statistics lists the characteristics of the data collection and inferential statistics aid in drawing inferences about the population A subset of statistics known as inferential statistics uses a variety of analytical techniques to extrapolate conclusions about population data from sample data (Trochim, 2022). Through descriptive analyses of data, frequencies and percentages were used to compare the proportions of subjects that responded in different directions. Demographic information of each data set was presented separately in graphs and in some cases, tables. Section A was designed to collect demographic data from participants in both survey questionnaires. Demographic information was analysed and presented in tables and graphs (Trohim, 2007).

Descriptive analysis of the remainder of the sections in the survey questionnaires was conducted using SPSSS 27, and findings were presented in tables and graphs. Regarding

inferential statistics, Spearman's correlations as non-parametric tests were used in the second part of the data analysis process. Spearman's correlation coefficient was used to evaluate the strength and direction of association between two variables measured on at least an interval scale. A high correlation confirms that a strong relationship exists between two or more variables, whereas a weak correlation confirms that the variables are hardly related. The closer the value is to ±1, the stronger the relationship between variables (Trochim, 2022).

Through descriptive analyses, frequencies and percentages, comparisons could be drawn between the proportions of subjects who responded in different directions. Conclusions drawn through inferential statistics were useful for evaluating the significance and relation of collected data to the research objectives and questions to generalise the results to the entire population. An alpha level of .05 was used for all inferential analyses. The researcher classified data into categories before it was discussed meaningfully.

Coding and Analysis of Quantitative Data

Both male and female study participants were included in the study. Gender, as an independent variable, is a categorical nominal variable and participants were required to select either male or female. The two categories of gender were coded as Male = 1 and Female = 2. The coding guide provides details regarding the coding of nominal demographic variables and ordinal variables measured through the 5-point Likert scale responses.

Items that required participants to rate their level of agreement or disagreement were coded as Strongly Disagree = 1, Disagree = 2, Uncertain = 3, Agree = 4 and Strongly Agree = 5. Items that required participants to rate the frequency of using Moodle tools were coded as: Never = 1, Almost never = 2, Occasionally/Sometimes = 3, Almost every time = 4 and Every time = 5. Dichotomous, nominal variables in this study included Yes and No responses, coded as No = 1 and Yes = 2. Missing data were coded 999, and items with missing data were excluded from the subsequent data analysis. The Excel spreadsheet was imported into SPSS.

The “values” column that presents the list of valid options (multiple choice list) of each of the variables in a 5-point Likert scale in each data set was updated in the SPPS datasheet according to details provided in the coding guide to ease the coding process.

The measurement level of each variable was updated in the SPSS spreadsheet. Age was changed to a scale variable as a measurement level in SPSS. The variable, year of study programme enrolled for, as well as the ordinal variables in the 5-point Likert scale, were presented as ordinal measurement levels in the SPSS spreadsheet. Nominal (text) data were presented as nominal measurement levels.

Coding and Analysis of Qualitative Data

Qualitative data were imported directly from the Ms Word files stored on the researcher’s computer. The coding process in NVivo 13 entails gathering connected material into a container called a Node. The following steps explain how to engage with coding in NVivo. Firstly, open a file and turn on coding strips. All data were coded by selecting the “Nodes” option in the navigation view. Secondly, an opportunity was provided to select the particular text coded in the source item. Thirdly, the selected text was then dragged and dropped into the list view using the “Drag selection here to code to a new node” prompt. Fourthly, the name and description of data were entered in the New Node dialogue box. This action was confirmed by selecting the OK tab. Coding strips were made available in the document's margins, allowing the researcher to view all codes used and where different codes were used in the documents. Memos were prepared about specific aspects of records and linked to relevant pieces of text in separate documents. Using NVivo allowed the researcher to run queries. It was also possible to visualise, model and map data.

Dollah et al. (2017) promote the use of computer software, such as NVivo 13 and describe it as a helpful multimedia web-based application for data analysis. The analysis of qualitative data using NVivo 13 was conducted in two phases. During Phase one, the researcher

analysed qualitative data collected through the web-based questionnaires with NVivo 13. Interview data already transcribed and available as MS Word files during Phase two were analysed using NVivo 13. The researcher mapped the pattern of critical ideas and concepts, presented keywords in groups, themes and sub-themes, and organised the thematic representation of the qualitative data (Nowell et al., 2017). Although NVivo 13 assisted with the data analysis, thematic analysis enabled the researcher to identify, evaluate, and report patterns (themes) inside data (Braun & Clarke, 2006). Thematic analysis is characterised as a descriptive strategy for flexibly reducing data that may be used with other data analysis techniques (Vaismoradi et al., 2013). It is widely employed because of the large range of research issues and subjects that may be addressed with this data analysis approach.

In order to ensure confidence in the findings, thematic analysis of open-ended responses from surveys and transcribed interviews explored textual data at a level of depth that quantitative analysis lacks while allowing flexibility and interpretation when analysing the data. However, it should be done with special care and attention to the method's transparency (Braun & Clarke, 2006). Relying on the computer software NVivo 13 and thematic analysis as data analysis methods increased the trustworthiness and credibility of the finding of this study. There are five qualitative data analysis processes: compiling, deconstructing, reassembling, interpreting, and concluding (Yin, 2015).

Firstly, the researcher compiled the data into a usable format. All video-recorded interviews were transcribed so that the researchers could view them readily. The data were segregated once they had been compiled and organised. Disassembling data in this study entailed breaking it down and organising it in valuable ways. This was accomplished through the process of coding. In qualitative research, coding is described as the process by which raw data are gradually turned into usable data through the identification of themes, concepts, or ideas that have some relationship to one another (Austin & Sutton, 2014). Researchers find

similarities and contrast in the data by coding it. When data is coded, the meaning "emerges from the data" is generally the first thing to notice. Coding is a multi-level process that methodically discovers relevant data characteristics across the entire data collection. Initially, codes are assigned to data units of various sizes (phrase, sentence, paragraph), but most codes represent a whole concept (Sutton & Austin, 2015).

During the reassembling stage, the codes or categories assigned to each notion were grouped together to form themes. A theme "represents some level of structured response or meaning within the data set and captures something essential about the data in connection to the research issue." (Braun & Clarke, 2006). Data, however, does not "speak for itself" (Yin, 2015). The researcher had to draw analytical inferences from the data supplied as codes and themes at this critical step in the research process. Even though data analysis processes are given in a linear order, interpretation does not have to wait until the end. According to Yin (2015), the researcher's interpretation should occur throughout the first three processes (compilation, disassembly, and reassembling). Once the data had been recreated through coding, the researcher took excerpts from the data and examined them in relation to and in coordination with one another. As a result, the data could evaluate what was happening inside and across various experiences, beliefs, and histories.

Consequently, thematic patterns in the data were uncovered. Themes encapsulated the core of the phenomena that were looked into in connection to the research question or study's goal. In a nutshell, raw data became codes, and codes became themes and thematic maps in the setting of thematic analysis. Interpretations emerged from the process of identifying and clarifying these topics. The response to the research questions or the study's objective represents the conclusion (Yin, 2015).

The researcher established and interpreted themes that produced meaning based on the research questions and objectives. Relevant themes were discussed in accordance with

transcribed data based on the in-depth interviews, open-ended responses in the survey questionnaires, the researcher's worldviews and the relevant theoretical frameworks that informed the study (Creswell & Poth, 2018). The data collection and analysis processes were planned thoroughly and administered systemically to ensure efficient and sound data analysis.

3.10 Trustworthiness of Findings

According to Merriam (1998), the following six techniques may be used to improve the internal validity of the research data and instruments: triangulation, member checks, long-term observation at the study site, peer review, participatory or collaborative forms of research, and researcher bias. Next, some critical elements of internal validity are unpacked.

Triangulation

Data validation by cross-correlation of data gathered from more than two sources is a process known as triangulation. To enhance the likelihood of managing the course of therapy or identifying some of the risks or many reasons influencing research outcomes, it examines the consistency of data collected through several instruments (Merriam, 1998). The triangulation of theories and data sources were used in this study. Triangulation of data sources offered more than one way to collect information, including in-depth interviews with professors and students as well as study participants from several departments to acquire information through both surveys and in-depth interviews. The practice of using many theoretical frameworks to understand a phenomenon is known as theory triangulation (Denzin & Lincoln, 2013). Masadeh (2012) recommends that researchers use a variety of data gathering methods to enhance one another. As a result, the results of qualitative and quantitative data were triangulated by using many research techniques. Cross-validation from more than two sources helps triangulation validate data. It enhances the possibility of analysing or controlling some of the risks or numerous reasons impacting research outcomes by evaluating the consistency of findings collected through various data gathering technologies (Denzin & Giardina, 2007).

In this study, triangulation assisted the researcher in relying on various data sources and applying multiple theoretical frameworks for an increased understanding of analysed data to strengthen the credibility of this investigation. According to Carvalho and White (1997), triangulation is a method used in research to enrich, refute, confirm and explain findings.

Researchers are encouraged to strengthen the validity of evaluation data and findings. Integrating several data sources, such as questionnaires, interviews and observations. Data collection relying on a single technique may be questionable, biased or weak.

Member Checks

Through member checking, research study results and inferences are returned to the participants for confirmation and verification (Yin, 2015). Interview results and interpretations were available to the study participants to confirm that the content corresponds with what was stated in the initial interview. The credibility and truthfulness of data collected through the one-on-one interviews were recognised and supported through member checking.

Peer Examination

Researchers rely on peer examination by involving field specialists as nonparticipants to examine, review and comment on the research process and study findings (Denzin & Giardina, 2007). The involvement of field experts in the present study to scrutinise, evaluate and clarify the research process and conclusions augmented the study's validity.

Transferability

The degree to which study results can be transferred to external contexts and other participants refers known as transferability (Leung, 2015). Regarding the present study, a detailed description was provided regarding the methodological aspects described as 'thick description', which is directly linked to the purposive sampling technique that guarantees the selection of information-rich participants in the sample (Bitsch 2005). In line with the thick principle, the research report sections contain detailed descriptions of contextual,

philosophical, methodological and procedural characteristics relevant to this research study. A comprehensive final report was provided, which offers details of all appropriate research stages, starting with the research paradigms and ending with the final report (Anney 2014).

Through the technique of a thick description, researchers can pave the way for other inquirers to judge how well a particular investigation relates to different contexts with similar characteristics, aimed at the possible generalisation of study results (Yilmaz 2013). Ary et al. (2010) define purposive sampling as a method that allows researchers to select information-rich participants who can contribute to collecting meaningful data for a deep understanding of the phenomenon of study. Moreover, Chiromo (2009) postulates that purposive sampling promotes the transferability of research findings because it concentrates on important participants who are informed about the investigation's central focal areas (Chiromo, 2009). Using purposive sampling for the present study aligns with the above assumptions. Next, the element of dependability as a validity technique is discussed in the context of the present study.

Dependability

Dependability refers to a reliability technique employed by positivists to demonstrate that the study can be repeated in the same context, relying on the same methods, participants, and similar study findings may be obtained (Ary et al. 2010). To meet the principle of dependability, researchers should provide a detailed report of the study to facilitate duplication of the study by researchers in future. The technique of dependability permits readers of the study to judge the level of appropriateness applied in the study, which was an element included in the present study. In the context of the present study, dependability is linked to in-depth coverage of the entire research process to produce a similar conclusion in the event the study is repeated. In contrast, transferability pursues a comprehensive reporting of the complete research process to establish whether the research findings can be generalised in other contexts with similar characteristics. Hence, a complete synopsis was presented about the study's

ontological, epistemological, axiological, methodological and rhetorical frameworks. The researcher explained the data collection methods, the sample size and the data collection procedure in the report. The research findings were published as a research report, followed by an article published in a peer-reviewed journal. Consequently, the study results are available to other researchers to appraise this study for effectiveness.

Confirmability

The notion of confirmability links to a technique used in qualitative studies to augment objectivity. Tobin and Begley (2004) state that confirmability necessitates several steps to be taken by researchers to ensure the findings of the study results reflect the participants' experiences and viewpoints and not the opinions and inclinations of the researcher. To adhere to confirmability, the researcher kept a journal to record the personal reflections concerning the study and other issues that arose during the investigation process (Anney, 2014). All electronic records of video recording during the virtual interview sessions allowed the researcher to validate the data to produce the final research report.

Researcher's Bias

This refers to the reality that every study is influenced by the researcher's unique values, beliefs and worldviews. Although the researcher holds a post-positivist view, the present study was conducted within a pragmatic paradigm. This choice was necessary to suggest a solution to an authentic problem in the research. Every researcher has particular values, beliefs and worldviews. However, the investigator must collect, analyse and interpret data as objectively as possible (Smith & Nobel). The researcher disclosed that she was a full time employed at NUST as an instructional designer. However, all ethical principles were followed throughout this investigation. A panel of Moodle experts evaluated the research tools, a pilot study was conducted, and data collection and analysis were conducted (Creswell, 2014). There are other ways, such as the sample size, which is a very good determining factor in maintaining the

research's reliability and validity (Creswel and Creswel, 2018) The researcher should understand what the ideal sample size is in order to obtain accurate results. A quantitative study uses statistical tools to assess the research's validity and reliability. The application of tests and measures designed to check the authenticity of the research were used in phase one of the study, the quantitative research to check the validity and reliability. Statistical tests included the chronbach alpha, chi square and Spearman correlations. Each of these tests served a different purpose and aided in determining the validity of the quantitative phase in this investigation. Upholding objectivity throughout the study necessitated the researcher to maintain critical, faithful and explicit during various study phases. Regardless of the researcher's function as an instructional designer at the research site, she remained impartial and non-judgmental throughout the research procedure. The researcher conducted the evaluation as precisely as feasible while abiding by ethical guidelines, and she meticulously recorded the study's findings.

Summary

This mixed-method single case study evaluated the effective use of Moodle as an LMS at NUST. The first part of this chapter discusses the preferred research approach and design adopted to answer the research questions and achieve this investigation's objectives. To collect data from multiple data sources, quantitative and qualitative data collection tools were used (Creswell & Creswell, 2018).

The second part of the chapter provides an overview of the population and sampling strategies employed to conduct this study. Probability and non-probability sampling were used to draw appropriate samples from the intended population. Probability sampling was used to select study participants to obtain quantitative data. Non-probability sampling was used to select a small sample through the purposive sampling technique. The latter techniques allowed the researcher to collect qualitative data through one-on-one in-depth interviews (Sarantakos, 2013). The third part of the chapter discussed the data collection instruments used in this investigation. The web-based survey questionnaires were designed based on suggestions from existing literature of key theorists. These theorists contributed significantly towards establishing quality frameworks to support successful blended learning integration in various higher education settings. Web-based survey questionnaires were adapted from existing blended e-learning theorists to augment sustainable blended learning integration using Moodle as an LMS. Frameworks relevant to the context of this investigation included the blended e-learning model (Ozkan & Koseler, 2009), the Learning Design Methodology (Antonis et al., 2011), Khan's Octagonal Framework (Khan, 2010), Orbital E-education Framework (Elameer & Idrus, 2012) and The Community of Inquiry Framework (Garrison et al., 2009).

Web-based survey questionnaires were administered to the participants to collect quantitative data. Using Google Forms to design, develop and administer questionnaires is convenient, easy to use and cost-effective. This approach allowed participants real-time access

to the survey (Howard, 2019). Qualitative data were collected through the facilitation of in-depth one-on-one interviews. The fourth part of this chapter discusses the measures employed to increase the reliability and validity of the relevant research tools and the findings of this investigation (Merriam, 1998; Yin, 2015). In light of leading theorists, ethical principles were discussed at all stages of this inquiry (Benatar et al., 2016; Yin, 2018).

The final part of this chapter discusses the data collection tools used in this study. Quantitative data were analysed using the SPSS package. NVivo 13 computer software Dollah et al. (2017) and thematic analysis by Braun and Clarke (2006) were used to assist with the coding and analyses of qualitative data. The findings of this investigation created new knowledge for developing a sustainable e-learning strategy to augment Moodle's effective and safe use as an LMS in higher education to equip Moodle users with critical skills for effective and safe use of Moodle. The next chapter presents and discusses the data and provides discourse on data analysis and interpretation of the main finding of this investigation.

CHAPTER 4: FINDINGS

The purpose of this mixed-methods case study was to evaluate the effective use of Moodle as LMS at NUST. NUST is a public, non-profit university that offers full-time, part-time, and distance education learning opportunities through blended and full-fledged online learning. The pilot study was conducted from the 15th of April 2021 to the 31st of August 2021 at the main campus of NUST, located in the capital city of Namibia, Windhoek and extended to ten distance education centres across the country.

This study adopted a mixed-methods appoached where quantitative data were collected using Google Forms to administer surveys to students and lecturers. Stratified sampling was used as a probability sampling strategy to collect quantitative data. However, purposeful sampling, a non-probability sampling strategy, was necessary for the collection of qualitative data. Quantitative data were collected by administering based survey questionnaires to students and academics. Qualitative data were collected through open-ended responses from the survey questionnaires and data obtained from semi-structured interviews conducted with faculty and administrative staff. The study was conducted to get insight into the effective use of Moodle at NUST to study the responsiveness of students' and lecturers' using Moodle tools. The research identified the factors influencing teaching and learning in a blended learning environment. Furthermore, the use of Moodle for teaching learning and assessment has been evaluated to establish whether the usage of Moodle has led to increased course engagement, communication and problem-solving skills development.

The literature review presented relevant e-learning and blended learning models underpinning this empirical investigation. A primary concern at the research site was the absence of a clear-cut e-learning strategy for NUST to reap optimally from the benefits provided through online learning. This investigation yielded results to craft a plan for the university to ensure the effective use of Moodle as an LMS across all faculties.

Firstly, this chapter provides a general description of the research site, study design, and all steps followed in terms of the trustworthiness of this study. Secondly, this chapter presents the descriptive analyses of quantitative data, followed by inferential statistics using Spearman's correlations. Thirdly, this chapter presents the qualitative data collected through semi-structured interviews. The final section of this chapter provides an evaluation of the results. The research questions are restated in the section to follow.

Research Questions

Research question 1: What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

Research question 2: What signifying factors affect blended learning using Moodle at NUST?

Research question 3: What impact does the use of Moodle at NUST have on students' course engagement?

Research question 4: What impact does the use of Moodle at NUST have on students' communication?

Research question 5: What impact does the use of Moodle at NUST have on the development of students' problem-solving skills?

Research question 6: What strategies can be adopted by NUST to increase the effective and safe use of Moodle as an LMS?

4.1 Overview of the Site and the Participants

This section provides a synopsis of the research site and respondents sampled for this empirical investigation. It also discusses the procedures followed to gain access to the research site to engage in the actual process of data collection. A detailed discussion is provided on the reliability and validity of the quantitative data collection tools and the trustworthiness of the qualitative data.

Background Information about the Research Site

NUST is a public tertiary institution located in Windhoek, Namibia. It was established in 1994 as the Polytechnic of Namibia (Act No. 33 of 1994) but gained university status in 2016. As a public tertiary institution, it introduced Moodle as a learning management system in 2011, with the vision to advance the learning and teaching experiences of students and staff members, yielding enhanced learning experiences and improved academic performances amongst all faculties in the university.

Given the students and lecturers not being responsive to using Moodle optimally, coupled with the challenges of Moodle users using Moodle as a teaching, learning and assessment mechanism, this study sought to evaluate the effective use of Moodle as an LMS at the research site. Firstly, the study established the responsiveness of students and lecturers using Moodle tools to capitalise on the benefits of Moodle. Secondly, the study identified the factors that affect blended learning in higher education; and thirdly, the study established the impact the use of Moodle has on course engagement, communication and problem-solving abilities amongst students. Lastly, the study suggested strategies to increase the effective use of Moodle amongst students and lecturers at the research site.

Permission from Participants and Research Site

Permission was granted from both the research review boards of Unicaf and NUST. Each online survey participant signed a digital informed consent form and participated in this empirical investigation voluntarily. Approval for this study to be conducted at NUST was granted on 18 December 2020. Strategies related to sampling are discussed next.

Sampling

Online survey questionnaires via Google Forms were designed and administered to student participants, drawn from two representative samples to include 278 students and 64 lecturers using stratified sampling. The lecturers who participated in the study were employed

at NUST full-time during the 2021 academic year. Student participants were registered on the full-time, part-time and distance education modes across six faculties at the institution. The first stratum (students) comprised 278 elements who completed and submitted 113 online questionnaires. The second stratum (lecturers) included 64 respondents who submitted 35 online questionnaires.

A pilot study preceded the data collection process to increase the reliability and validity of the main research. The following paragraph describes the pilot study:

Pilot Study

A pilot study was conducted between the 1st and 7th of April 2021 to assess the survey questionnaires' validity and reliability. Invitations were sent to fifteen students and twelve faculty members to participate in the pilot tests from the Faculty of Management Sciences, the most prominent faculty at the research site. Quantitative data for the pilot study were collected via web-based survey questionnaires designed and administered with Google Form. Quantitative data collected during the pilot study were coded and analysed with the use of SPSS 27. Cronbach's alpha tests were computed to establish internal consistency of survey item responses of students' and lecturers' questionnaires with the following dimensions: responsiveness to use the Moodle tools, factors affecting blended learning, increased course engagement, improved communication and increased problem-solving development. The outcomes of Cronbach's alpha tests Pallant (2001), are displayed and discussed in Chapter 3, Figures 9 and 10.

Interviews for the main study were preceded by pilot interviews conducted at the research site in June 2021. Pilot interviews were conducted with one instructional designer and one administrative officer who were excluded from the final study. Feedback regarding the pilot study yielded recommendations to align the interview questions to the research questions and objectives. Following the pilot research, technical jargon was clarified for ease of

comprehension, as advised. This assessment aided the researcher to review particular questions about Moodle's vulnerability as an open-source project and regular cyber-attacks that Moodle users face. The projected time to conduct the interviews was cut in half, from 90 minutes to 45 minutes. The next paragraph provides an overview of the main study.

The Main Study - Data Collection of Quantitative and Qualitative Data

After lengthy email communication and follow-up virtual meetings, it was confirmed that both sets of quantitative web-based questions were reliable. Quantitative data were collected from 15 April to 31 August 2021 using Google Forms by administering a survey to students and lectures. Both students and lecturers received a web link via email with an invitation to participate in the survey. Completed responses were submitted automatically through Google Forms. Each set of questionnaires consisted of six sections and contained questions to evaluate the effective use of Moodle as a learning management system at NUST, a public tertiary institution in Windhoek, Namibia. Quantitative and qualitative data were collected concurrently but analysed separately. Next, details on the reliability and validity of the data collections tools are provided.

4.2 Reliability and Validity of Data

Content Validity

The study relied on the expertise of a panel to assess the substance of the questionnaires to ensure content validity. The panel consisted of instructional designers, the deputy head and a senior lecturer of the Department of Social Sciences in the Faculty of Human Sciences at NUST. As overseeing body of this investigation, the Unicaf Research Ethical Committee (UREC) and research supervisor approved the survey questionnaires and semi-structured questionnaire guide. Following the pilot study, content validity was established with the help of two Moodle specialists who reviewed survey questionnaire questions. As such, both sets of

survey questionnaires were modified to eliminate confusion and strengthen the alignment of the survey questions to the research questions and objectives.

Reliability of Data Collection Tools

The reliability of data collection tools refers to how such instruments represent the consistency of the measures acquired of the characteristics if used on repeated trials (Grove et al., 2013). According to Sekaran and Bougie (2013), the most popular test of inter-item consistency reliability is Cronbach's alpha coefficient. Several of Cronbach's alpha tests were computed to establish the reliability and internal consistency of survey items administered to students and lecturers.

Data Collection of Qualitative Data

Qualitative data were collected from 1st July 2021 to 31st August 2021. Invitations were forwarded via email to twelve participants. Interview participants were sampled purposively across various units/faculties, COLL, TLU, DICT, the Faculty of Management Sciences and the Faculty of Human Sciences at NUST. The selection was based on the inclusion of crucial respondents involved in rendering various support services to the institution to enhance the effective use of Moodle as a learning management system. After several reminder emails, it was necessary to contact participants who agreed to participate in the study by phone to confirm their availability.

Each of the interview participants signed informed consent before the commencement of the interview. Permission was obtained from the interviewees to video record individual interviews. Due to the unavailability of key participants, the interview process took longer than expected. It was challenging for one of the respondents in the technical department to confirm availability to participate in the study due to workload demands. Only seven individuals out of the twelve sampled participants agreed to participate in the study. Five participants declined the invitation to be included in the interviews due to the heavy workload they were

experiencing during the interviews. The interview with the Moodle site administrator could not realise; in lieu, the most appropriate substitute for the Moodle site administrator was to invite a senior systems analyst to be included as study participant.

Semi-structured interviews were conducted virtually with two lecturing staff members, one instructional designer, the educational technologist, two administrative coordinators and a systems analyst. Virtual engagements were most appropriate due to COVID-19 restrictions applicable at time the main study was conducted. Two, out of the seven interviews were conducted via Zoom and five via MS Teams. A panel of Moodle specialists, mostly senior teaching staff members, confirmed the reliability of all survey questionnaires and questions in the interview guide, which was a lengthy procedure.

After participants were granted permission to participate in the study, interviews were booked and conducted over eight weeks.

Data Analysis of Quantitative Data

Results of quantitative data were available in real-time, as the Google Forms feature provides real-time data analysis and graphic presentation of data. Both data sets of quantitative data were downloaded as Excel sheets and coded according to the codebook explained in Chapter 3. Quantitative data were cleared, sorted and classified to ease the presentation of the findings. Descriptive analysis and inferential analysis of data were possible using SPSS version 27. It was feasible to compare the proportions of respondents who responded differently using descriptive analyses, frequencies, and percentages. Conclusions drawn through inferential statistics were practical to evaluate the significance and relation of collected data to the research objectives and questions. It was also possible to generalise the results to the entire population. An alpha level of .05 was used for all inferential analyses.

Data Analysis of Qualitative Data

Transcription of interviews. The transcription process was twofold. Firstly, the video recordings were transcribed through the use of Office 365. As Office 365 restricted the size of media files to be uploaded for transcription, the researcher used the transcription feature of NVivo 13, which was an expensive avenue. Secondly, several times, video recordings were re-listened to strengthen transcriptions' accuracy and to correct transcriptions' misinterpretations done by Office 365 and NVivo 13. Transcribed files were password protected and emailed to all respondents to verify the accuracy of transcribed text to increase the trustworthiness of the data (Nowell et al., 2017). NVivo 13 was used to assist with data management in conjunction with the following steps that guided data analysis (Dollah et al., 2017; Schulze, 2000).

- Transcripts were read and re-read to get a sense of the data.
- Individual data sets were selected, and the underlying meaning of the information was thought about.
- Data were re-read several times to establish themes and categories.
- Colour codes were assigned to distinguish different themes and categories.
- Interrelationships were shown between categories.
- A final decision on themes and categories to focus on was made.
- The content of each theme was grouped.

Guided by the steps above, the seven interview transcripts were read and re-read to identify units of meaning, phrases, sentences, the nature of thinking that appeared regularly and the essential information to answer the research questions.

Masadeh (2012) suggests that researchers could employ multiple data collection tools to complement each other. Hence, the findings of qualitative and quantitative data were triangulated through the application of multiple research methods.

4.3 Trustworthiness of Qualitative Data

According to Sandelowski (1993), trustworthiness is an umbrella term that encompasses credibility, reliability, transferability and confirmability. As suggested by Merriman (1998), several techniques were used to strengthen the internal validity of the research data and instruments. Hence, a combination of the following methods was integrated with this study to add to the trustworthiness of interview data and findings: triangulation, member checks, peer examination, participatory or collaborative modes of research and researcher's bias. As far as the reliability of qualitative data collection tools were concerned, the suitability of the questions included in the interview guide was confirmed by several individuals.

Confirmability

In terms of confirmability, the researcher relied on several steps to ensure that the study results reflect the participants' experiences and viewpoints - and not the opinions and inclinations of the researcher. A journal was kept to record the personal reflections about the study and other issues during the investigation process (Anney, 2014). All electronic records of audio recording during the semi-structured interview sessions allowed the researcher to validate the data to produce the final research report.

Researcher's Bias

Strict adherence to all ethical rules and principles was essential throughout the research process (See Chapter 3.10). The researcher remained non-judgemental and objective throughout the research period, notwithstanding her role as an instructional designer at the research site. The researcher adhered to the ethical rules and principles, accomplished the evaluation as precisely as possible and reported the study findings scrupulously. Several discussions made by the researcher eliminated research bias. This study relied on randomisation to select a representative sample from the population. Data were collected from three different samples.

Several statistical tests were conducted to ensure validity and reliability. A pilot study was conducted to ensure the appropriateness of the data collection tools. By providing a thick description, the researcher could pave the way for other inquirers to judge how well a particular investigation relates to different contexts with similar characteristics, aimed at the possible generalisation of study results (Masadeh, 2012).

Audit Trail

Relying on an audit trail during data analysis helped manage the threats of trustworthiness. The researcher could clearly describe the steps and descriptions of the reflexivity within each step of the research process. The audit trail allowed the researcher to rely on her research procedures consistently. The researcher provided a detailed description of the research procedures used to carry out this study, and critique from other researchers was welcome (Sandelowski, 1993).

Triangulation

Triangulation is a data validation process that involves cross-checking data from two or more sources. It refers to using and combining different research approaches in investigating a single topic (Patton, 1999). This study used data triangulation to collect data through various sources, including quantitative and qualitative data via questionnaires from different populations and study participants from multiple departments to collect data via semi-structured interviews. According to Carvalho and White (1997), triangulation is a method used in research to enrich, refute, confirm and explain findings. Furthermore, by integrating three different theoretical frameworks to underpin the investigation, the study also relied on theoretical triangulation for a deeper understanding of the phenomenon.

Field specialists examined, reviewed and commented on the research process and findings as nonparticipants in the study. The involvement of field experts in the present research assisted in scrutinising, evaluating and clarifying the research process and results, which augmented the study's validity.

4.4 Inferential Statistics

Spearman's rank-order correlation coefficient (Spearman's correlation) was computed because the Likert scale data lacked normality. Spearman's correlation is a non-parametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale. The following assumptions are applied to Spearman's correlation:

- Assumption #1: Two variables could be measured on an ordinal, interval or ratio scale.
- Assumption #2: Two variables represent paired observations.
- Assumption #3: There is a monotonic relationship between the two variables.

Frequency in using Moodle tools' subscale for the student questionnaire consisted of 14 items (α = .81), and the factors affecting the blended learning subscale consisted of eight items (α = .67). The course engagement subscale consisted of six items (α = .66). Cronbach's alpha for the six communication and ten problem-solving skill development items were .73 and .85, respectively. The internal consistency is expressed on a scale between 0 and 1. Usually, a value of .07 or higher is acceptable (Tavakom & Dennick, 2011). Table 5 presents the results of the Cronbach's alpha tests that were run through SPPSS.

Table 5

Overall Internal Consistency of the Student Questionnaires

Questionnaire Items	Cronbach's Alpha	Items
Responsiveness of students in using the tools of Moodle	.81	14
Factors affecting blended learning	.67	8
Increased course engagement	.66	6
Increased communication	.73	6
Increased problem-solving skills	.86	10

Table 5 presents the Cronbach alpha test results that were computed through SPPSS version 27 to establish the internal consistency of the lecturer questionnaires. Frequency in using Moodle tools subscale for the lecturer questionnaire consisted of twenty items (α = .76), the factors affecting blended learning subscale consisted of eleven items (α =- .65), and the course engagement subscale consisted of 6 items (α = .66). Cronbach's alpha for increased problem-solving skills development consisted of ten items were (α = 68). The internal consistency is expressed on a scale between 0 and 1. According to Pallant (2001), a Cronbach alpha value of at least 0.6 is regarded as a reliable and respectable measure. While a Cronbach alpha value of less than 0.6 is regarded to be poor. Values of Cronbach's alpha between 0.60 and 0.80 are regarded as acceptable (Nunnally & Bernstein, 1994). Table 6 illustrates the Cronbach alpha values that are acceptable in the discussion above.

Table 6

Overall Internal Consistency of the Lecturer Questionnaires

Questionnaire Items	Cronbach's Alpha	Items
Responsiveness of students in using the tools of Moodle	0.76	20
Factors affecting blended learning	0.65	11
Increased communication	0.66	10
Increased problem-solving skills	0.68	10

Table 7 illustrates the number of survey questionnaires that were submitted via Google Forms. A total number of 113 respondents out of 278 students who received the survey link completed and submitted their survey questionnaires via Google Forms. Thus, a response rate of 40.7% for students was recorded.

Table 7

Response Rates of Students' Online Survey Questionnaires

Number of online questionnaires submitted	Frequency N	%
Questionnaires submitted via Google Docs	113	40.7
Questionnaires not submitted	165	59.3
Total students provided with the survey link	278	100

Table 8 reveals that 64 lecturers received the survey questionnaire link, and 35 respondents completed the survey questionnaires administered and submitted via Google Forms. This represents a 54.7% response rate of the respondents from stratum two who participated in this research.

Table 8

Response Rate of Lecturers' Online Survey Questionnaires

Number of questionnaires submitted	Frequency *N*	%
Questionnaires submitted via Google Docs	35	54.7
Questionnaires not submitted	29	45.3
Total of lecturers who received the survey link	64	100

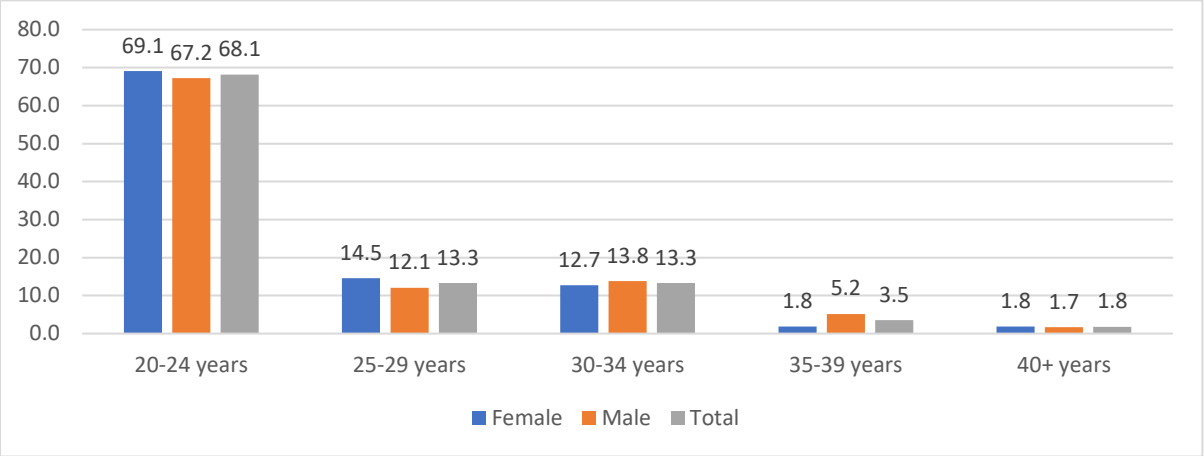
Next, the quantitative data presentation of student questionnaires follows.

4.5 Quantitative Data Presentation of Student Questionnaires: Descriptive Statistics

The demographic information of students and lecturers has been presented separately to portray the results of this study as logically as feasible. Figure 11 illustrates the student respondents by age and sex, showing that the majority (68.1%) of the respondents were aged 20 – 24 years. Only 1.8% of the respondents were aged 40 years and above. Slightly more females (69.1%) were aged 20 – 24 years than their male counterparts (67.2%).

Figure 11

Student Respondents by Age and Sex



The study revealed that about 59% of the respondents reported that they were studying full time, while 21.2% indicated that they were part-time students. More male students (67.2%) were studying full time compared to their female counterparts (50.9%). Furthermore, Figure 12 shows that more female students (27.3%) studied in distance mode of study.

Figure 12

Student Respondents by Mode of Study and Sex

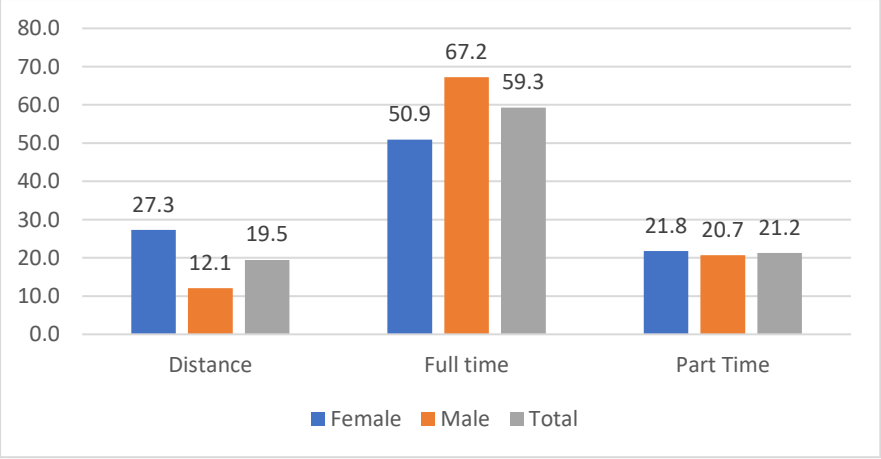


Figure 13 shows that the majority of the respondents are in their 3rd year of study.

Figure 13

Student Respondents by Year of the Study Programme

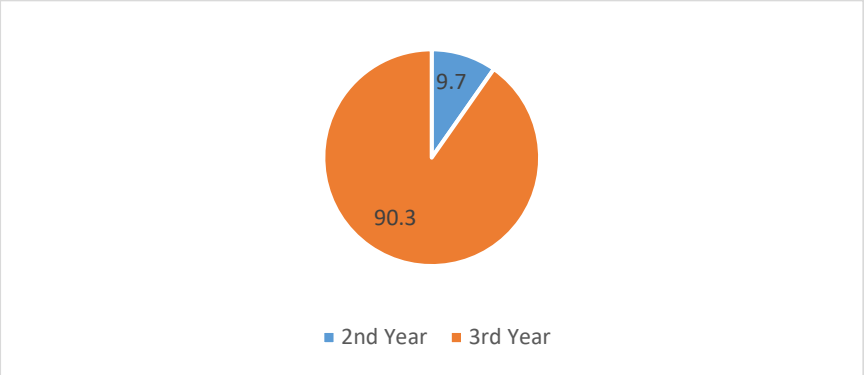
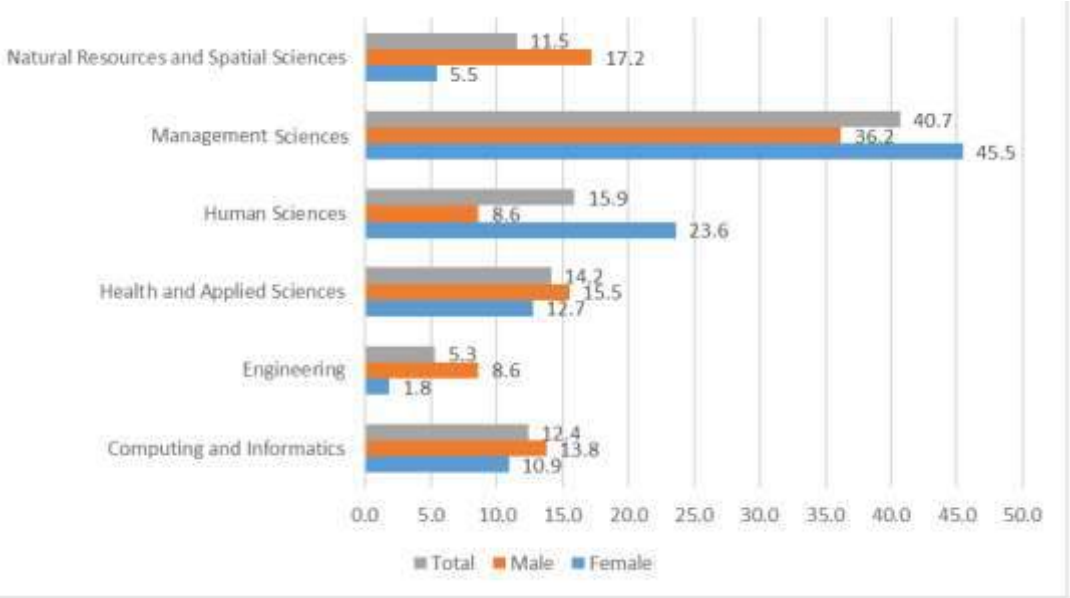


Figure 14 represents the faculty linked to their programme. It shows that 40.7% of the respondents are from the Faculty of Management Sciences, while only 5.3% are from Engineering. More female respondents (45.5%) are from the Faculty of Management Sciences and the Faculty of Human Sciences (23.6%) compared to their male counterparts, with 36.2% and 15.9%, respectively.

Figure 14

Student Respondents by Faculty



The next section presents evidence on the responsiveness of students' using the MyNUST e-learning platform centred around Research Question one.

Research Question one: Students Questionnaire - Responsiveness in Using MyNUST e-learning Platform (Moodle)

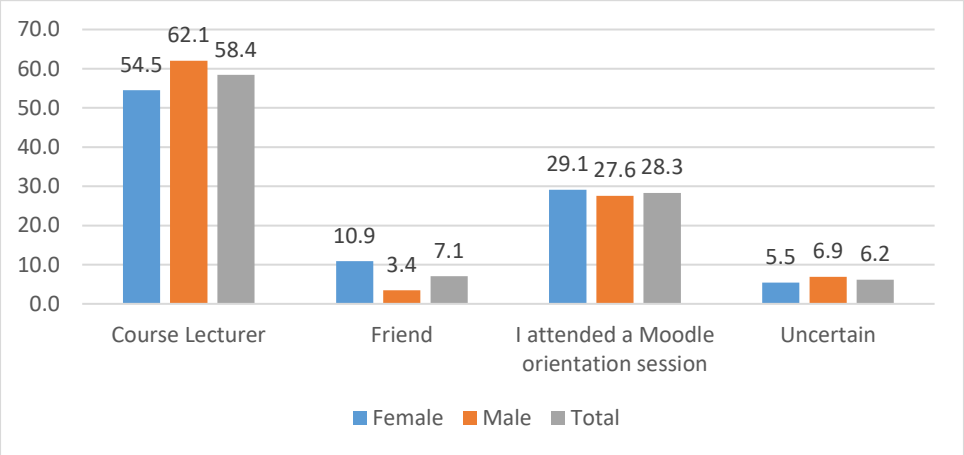
This section presents data to answer the first research question: What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

Awareness

Students were asked how they found out about the MyNUST e-learning platform's existence; the majority, 58.4%, reported that their course lecturer informed them. About 28% of the respondents revealed that they attended a Moodle orientation session. It is worth noting that 6.2% of the respondents indicated they were uncertain.

Figure 15

Student Respondents by Awareness of the MyNUST E-learning Platform

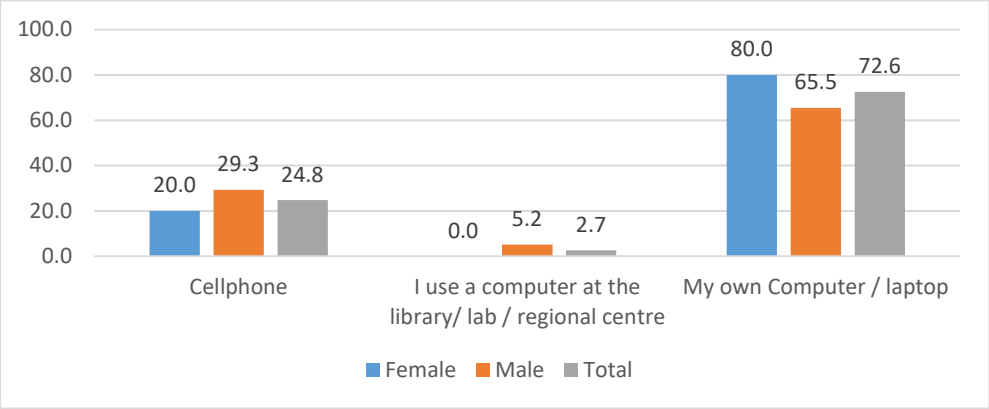


Access – Type of Device

Students were asked to indicate the device they usually use to access the MyNUST e-learning platform, and 72.6% reported using personal computers or laptops to access the MyNUST e-learning platform. In comparison, 2.7% of the respondents indicated using a computer at the library, lab or regional centre. More females (80%) compared to their male counterparts (65.5%) used their computer or laptop to access the MyNUST e-learning platform.

Figure 16

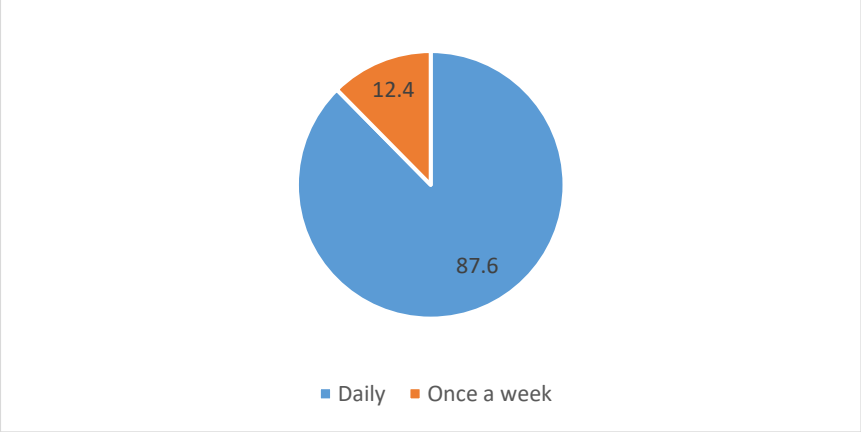
Student Respondents by Type of Device



The majority of the respondents (87.6%) reported that they accessed the MyNUST e-learning platform daily. The same pattern could be observed among both sexes.

Figure 17

Student Respondents by Frequent Access to the E-learning Platform



Students were asked how often they used the MyNUST e-learning platform (Moodle) to engage in the activities. Respondents had the option to select Never ‘1’, Almost never ‘2’, Occasionally/Sometimes ‘3’, Almost every time ‘4’, and Every time ‘5’.

Usage of MyNUST E-learning Platform

According to Table 9, out of the 113 respondents, 35.4% revealed that they used the MyNUST e-learning platform (Moodle) every time to view course announcements or news. About 33% of the respondents indicated that they used the MyNUST e-learning platform (Moodle) occasionally or sometimes to view the course syllabus, participated in online forum discussions, contacted lecturers for general inquiries and sought academic support from lecturers. More than 40% of the respondents revealed that they used the MyNUST e-learning platform (Moodle) every time to write an online test, take Moodle quizzes or submit assignments on the e-learning platform. About 52% of the respondents indicated that they used the MyNUST e-learning platform (Moodle) every time to download course material. In comparison, 61.9% of the respondents reported using the MyNUST e-learning platform (Moodle) every time to download assignments. Furthermore, more than 50% of the respondents indicated that they never used the MyNUST e-learning platform (Moodle) to contact classmates or seek academic support. About 42% of the respondents reported that they never used the MyNUST e-learning platform (Moodle) to report technical issues experienced with the My NUST e-learning platform.

Table 9

Respondents by Usage of MyNUST e-learning Platform

Usage of MyNUST e-learning platform	% Every time	% Almost every time	% Occasionally/ Sometimes	% Almost never	% Never	% Total
View course announcements/news	35.4	31.0	27.4	3.5	2.7	100.0
View course syllabus	28.3	28.3	33.6	9.7	0.0	100.0
Download course material	52.2	30.1	15.0	2.7	0.0	100.0
Download assignments	61.9	18.6	16.8	2.7	0.0	100.0
Taking Moodle quizzes	46.0	27.4	23.0	2.7	0.9	100.0
Writing online tests	40.7	31.0	24.8	2.7	0.9	100.0
Using the Workshop feature for peer assessment	12.4	8.8	26.5	23.9	28.3	100.0
Participate in online forum discussions	31.9	20.4	32.7	8.8	6.2	100.0
Submit assignments on the e-learning platform	46.0	36.3	15.0	2.7	0.0	100.0
Contact lecturers for general inquiries	3.5	7.1	39.8	21.2	28.3	100.0
Contact classmates	0.9	2.7	16.8	29.2	50.4	100.0
Seek academic support from lecturers	1.8	8.0	33.6	23.9	32.7	100.0
Seek academic support from classmates	0.9	2.7	17.7	25.7	53.1	100.0
Report technical issues experienced with the My NUST e-learning platform	3.5	8.0	21.2	24.8	42.5	100.0

Factors that Affect Blended Learning at NUST

This section presents data to answer the second research question**:** What signifying factors affect blended learning using Moodle at NUST?

Students were asked to indicate their agreement or disagreement with the statements relating to the factors that affect blended learning at NUST. Respondents had the option to select Strongly Disagree '1', Disagree '2', Uncertain '3', Agree '4', and Strongly Agree '5'.

More than 53% of the respondents agreed or strongly agreed that they had open access to reliable internet at home and were motivated to study online through the MyNUST e-learning Platform/Moodle. Equally, more than 53% of the respondents agreed or strongly agreed that they were afforded ample time to complete online tasks and that studying online provided opportunities to manage their studies better, although it created a feeling of isolation from their peers.

Table 10 shows that 69% of the respondents agreed or strongly agreed that they were ready to engage with online learning at the beginning of the semester and that studying online requires a certain level of computer literacy to navigate through the platform. More than 75% of the respondents agreed or strongly agreed that engaging in online learning provides flexible learning opportunities in a self-directed manner. Using the MyNUST e-learning platform allowed them to take ownership of their studies. Furthermore, more than 31% of the respondents disagreed that they found it challenging to adapt to online learning. These respondents indicated they felt lost and unsure about their ability to manage online learning.

Table 10

Respondents by Factors that Affect Blended Learning at NUST

Factors that affect blended learning at NUST	Strongly agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	Total %
Have open access to reliable internet at my home.	16.8	36.3	20.4	15.9	10.6	100.0
I was motivated to study online through the MyNUST e-learning platform/Moodle.	24.8	34.5	22.1	13.3	5.3	100.0
Ready to engage with online learning at the beginning of the semester.	27.4	41.6	14.2	10.6	6.2	100.0
Found it difficult to adapt to online learning.	8.0	28.3	8.8	31.9	23.0	100.0
Studying online requires a certain level of computer literacy to navigate through the platform.	21.2	47.8	5.3	15.9	9.7	100.0
I am afforded ample time to complete online tasks.	8.0	46.0	22.1	13.3	10.6	100.0
Engaging in online learning provides flexible opportunities to learn in a self-directed manner.	24.8	50.4	14.2	8.8	1.8	100.0
Using the MyNUST e-learning platform allowed me an opportunity to take ownership of my studies.	29.2	49.6	13.3	5.3	2.7	100.0
Studying online provides opportunities to manage my studies better.	16.8	41.6	12.4	23.0	6.2	100.0
Studying online creates a feeling of isolation from my peers.	40.7	12.4	16.8	9.7	20.4	100.0
I feel lost and unsure about my ability to manage online learning.	26.5	32.7	5.3	26.5	8.8	100.0

Student Questionnaires: The Use of Moodle to Increase Students' Course Engagement

This section presents data to answer the third research question**:** What impact does the use of Moodle at NUST have on students' course engagement?

Respondents were asked to rate their agreement or disagreement with the statements relating to using Moodle to increase students' course engagement. Respondents had the option to select Strongly Disagree '1', Disagree '2', Uncertain '3', Agree '4', and Strongly Agree '5'.

Table 11 shows that about 61% of the respondents agreed or strongly agreed that adequate opportunities are available in their courses to engage in online forum discussions. More than 48% of the respondents agreed or strongly agreed that the topics provided for online forum discussions were interesting; peer interaction was stimulated, and they knew how to use the ePortfolio on the MyNUST e-learning platform for self and peer reflections. About 36.3% agreed or strongly agreed that online course facilitators provided feedback on online discussions promptly.

Furthermore, 58.4% of the respondents agreed or strongly agreed that online course facilitators provide enough reading materials and online resources to increase course engagement. Finally, more than 50% of the respondents agreed or strongly agreed that using the MyNUST e-learning platform had led to increased course engagement opportunities.

Table 11

Respondents by The Use of Moodle to Increase Student Course Engagement

The use of Moodle to increase student course engagement	Strongly Agree %	Agree %	Disagree %	Strongly disagree %	Uncertain %	Total %
Adequate opportunities are available in my courses to engage in online forum discussions.	5.3	56.6	11.5	7.1	19.5	100.0
The topics provided for online forum discussions are interesting; as such, they stimulate peer interaction.	7.1	41.6	15.9	8.0	27.4	100.0
Online course facilitators provide feedback on online discussions promptly.	6.2	30.1	23.0	16.8	23.9	100.0
I know how to use the ePortfolio on the MyNUST e-learning platform for self and peer reflections.	14.2	34.5	19.5	9.7	22.1	100.0
Online course facilitators provide enough reading materials and online resources to increase course engagement.	15.9	42.5	15.9	7.1	18.6	100.0
Using the MyNUST e-learning platform has led to increased course engagement opportunities.	12.4	38.1	17.7	4.4	27.4	100.0

The use of Moodle for Increased Communication

This section provides data to answer the fourth research question**:** What impact does the use of Moodle at NUST have on students' communication?

Respondents were asked to rate their agreement or disagreement with the statements relating to the use of Moodle to increase student course engagement. Respondents had the option to select Strongly Disagree '1', Disagree' 2', Uncertain '3', Agree '4', and Strongly Agree '5'.

According to Table 12, about one-third of the respondents agreed or strongly agreed that communication in an online environment was more open than in face-to-face classes and that access to the MyNUST e-learning Platform/Moodle made communication with lecturers easier. About 39% of the respondents indicated they used the My NUST e-learning Platform/Moodle messaging feature to contact their lecturers. About 62% of the respondents agreed or strongly agreed that they relied on the 'upcoming events' feature to get information on offline activities that take place at a specific time. Furthermore, 71.7% of the respondents agreed or strongly agreed that they rely on the 'upcoming events' feature to get information on online planned activities to take place at a specific time. Finally, 38.9% of the respondents agreed or strongly agreed that using the MyNUST e-learning platform had led to increased communication opportunities.

Table 12

Respondents by The Use of Moodle to Increase Students' Communication

The use of Moodle for increased communication	Strongly Agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	Total %
Access to the MyNUST e-learning Platform/Moodle makes communication with lecturers easier.	4.4	30.1	23.9	30.1	11.5	100.0
Use the messaging feature of the My NUST eLearning Platform/Moodle to contact my lecturers.	3.5	35.4	9.7	30.1	21.2	100.0
Communication in an online environment is more open than in face-to-face classes.	13.3	20.4	19.5	23.0	23.9	100.0
Rely on the 'upcoming events' feature to get information on offline activities that take place at a specific time	26.5	36.3	20.4	7.1	9.7	100.0
Rely on the 'upcoming events' feature to get information on online planned activities to take place at a specific time.	31.9	39.8	14.2	10.6	3.5	100.0
Using the MyNUST e-learning platform has led to increased communication opportunities.	4.4	34.5	27.4	22.1	11.5	100.0

The Use of Moodle to Develop Problem-Solving Skills

This section provides data to answer the fifth research question**:** What impact does the use of Moodle at NUST have on the development of students' problem-solving skills?

Respondents were asked to indicate their level of agreement or disagreement with the statements relating to the use of Moodle to develop problem-solving skills. Respondents had the option to select Strongly Disagree '1', Disagree'2', Uncertain '3', Agree '4', and Strongly Agree '5'.

Table 13 shows that about 54% of the respondents agreed or strongly agreed that assessment activities on the MyNUST e-learning platform (Moodle) were structured in such a way to find solutions to real-life problems. About 79% of respondents agreed or strongly agreed that online tasks were structured in such a way as to promote rational thinking. More than 75% of the respondents indicated that online tasks were structured in such a way to encourage independent thinking, and the learning activities in their online courses assist with the development of critical thinking skills. More than 66% of the respondents agreed or strongly agreed that online tasks were structured to provide multiple paths to solve problems. About 66% of the respondents agreed or strongly agreed that they are required to complete additional assignments on real-time issues based on particular units. About 88% of the respondents agreed or strongly agreed that online discussion topics needed critical thinking skills. About 36% of the respondents disagreed that they used the quick messaging tool to share some thoughts and perspectives with online course participants. Finally, 59.3% of the respondents agreed or strongly agreed that their engagement in online tasks had increased their ability to solve problems.

Table 13

Respondents by The Use of Moodle to Develop Problem-Solving Skills

The use of Moodle to develop problem-solving skills	Strongly Agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	Total %
Assessment activities on the MyNUST e-learning platform (Moodle) is structured in such a way as to find solutions to real-life problems.	9.7	44.2	27.4	14.2	4.4	100.0
Online tasks are structured in such a way as to promote rational thinking.	19.5	60.2	9.7	8.0	2.7	100.0
Online tasks are structured in such a way to promote independent thinking	25.7	52.2	11.5	6.2	4.4	100.0
Online tasks are structured in a manner to provide multiple paths to solve problems.	17.7	48.7	17.7	9.7	6.2	100.0
The learning activities in my online courses assist with the development of critical thinking skills.	20.4	59.3	10.6	7.1	2.7	100.0
Online discussion topics require the application of critical thinking skills.	27.4	61.1	2.7	5.3	3.5	100.0
Use the quick messaging tool to share some thoughts and perspectives with online course participants.	2.7	20.4	15.0	36.3	25.7	100.0
I am required to complete additional assignments on real-time problems based on particular units.	8.8	58.4	20.4	9.7	2.7	100.0

Table 13 Continued

Table 13 Continued

The use of Moodle to develop problem-solving skills	Strongly Agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	Total %
Quality assignment feedback is provided to assist with the development of problem-solving skills.	8.0	36.3	20.4	22.1	13.3	100.0
My engagement in online tasks has increased my ability to solve problems.	9.7	49.6	26.5	9.7	4.4	100.0

Effective and Safe use of the MyNUST e-learning Platform

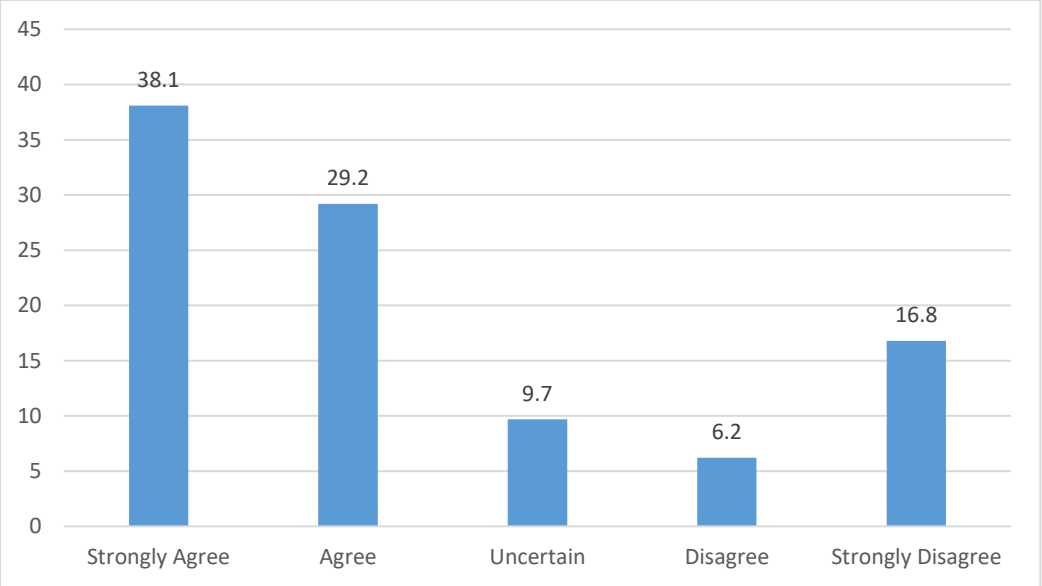
This section presents data to answer the sixth research question: What strategies can be adopted by NUST to increase the effective and safe use of Moodle as an LMS?

Respondents were asked whether they were the only person that had access to their e-learning account on the MyNUST platform Respondents had the option to select Strongly Disagree ‘1’, Disagree ‘2’, Uncertain ‘3’, Agree ‘4’, and Strongly Agree ‘5’.

Figure 18 shows that 67.3% of the respondents agreed or strongly agreed that they were the only person that had access to their e-learning account on the MyNUST platform.

Figure 18

Student Respondents by Only Person that had Access to E-learning Accounts on the MyNUST Platform

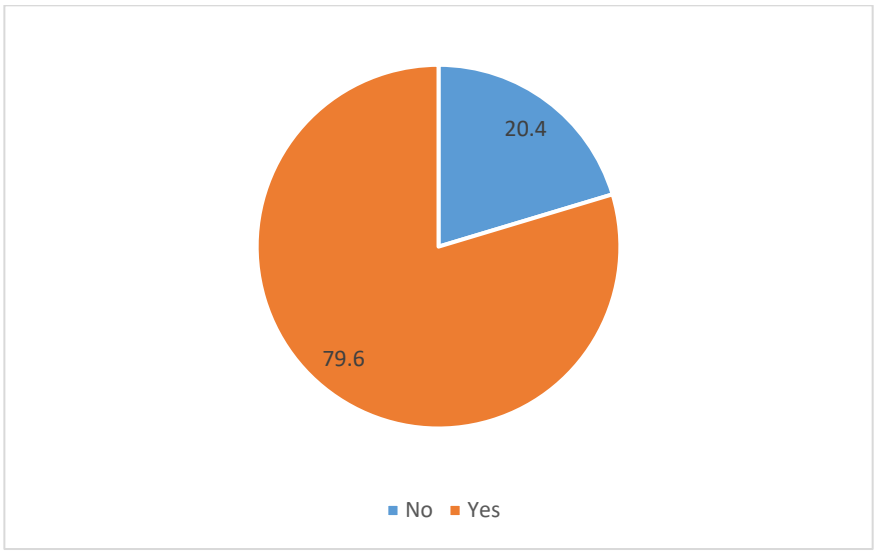


Respondents were asked whether they think the MyNUST e-learning Platform (Moodle) was used effectively at NUST. Respondents could select No '1' or Yes '2'.

Figure 19 shows that 79.6% of the respondents agreed that the MyNUST e-learning Platform (Moodle) was used effectively at NUST.

Figure 19

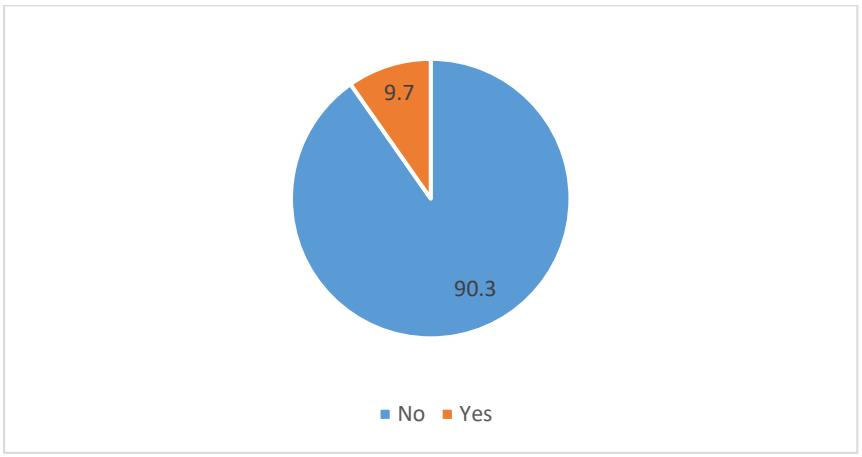
Student Respondents by the Effective Use of the MyNUST E-learning Platform



Respondents were asked whether they experienced situations where someone took an online test/quiz illegally on their behalf. Respondents had the option to select No '1' or Yes '2'. Figure 20 shows that 9.7% of the respondents experienced situations where an online test/quiz was completed illegally by someone on their behalf.

Figure 20

Student Respondents by Online Tests Completed Illegally by Someone Else



4.6 Validity and Reliability

As explained earlier, reliability has to do with the research outcomes and relates to the integrity of the findings. It, therefore, refers to the extent to which the results may be generalised to different occasions or measurements. The validity, however, also relates to how the findings accurately signify what is happening in the situation. (Masadeh, 2012).

The Use of Moodle to Increase Student Course Engagement

Reliability analysis was conducted, and a Cronbach's Alpha coefficient of 0.66 was obtained. Just more than 50% of the students think that using Moodle increased students' course engagement.

The Use of Moodle for Increased Communication

Reliability analysis was conducted, and a Cronbach Alpha coefficient of 0.73 was obtained. Only a few students think that the use of Moodle increased communication.

The use of Moodle to Develop Problem-Solving Skills

Reliability analysis was conducted, and a Cronbach Alpha coefficient of 0.86 was obtained. Most of the students think that the use of Moodle develops problem-solving skills.

The following section presents the descriptive statistic of the lecturer questionnaire.

4.7 Descriptive Statistics: Lecturer Questionnaires

This section presents descriptive statistics of lecturer questionnaires to answer research questions one to five, starting with participants' demographic information.

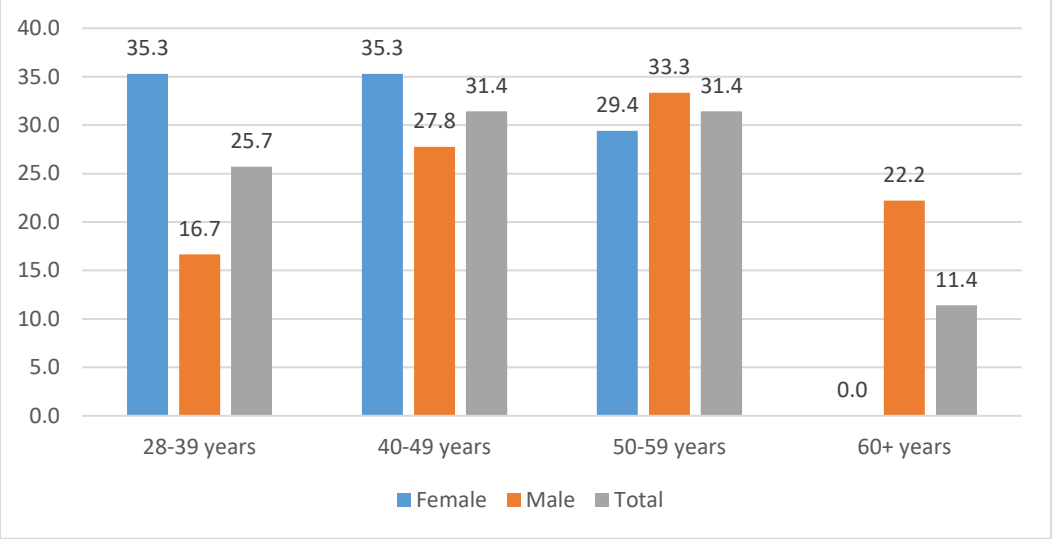
Demographics

Gender and Age

Figure 21 shows that 31.4% of the respondents are aged 40-49 years and 50-59 years, while only 11.4% are aged 60+ years. More females than their male counterparts are aged 28-39 years and 40-49 years, with 35.3%, respectively.

Figure 21

Lecturer Respondents by Age and Sex



Teaching experience in Higher Education and Sex

According to Figure 22, about 34.3% of the respondents reported 5-9 years of teaching experience in higher education. More females (41.2%) than their male (27.8%) counterparts had 5-9 years of teaching experience in higher education. It is worth noting that 28.6% of the respondents had more than 15 years of teaching experience in higher education. In contrast with those respondents who had 5-9 years of teaching experience in higher education, more males

(38.9%) than their female counterparts (17.6%) had more than 15 years of teaching in higher education.

Figure 22

Respondents by Teaching Experience and Sex

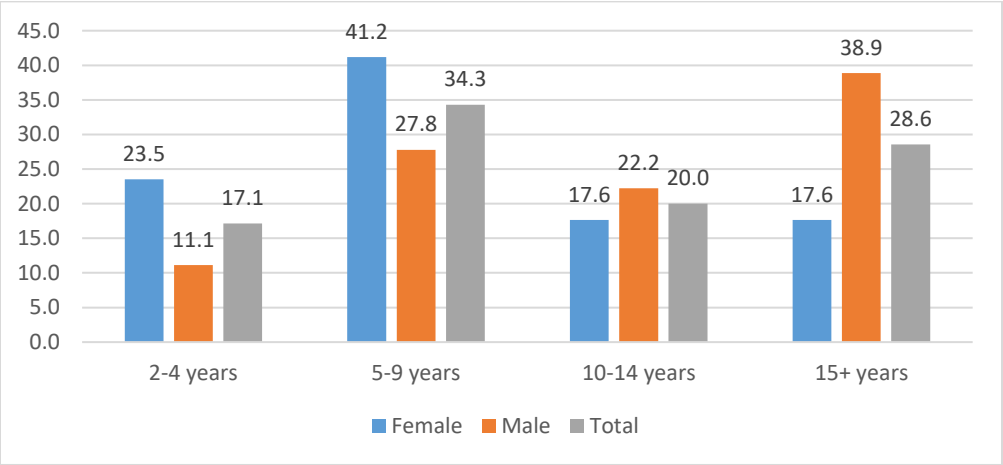
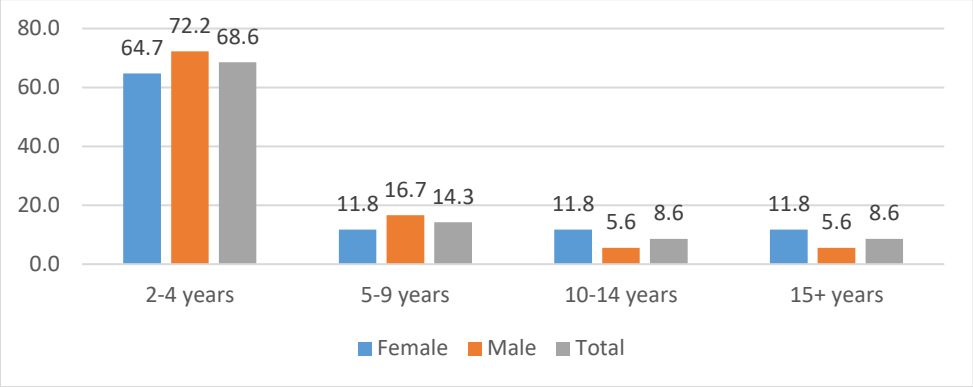


Figure 23 represents respondents' years of teaching experience using the Moodle platform. It shows that most of the respondents (68.6%) reported that they only have 2-4 years of teaching experience using Moodle platform. In comparison, only 8.6% of the respondents indicated that they have more than 15 years of teaching experience using Moodle platform. More females (11.8%) than their male counterparts (5.6%) had more than 15 years of teaching experience using Moodle platform.

Figure 23

Respondents by Teaching Experience using Moodle and Sex

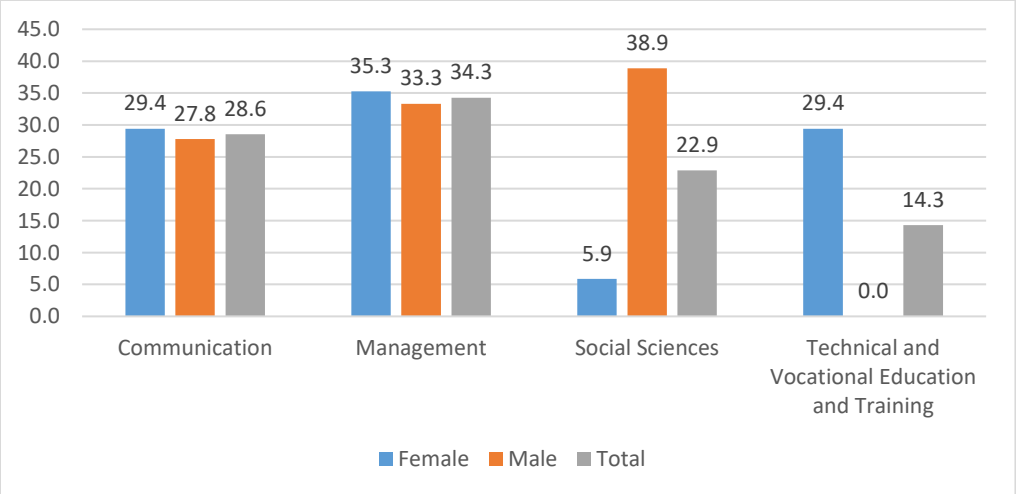


Department

Figure 24 shows that about 34% of the respondents are from the Department of Management, followed by the Department of Communication (28.6%).

Figure 24

Respondents by Department and Sex



Lecturer Questionnaires: Responsiveness to Use Moodle Tools

This section provides data to answer the first research question: What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

Respondents were asked to rate how often they use the tools to upload content on the MyNUST e-learning platform (Moodle). Respondents had the option to select ’1’', Almost never ‘’', Occasionally/Sometimes ‘3’, Almost every time ‘4’, and Every time ‘5’.

Table 14 shows that 37.1% of the respondents reported that they upload course materials using the File tool almost every time. About 31% of the respondents indicated that they upload course materials using the Folder tool almost every time. Furthermore, 45.7% of the respondents revealed that they almost never upload videos on the MyNUST e-learning platform (Moodle).

Table 14

Respondents by Frequent Use of Moodle Tools/Features

Using Moodle to upload resources	Every time %	Almost every time %	Occasionally/Sometimes %	Almost never %	Never %	Total %
Upload course materials using the File tool	14.3	37.1	31.4	17.1	0.0	100.0
Upload course materials using the Folder tool	14.3	31.4	22.9	31.4	0.0	100.0
Upload videos	8.6	17.1	25.7	45.7	2.9	100.0

Respondents were asked to rate how often they use specific Moodle tools for teaching Respondents had the option to select ‘1’, Almost never ‘2’', Occasionally/Sometimes ‘3’, Almost every time ‘4’, and Every time ‘5’.

Table 15 shows that more than 80% of the respondents almost never or never used the Chat feature that creates opportunities for participants to engage in real-time synchronous discussion, the Feedback tool that allows teachers to design and conduct surveys to collect data or feedback, the Moodle Workshop tool for peer assessment and the Glossary – like a dictionary – that will enable participants opportunities to develop and retain a list of definitions. About 57% of the respondents almost never used the Glossary. Furthermore, 65.7% of the respondents used the Quiz tool to design and set various tests or quizzes almost every time. More than 85% of the respondents used the Assignments Tool to create tasks or assignments for students almost every time.

Table 15

Respondents by Using Moodle Tools for Teaching

Using Moodle tools for teaching	% Every time	% Almost every time	% Occasionally/ Sometimes	% Almost never	% Never	% Total
Chat feature: The Chat activity creates opportunities for participants to engage in real-time synchronous discussion.	0.0	2.9	8.6	40.0	48.6	100.0
Forum (online discussion): This tool allows participants to engage in asynchronous discussions at different times. All participants do not have to be online at the same time.	8.6	20.0	14.3	20.0	37.1	100.0
Quiz: Teachers use this tool to design and set various kinds of tests or quizzes.	22.9	42.9	20.0	8.6	5.7	100.0
Assignments: Teachers use the assignments tool to create tasks or assignments for students.	42.9	42.9	8.6	2.9	2.9	100.0
Feedback Tool: It allows teachers to create and conduct surveys to collect data or feedback.	8.6	5.7	5.7	74.3	5.7	100.0
Moodle workshop tool for peer assessment	0.0	5.7	5.7	42.9	45.7	100.0
Glossary: Allows participants opportunities to create and retain a list of definitions, like a dictionary.	2.9	8.6	5.7	42.9	40.0	100.0

Respondents were asked to rate how often they use the Moodle tools for teaching Respondents had the option to select ‘1’, Almost never ‘2’, Occasionally/Sometimes ‘3’, Almost every time 4’, and Every time ‘5’.Table 16 shows that more than 80% of the respondents almost

never or never used the lesson tool to deliver content in flexible ways and the choice activity that allows the teacher to ask a question to students and specify a choice of multiple responses. Furthermore, more than 90% of the respondents almost never or never used the Wiki tool that allows participants to create web pages that anyone can add to or edit, the Shareable Content Object Reference Model (SCORM) that enables SCORM packages to be included as course content and the HTML5 package that aims to make it easy for everyone to create, share and reuse interactive HTML5 content.

Table 16

Respondents by Using Moodle Tools for Teaching

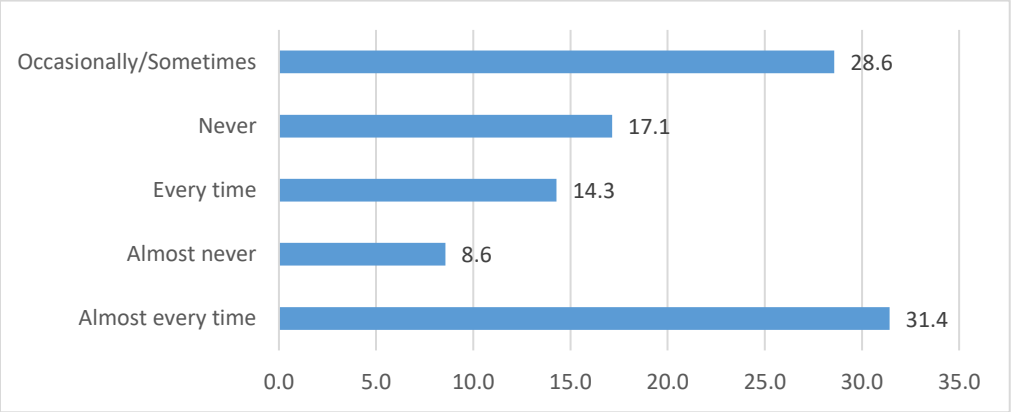
Frequent Use of Moodle Tools/Features	Every time %	Almost every time %	Occasionally/Sometimes %	Almost never %	Never %	Total %
Lesson: This tool is used to deliver content in flexible ways.	2.9	11.4	5.7	28.6	51.4	100.0
Wiki: This tool allows participants to create web pages that anyone can add to or edit.	0.0	5.7	2.9	25.7	65.7	100.0
Choice: This activity allows the teacher to ask students a question and specify a choice of multiple responses.	0.0	11.4	5.7	20.0	62.9	100.0
Shareable Content Object Reference Model (SCORM) enables SCORM packages to be included as course content.	0.0	2.9	5.7	14.3	77.1	100.0
Survey feature: Teachers can create a survey to collect data from students to help teachers learn about their class and reflect on their teaching	0.0	20.0	8.6	2.9	68.6	100.0
Tab. Create, share and reuse interactive HTML5 content	0.0	2.9	5.7	17.1	74.3	100.0

Respondents were asked to rate how often they use the Moodle tools for teaching Respondents had the option to select ‘1’, Almost never ‘2’, Occasionally/Sometimes ‘3’, Almost every time 4’, and Every time ‘5’.

Figure 25 reveals that about 31% of the respondents reported using the announcements/news tool to send out course reminders to students almost every time. Less than 10% of the respondents indicated that they almost never use the announcements/news tool to send out course reminders to students.

Figure 25

Respondents by Sending out Announcements

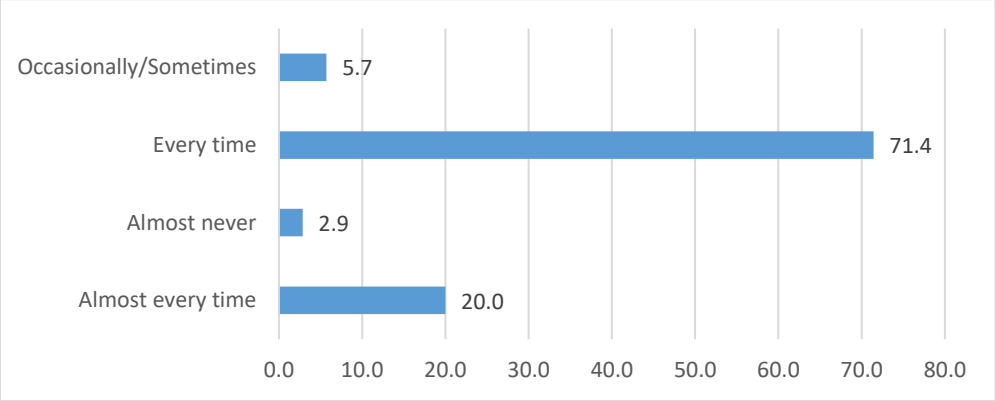


Respondents were asked to rate how often they grade students' assignments online on the MyNUST e-learning platform. Respondents had the option to select '1', Almost never '2', Occasionally/Sometimes '3', Almost every time 4', and Every time '5'.

As shown in Figure 26, the majority (71.4%) of the respondents indicated that they grade students' assignments online on the MyNUST e-learning platform every time. Only 2.9% of the respondents indicated that they almost never grade students' assignments online on the MyNUST e-learning platform.

Figure 26

Respondents by How often Assignments are Graded Online

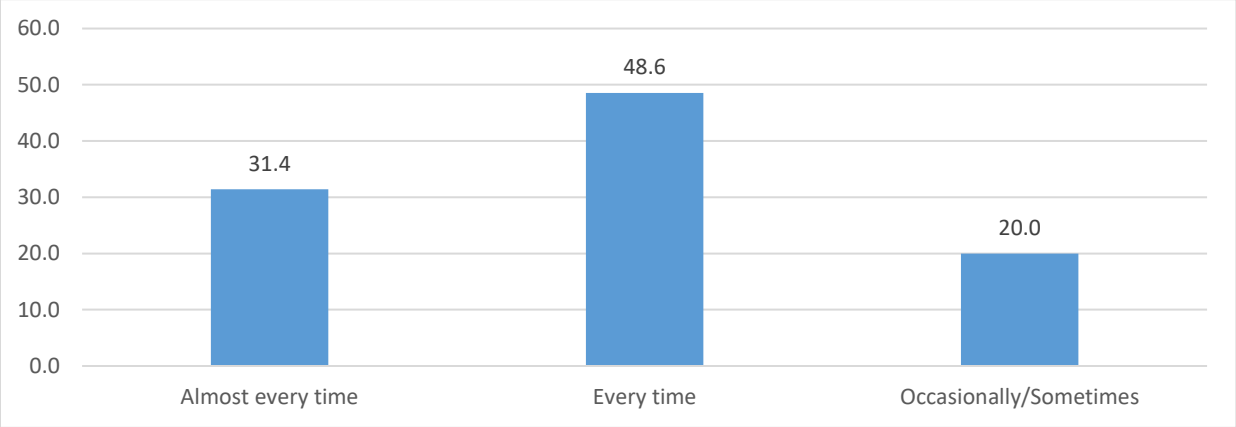


Respondents were asked to rate how often they provide assignment feedback online on the MyNUST e-learning platform. Respondents had the option to select '1', Almost never '2', Occasionally/Sometimes '3', Almost every time 4', and Every time '5'.

Figure 27 shows that nearly half of the respondents (48, 6%) said they always upload assignment feedback to their students using the MyNUST e-learning platform.

Figure 27

Respondents by How Often Online Assignment Feedback is Provided

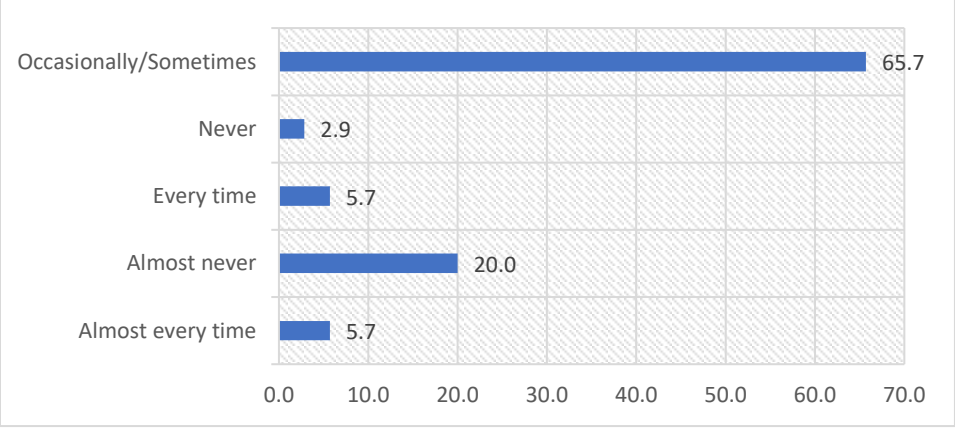


Respondents were asked to rate how often they provide opportunities to students to resubmit assignments on the MyNUST e-learning platform. Respondents had the option to select '1', Almost never '2', Occasionally/Sometimes '3', Almost every time 4', and Every time '5'.

As depicted in Figure 28, the majority (65.7%) of the respondents indicated that they occasionally/sometimes allow students the opportunity to resubmit assignments. Less than 3% of the respondents reported that they never allow students the opportunity to resubmit assignments.

Figure 28

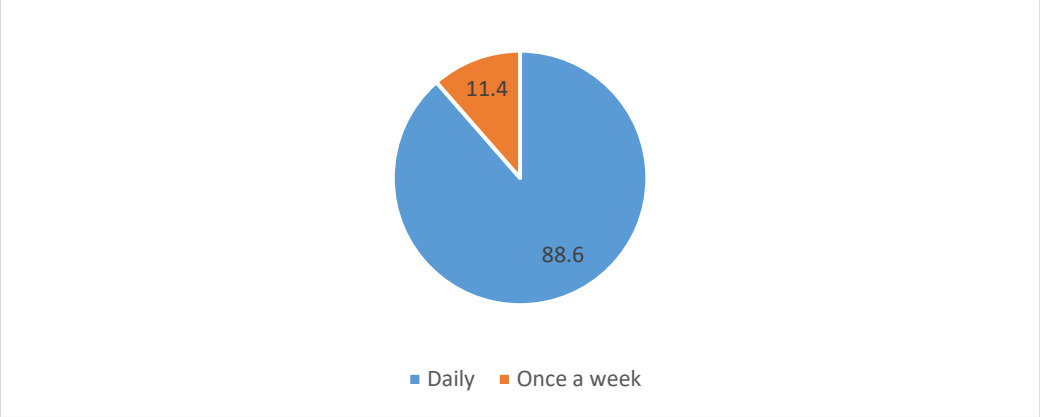
Respondents by How often Assignment Resubmission Opportunities are Provided



Respondents were asked how frequently they used the MyNUST e-learning platform. Figure 29 reveals that 88.6% of the respondents reported using the MyNUST e-learning platform daily.

Figure 29

Respondents by Frequent Use of the Platform



Respondents were asked to indicate the type of faculty development toward the effective use of Moodle they participated in during the last 12 months. Table 17 reveals that all of them (100%) indicated that they attended training workshops. More than 97% reported that during the last 12 months, they were not part of small-group sessions (10 or fewer participants), did not receive one-on-one training or were not assigned to a mentor by the institution.

Table 17

Respondents by Using Moodle Training/Development Opportunities

Type of Training/Development Opportunities	**Yes**	**No**	**Total**
	%	**%**	**%**
Attended training workshops	100.0	0.0	100.0
Participate in small group sessions (10 or fewer participants)	2.9	97.1	100.0
Received one-on-one training	0.0	100.0	100.0
Assigned to a mentor by the institution	2.9	97.1	100.0

Factors that Affect Blended Learning at NUST

This section presents data that answered the second research question: What signifying factors affect blended learning using Moodle at NUST?

Lecturers were asked to indicate their level of agreement or disagreement with the statements relating to the factors that affect blended learning at NUST. Respondents had the option to select Strongly Disagree '1', Disagree '2', Uncertain '3', Agree '4', and Strongly Agree '5'.

Table 18 represents the factors that affect blended learning at NUST. It shows that 94.3% agreed or strongly agreed that students could submit assignments after the due date with the necessary permission. More than 82% of the respondents agreed or strongly agreed that they were afforded flexible opportunities for students to learn in a self-directed manner and that they need more training to improve their confidence in using Moodle tools. More than 74% of the respondents agreed or strongly agreed that they have open access to reliable internet in their homes and that facilitating online teaching allows them a chance to take ownership of their courses. About 65% of the respondents agreed or strongly agreed that they are motivated to teach online through the MyNUST e-learning platform/Moodle. More than 65% agreed or strongly agreed that facilitating online teaching requires a certain level of computer literacy to navigate the platform. About 68% of the respondents agreed or strongly agreed that facilitating online teaching improves course management. Close to 70% of the respondents feel lost and unsure about their ability to manage and facilitate online teaching, and 68% of the respondents agreed or strongly agreed that a heavy workload makes it difficult to use the MyNUST platform effectively. Furthermore, 57.1% of the respondents agreed or strongly agreed that they were ready to engage with online teaching at the beginning of the semester. About 48% of the respondents reported that they are uncertain

whether they afford students ample opportunities to communicate with their classmates through the MyNUST e-learning platform/Moodle.

Table 18

Respondents by Agreement on Factors that Affect Blended Learning at NUST

Factors that affect blended learning at NUST	Strongly agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	Total %
Open access to reliable internet at my home.	17.1	60.0	0.0	20.0	2.9	100.0
I am motivated to teach online through the MyNUST e-learning platform/Moodle.	11.4	54.3	0.0	34.3	0.0	100.0
I was ready to engage with online teaching at the beginning of the semester.	11.4	45.7	0.0	42.9	0.0	100.0
I experience challenges to adapt to online teaching.	2.9	71.4	0.0	20.0	5.7	100.0
I afford students ample opportunities to communicate with their classmates through the MyNUST e-learning platform/Moodle	5.7	28.6	48.6	17.1	0.0	100.0
I facilitating online teaching requires a certain level of computer literacy to navigate through the platform.	0.0	65.7	5.7	28.6	0.0	100.0

Table 18 Continued

Table 18 Continued

Factors that affect blended learning at NUST	Strongly agree %	Agree %	Uncertain %	Disagree %	Strongly disagree %	Total %
I afford flexible opportunities for students to learn in a self-directed manner.	8.6	74.3	11.4	5.7	0.0	100.0
Students are allowed to submit assignments after the due date with the necessary permission.	5.7	88.6	0.0	5.7	0.0	100.0
Facilitating online teaching provides opportunities to manage my course better.	8.6	60.0	5.7	25.7	0.0	100.0
I feel lost and unsure about my ability to manage and facilitate online teaching.	2.9	60.0	2.9	28.6	5.7	100.0
I need more training to improve my confidence in using Moodle tools.	8.6	74.3	2.9	14.3	0.0	100.0
A heavy workload makes it difficult to use the My NUST platform effectively.	8.6	60.0	0.0	28.6	2.9	100.0

Lecturer Questionnaires: The Use of Moodle for Increased Communication

This section presents data that answered the fourth research question: What impact does the use of Moodle at NUST have on students' communication?

The use of Moodle for Increased Communication

Respondents were asked to indicate their level of agreement or disagreement regarding the factors that affect blended learning at NUST. Respondents had the option to select Strongly Disagree ‘1’, Disagree ‘2’, Uncertain ‘3’, Agree ‘4’, and Strongly Agree ‘5’.

Table 19 reveals that more than 85% of the respondents agreed or strongly agreed to use the MS Teams chat tool to maintain effective communication with their class group. They use the MS Teams call tool to communicate effectively with their class group. More than 71% of the respondents agreed or strongly agreed that they use WhatsApp to maintain effective communication with their class group and email students to maintain effective communication with their class group. More than 60% of the respondents agreed or strongly agreed that using the e-learning platform/Moodle at NUST has increased communication between their students and themselves. They use the MyNUST Moodle messaging tool to maintain effective communication with their class group. About 51% of the respondents agreed or strongly agreed that the messaging tool in Moodle is an effective manner to communicate with students.

Furthermore, 71.4% of the respondents disagreed that they use Telecom's Short message services (SMS) to maintain effective communication with their class group. About 82% of the respondents agreed or strongly agreed that communication in an online environment is more open than in face-to-face classes. About 57% of the respondents disagreed that they use Facebook to communicate effectively with their class group.

Table 19

The Use of Moodle for Increased Communication

The use of Moodle for increased communication	Strongly Agree %	Agree %	Uncertain %	Disagree %	Strongly Disagree %	Total %
The use of the e-learning platform/Moodle at NUST has led to increased communication between my students and myself.	2.9	57.1	0.0	28.6	11.4	100.0
The messaging tool in Moodle is an effective manner to communicate with students.	5.7	45.7	5.7	40.0	2.9	100.0
Make use of WhatsApp to maintain effective communication with my class group.	20.0	51.4	0.0	28.6	0.0	100.0
Make use of Telecom's Short message services (SMS) to maintain effective communication with my class group.	14.3	71.4	2.9	11.4	0.0	100.0
Make use of the MyNUST Moodle messaging tool to maintain effective communication with my class group.	62.9	28.6	5.7	0.0	2.9	100.0
Email students to maintain effective communication with my class group.	71.4	17.1	5.7	0.0	5.7	100.0
Make use of the MS Teams chat tool to maintain effective communication with my class group.	68.6	11.4	17.1	0.0	2.9	100.0
Make use of the MS Teams call tool to maintain effective communication with my class group.	8.6	74.3	2.9	8.6	11.4	100.0

Table 19 Continued

Table 19 Continued

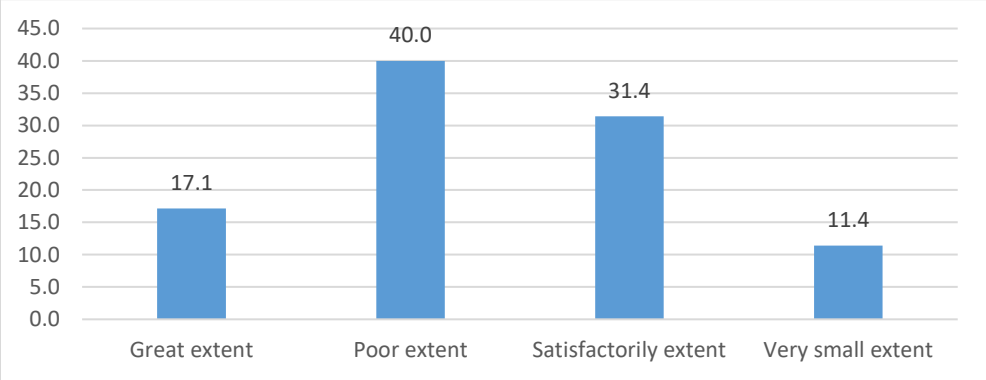
The use of Moodle for increased communication	Strongly Agree %	Agree %	Uncertain %	Disagree %	Strongly Agree %	Total %
Make use of personal phone calls to maintain effective communication with my class group.	57.1	22.9	0.0	57.1	5.7	100.0
Make use of Facebook to maintain effective communication with my class group.	57.1	2.9	0.0	57.1	0.0	100.0
Communication in an online environment is more open than in face-to-face classes.	71.4	11.4	0.0	71.4	5.7	100.0

Respondents were asked to what extent the use of Moodle has increased communication at NUST. Respondents had the option to select Great extent ‘4’, Satisfactory extend ‘3’, Very small extent ‘2’, and Poor extent ‘1’.

Figure 30 shows that 40% of the respondents reported that the use of Moodle led to increased communication at NUST to a poor extent.

Figure 30

Respondents by The Use of Moodle Led to Increased Communication at NUST



Lecturers' Views on the Development of Problem-Solving Skills

This section presents data that answered the fifth research question: What impact does the use of Moodle at NUST have on students' problem-solving skills?

Respondents were asked to indicate their level of agreement or disagreement with statements related to developing problem-solving skills using Moodle. Respondents had the option to select Strongly Disagree ''1', Disagree '2', Uncertain '3', Agree '4', and Strongly Agree '5'.

According to Table 20, more than 71% of the respondents agreed that online tasks submitted for grading show that Moodle at NUST has promoted students' rational thinking. Students are required to submit additional activities to promote real-time problem-solving based on particular units. About 68% of the respondents agreed that online tasks submitted for grading show evidence that using Moodle at NUST had promoted independent thinking. More than 80% of the respondents agreed that using Moodle as an LMS at NUST capacitated students to seek multiple paths to analyse problems. About 84% of the respondents agreed or strongly agreed that assignments are set in such a way to challenge students to solve authentic workplace-related issues, and their courses provide PowerPoint presentations that are related to real-life scenarios to engage students in solving problems. About 45% of the respondents disagreed that students' engagement in discussion forums in Moodle has developed their ability to think critically.

Furthermore, 74.3% (Table 20) of the respondents disagreed that they encourage students to use the quick messaging tool to share some thoughts and perspectives with online course participants. About 65% of the respondents disagree that their course provides videos related to real-life scenarios to develop problem-solving skills among students. More than half of the respondents (51.4%) disagreed that their course includes web links to articles related to real-life scenarios to engage students in solving problems.

Table 20

The Use of Moodle to Develop Problem-Solving Skills

Development of problem-solving skills	Strongly agree %	Agree %	Uncertain %	Disagree %	Strongly Disagree %	Total %
Online tasks submitted for grading show evidence that using Moodle at NUST has promoted students' rational thinking.	0.0	71.4	5.7	22.9	0.0	100.0
Online tasks submitted for grading show evidence that the use of Moodle at NUST has promoted independent thinking.	0.0	68.6	14.3	17.1	0.0	100.0
Moodle as an LMS at NUST allowed students to seek multiple paths to analyse problems.	0.0	80.0	14.3	5.7	0.0	100.0
Students' engagement in discussion forums in Moodle has developed their ability to think critically.	5.7	40.0	8.6	45.7	0.0	100.0
Encourage students to use the quick messaging tool to share some thoughts and perspectives with online course participants.	0.0	17.1	0.0	74.3	8.6	100.0
Assignments are set in such a way as to challenge students to solve authentic workplace-related issues.	5.7	88.6	2.9	2.9	0.0	100.0
Students are required to submit additional activities to promote real-time problem-solving based on particular units.	2.9	77.1	0.0	20.0	0.0	100.0

Table 20 Continued

Table 20 Continued

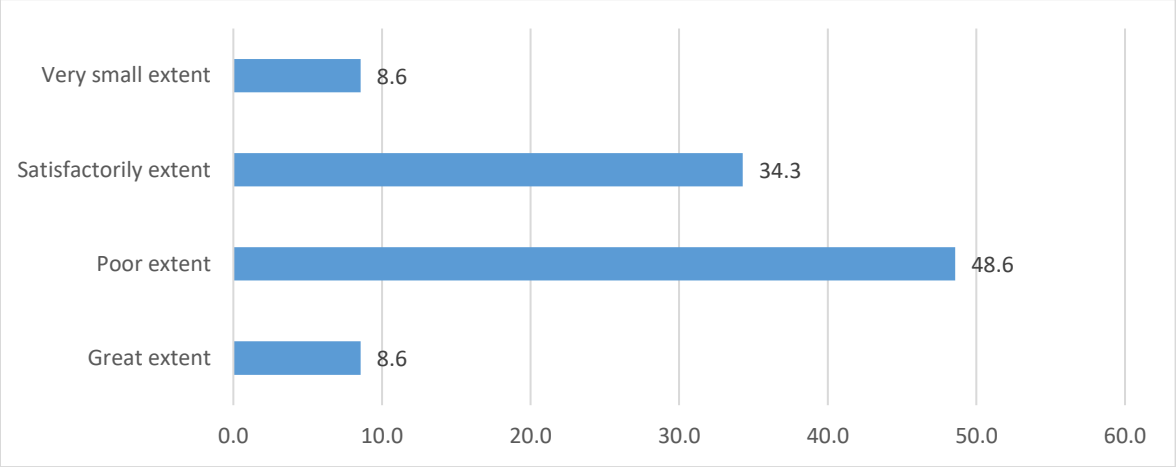
Development of problem-solving skills	Strongly agree %	Agree %	Uncertain %	Disagree %	Strongly Disagree %	Total %
The course provides videos related to real-life scenarios to develop problem-solving skills among students.	2.9	25.7	2.9	65.7	2.9	100.0
The course provides web links to articles related to real-life scenarios to engage students in solving problems.	2.9	4 2.9	0.0	51.4	2.9	100.0
The course provides PowerPoint presentations on real-life scenarios to engage students in solving problems.	5.7	88.6	0.0	5.7	0.0	100.0

Respondents were asked to what extent the use of Moodle as an LMS led to increased problem-solving abilities among students in their classes. Respondents had the option to select Great extent ‘4’, Satisfactory extend ‘3’, Very small extent ‘2’, and Poor extent ‘1’.

Figure 32 shows that about 48% of the respondents reported that using Moodle as an LMS led to increased problem-solving abilities among students in their classes.

Figure 31

Respondents by Use of Moodle Led to Increased Problem-Solving Skills at NUST



The following section presents the inferential statistics of Spearman's rho correlations as a non-parametric test.

4.8 Non-parametric Correlations: Spearman's rho Correlations: Students

This section presents Spearman's rho correlations of student statistics.

A Spearman's rho Correlation

A Spearman's rho correlation was computed to assess the relationship between the students' level of responsiveness using Moodle tools and students' level of communication using Moodle. Table 21 shows a weak positive nonsignificant correlation of .143 (p = NS) between the two variables.

Table 21

Correlation between Students' Level of Responsiveness in Using Moodle Tools and Student's Level of Communication Using Moodle

			Students' level of responsiveness in using Moodle tools	Students' level of communication using Moodle.
Spearman's rho	Students' level of responsiveness in using Moodle tools	Correlation Coefficient	1.	.143
		Sig. (2-tailed)	.	.132
		N	113	113
	Students' level of communication using Moodle.	Correlation Coefficient	.143	1.
		Sig. (2-tailed)	.132	.
		N	113	113

The Spearman's rho correlation was computed to assess the relationship between the level of students' responsiveness using Moodle tools and the level of students' course engagement using Moodle. Table 22 shows a weak positive nonsignificant correlation of .173 (p = *NS*) between responsiveness in using Moodle tools and whether the use of Moodle has increased course engagement opportunities.

Table 22

Correlation between the Level of Students' Responsiveness Using Moodle Tools and Students' Level of Course Engagement Using Moodle

			Level of Students' Responsiveness in using Moodle Tools	Students' Level of Course Engagement Using Moodle
Spearman's rho	Level of Students' Responsiveness in using Moodle Tools	Correlation Coefficient	1.	.173
		Sig. (2-tailed)	.	.068
		N	113	113
	Students' Level of Course Engagement Using Moodle	Correlation Coefficient	.173	1.
		Sig. (2-tailed)	.068	.
		N	113	113

According to Table 23, Spearman’s rho correlation assessed the relationship between the level of students' responsiveness using Moodle tools and students’ development of problem-solving skills. There was a very low positive nonsignificant correlation of .135 (p = NS) between the responsiveness in using Moodle tools and whether the use of Moodle has increased problem-solving skills.

Table 23

Correlation Between the Level of Students' Responsiveness Using Moodle tools and the Development of Problem-Solving Skills

			Level of Students' Responsiveness Using Moodle tools	Students’ Development of Problem-Solving Skills
Spearman’s rho	Level of Students' Responsiveness Using Moodle tools	Correlation Coefficient	1.	.135
		Sig. (2-tailed)	.	.155
		N	113	113
	Students’ Development of Problem-Solving Skills	Correlation Coefficient	.135	1.
		Sig. (2-tailed)	.155	.
		N	113	113

Table 24 shows the Spearman’s rho correlation between students’ level of communication using Moodle and the students’ level of course engagement. The two variables had a low positive significant correlation of .411 (p = <.001). A positive correlation indicates that when one variable increases, the other increases. As such, when the level of communication using Moodle increases, the level of course engagement of students also increases.

Table 24

Correlation Between students' Level of Communication using Moodle and the Students' Level of Course Engagement

			Students' level of Communication using Moodle	Students' Level of Course Engagement using Moodle
Spearman's rho	Students' Level of Communication using Moodle	Correlation Coefficient	1.	.411**
		Sig. (2-tailed)	.	<.001
		N	113	113
	Students' Level of Course Engagement using Moodle	Correlation Coefficient	.411**	1.
		Sig. (2-tailed)	<.001	.
		N	113	113

Note. **. Correlation is significant at the 0.01 level (2-tailed).

Table 25 shows a Spearman's rho correlation to examine the relationship between students' level of communication using Moodle and students' development of problem-solving skills using Moodle. There was a statistically significant positive correlation between the two variables, r_s (.46) p = <.001, n = 113. As such, when students' level of communication using Moodle increases, students' level of problem-solving also increases.

Table 25

Correlation Between Students' Level of Communication and Development of Problem-Solving Skills

			Students' Level of Communication	Students' Development of Problem-Solving Skills
Spearman's rho	Students' Level of Communication	Correlation Coefficient	1.000	.459**
		Sig. (2-tailed)	.	<.001
		N	113	113
	Students' Development of Problem-Solving Skills	Correlation Coefficient	.459**	1.000
		Sig. (2-tailed)	<.001	.
		N	113	113

Note. **. Correlation is significant at the 0.01 level (2-tailed).

Table 26 shows a Spearman's rho correlation that was computed to examine the students' level of course engagement using Moodle and the development of problem-solving skills using Moodle. There was a significant low positive correlation between the two variables, r_s (.41) p = <.001, n = 113. As such, when students' level of course engagement using Moodle increases, their level of problem-solving skills development also increases.

Table 26

Correlation Between Students' Level of Course Engagement Using Moodle and the Development of Problem-Solving Skills Using Moodle

			Students' Level of Course Engagement Using Moodle	Development of Problem-Solving Skills Using Moodle
Spearman's rho	Students' Level of Course Engagement Using Moodle	Correlation Coefficient	1.000	.413**
		Sig. (2-tailed)	.	<.001
		N	113	113
	Development of Problem-Solving Skills Using Moodle	Correlation Coefficient	.413**	1.000
		Sig. (2-tailed)	<.001	.
		N	113	113

Note. **. Correlation is significant at the 0.01 level (2-tailed).

4.9 Non-parametric Correlations: Spearman's rho Correlations: Lecturers

This section presents Spearman's rho correlations of Lecturers' statistics.

A Spearman's rho Correlation

Table 27 shows a Spearman's rho correlation to examine the relationship between Lecturers' level of communication using Moodle and Students' development of problem-solving abilities using Moodle. There was a nonsignificant low positive correlation between the two variables, r_s (.301) p = ns, n = 35.

Table 27

Correlation Between Lecturers' Level of Communication Using Moodle and Students' development of Problem-Solving Skills Using Moodle

			Lecturers' level of communication using Moodle	Students' development of problem-solving abilities using Moodle
Spearman's rho	Lecturers' level of communication using Moodle	Correlation Coefficient	1	.301
		Sig. (2-tailed)	.	.079
		N	35	35
	Students' development of problem-solving abilities using Moodle	Correlation Coefficient	.301	1
		Sig. (2-tailed)	.079	.
		N	35	35

Table 28 shows Spearman's rho correlation to examine the relationship between lecturers' level of communication using Moodle and their level of responsiveness using Moodle as an LMS. There was a significant and very low positive correlation between the two variables, r_s (.374) p = <.001, n = 35. As such, when the lecturers' level of communication using Moodle increases, the level of students' responsiveness using Moodle also increases.

Table 28

Correlation between Lecturers' Level of Communication Using Moodle and Level of Students' Responsiveness Using Moodle as an LMS

			Level of Lecturers' Communication using Moodle.	Level of Students' Responsiveness using Moodle as an LMS
Spearman's rho	Increased communication using Moodle.	Correlation Coefficient	1.	.374*
		Sig. (2-tailed)	.	.027
		N	35	35
	Responsiveness using Moodle as an LMS	Correlation Coefficient	.374*	1.
		Sig. (2-tailed)	.027	.
		N	35	35

*. Correlation is significant at the 0.05 level (2-tailed).

Table 29 shows a Spearman's rho correlation to examine the relationship between lecturers' level of responsiveness to using Moodle as an LMS and students' development of problem-solving skills using Moodle. There was a nonsignificant correlation between the two variables, r_s (.076) p = NS, n = 35.

Table 29

Correlations between Lecturers' Responsiveness Using Moodle as an LMS and Students' Problem-Solving Skill Development Using Moodle

			Lecturers' responsiveness using Moodle as an LMS	Students' Problem-solving skill development using Moodle
Spearman's rho	Lecturers' Responsiveness using Moodle as an LMS	Correlation Coefficient	1.	.076
		Sig. (2-tailed)	.	.664
		N	35	35
	Students' Problem-solving skill development using Moodle	Correlation Coefficient	.076	1.
		Sig. (2-tailed)	.664	.
		N	35	35

The following section presents the Chi-square results to show the relationship between categorical data related to students' data.

4.10 The Pearson's Chi-Square Results -Students

The Chi-Square statistic is most commonly used to examine the Tests of Independence when employing a crosstabulation (also known as a bivariate table). Crosstabulation displays the distributions of two categorical variables at once, with the categories of the variables' crossings shown in the table's cells. By contrasting the observed pattern of cell responses with the pattern that would be anticipated if the two factors were actually independent of one another, the Test of Independence determines if there is a link between the two variables. The Chi-Square statistics are computed and compared to a critical value drawn from the Chi-Square distribution to determine if the observed cell counts deviate considerably from the predicted cell counts (Kothari, 2007).

The following assumptions are applied for the Chi-square Test of Independence:

- #Assumption 1: Nominal or ordinal scales should be used to assess two variables (i.e., categorical data).
- #2 Assumption: Your two variables should be divided into two or more distinct category groupings.

The following formula applies when the Chi-square test of Impendence is applied.

Pearson's chi-square (*X2*) is the test statistic for the Chi-square test of Independence:

$$X^2 = \sum \frac{(O - E)^2}{E}$$

Where

- X^2 is the chi-square test statistic
- Σ is the summation operator (it means "take the sum of")
- is the observed frequency
- E is the expected frequency

A Chi-Square Test of Independence was performed to assess the relationship between gender and mode of study. There was no statistically significant relationship between gender and mode of study, *X2* (2, N = 113) = 4.64, *p* = .098.

A Chi-Square Test of Independence was performed to assess the relationship between gender and the type of device to access Moodle. There was no statistically significant relationship between gender and type of device to access Moodle, *X2* (2, *N* = 113) = 4.65, *p* = .10.

A Chi-Square Test of Independence was performed to assess the relationship between gender and access to reliable internet. There was no statistically significant relationship between gender and access to reliable internet, *X2* (4, *N* = 113) = 5.74, *p* = .22.

A Chi-Square Test of Independence was performed to assess the relationship between gender and the effective use of Moodle. There was a statistically significant relationship between gender and effective use of Moodle, *X2* (4, *N* = 113) *X2*= 43.65, *p* = < .001.

A Chi-Square Test of Independence was performed to assess the relationship between age and effective use of Moodle. There was a statistically significant relationship between age and the effective use of Moodle, *X2* (4, *N* = 113) *p* = 39,73 < .001.

A Chi-Square Test of Independence was performed to assess the relationship between age and the mode of study. There was a statistically significant relationship between age and the mode of study, $X2$ (1, N = 113) p = 39.73, < .001.

The following section discusses the findings of the semi-structured interviews, starting with the demographic details and the respondents.

4.11 Qualitative Data

Demographic Details of Interviewees

Table 30 presents the department's demographic details and the respondents who participated in the semi-structured interviews.

Table 30

Department/Unit/School by Gender

Department/Unit/School	Gender		
	Female	Male	Total
Instructional Designers	1	0	1
Educational Technologist	1	0	1
Distance Education Coordinators	1	1	2
Faculty: Lecturers	1	1	2
Systems Analysts	0	1	1
Total	4	3	7

Table 31 presents the age groups by gender of the interview participants.

Table 31

Age by Gender

Age groups	Gender		
	Female	Male	Total
20-25 years	0	1	1
26-30 years	0	0	0
31-35 years	0	0	0
36-40 years	0	1	1
41-45 years	1	0	1
46-50 years	0	0	0
51+	3	1	4
Total	4	3	7

The themes that emerged from the findings of the interviews formed five pillars to guide the presentation of data. The results of the analysis of the semi-structured interviews are presented in the next section.

Presentation of Qualitative Findings: Finding of Semi-structured Interviews

The questions that guided the qualitative dimension of the present investigation and informed data collection are:

- **Research question 2:** What signifying factors affect blended learning using Moodle at NUST?
- **Research question 6**: What strategies can be adopted by NUST to increase the effective and safe use of Moodle as an LMS?

Semi-structured interviews were conducted with one instructional designer, one educational technologist, two distance education coordinators, two lecturing staff members and one system analyst following an interview guide (Appendix C). An interview guide (Appendix C) was developed and used to inquire about the respective respondents' perceptions of the signifying factors that affect blended learning at the research site and suggestions on how to increase the effective use of Moodle at NUST. The same interview guide presented the interviews of all participants. However, questions were contextualised based on each participant's position at the university and the specific nature of individual support respondents offered at their respective units and faculties to evaluate the effective use of Moodle as a learning management system at NUST.

As a result of thematic analysis (Braun & Clarke, 2006), explained in Chapter three, the following five themes emerged from the findings of semi-structured interviews. The themes were: Theme 1: Availability of human capital to offer technical support, Theme 2: Course design, teaching, learning and assessment, Theme 3: Security vulnerabilities in Moodle, Theme 4: Communication opportunities, Theme 5: Strategies to improve the effective use of Moodle as an LMS.

Table 32 presents the themes and emergent categories established from the transcripts of the interviews.

Table 32

Themes that Emerged from Research Findings Based on the Semi-Structured Interviews

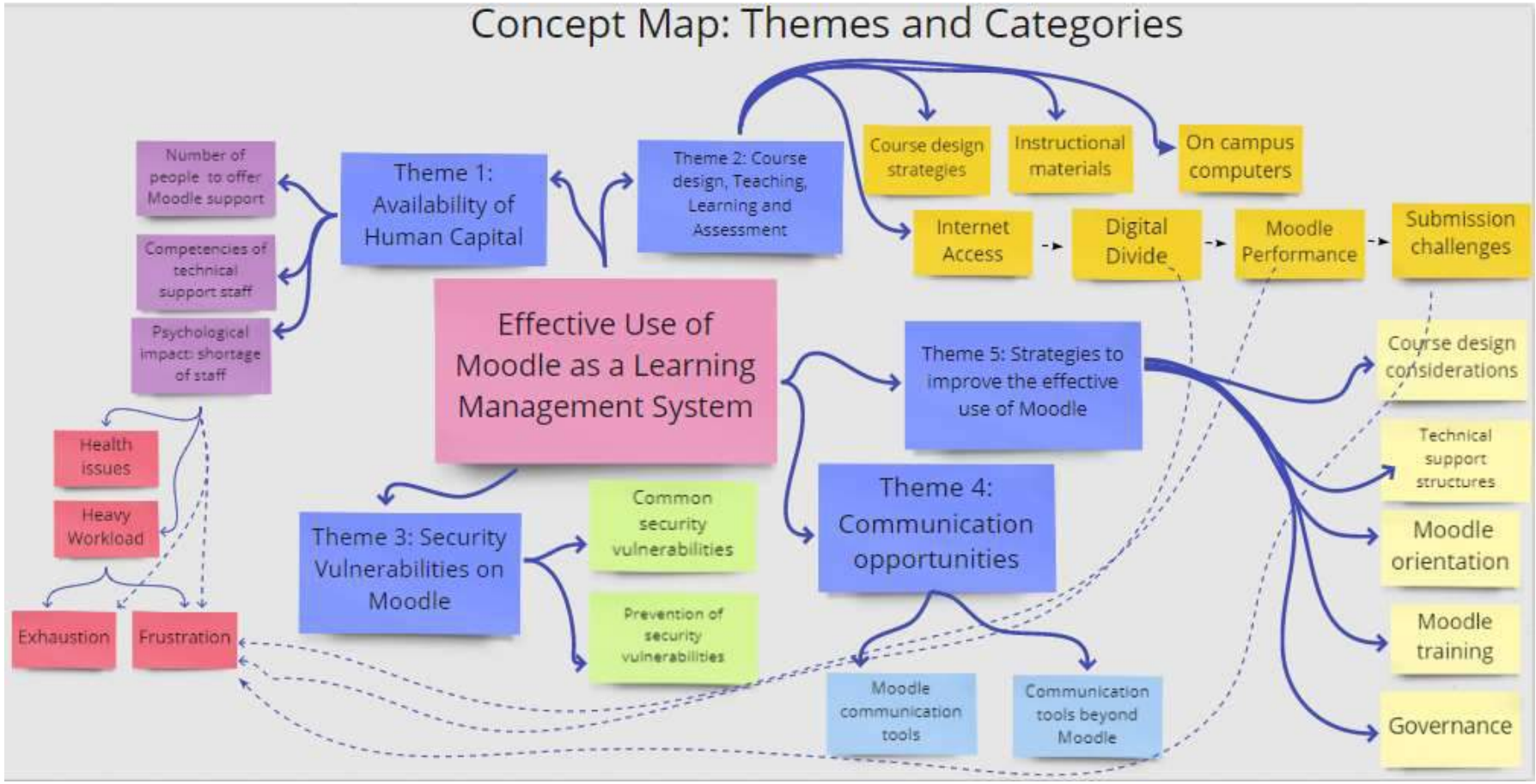
Name of Theme	**Name of Categories for the Theme**	**Corresponding Research Questions**
Theme 1: Availability of Human Capital to Offer Technical Support	• Number of people available to offer Moodle support • Level of competency of technical support staff o The psychological impact of the shortage of staff: Health issues, workload implication, exhaustion o Cancellations of online assessments o Role conflictions	Research Question 2: What signifying factors affect blended learning at NUST?
Theme 2: Course Design, Teaching, Learning and Assessment	• Course design strategies • Instructional Materials • On campus computers o The psychological impact of the Internet access challenges o Digital divide challenges o Moodle performance challenges o Submission challenges	Research Question 2: What signifying factors affect blended learning at NUST?
Theme 3: Security Vulnerabilities on Moodle	Common security vulnerabilities Prevention of security vulnerabilities	Question 6: What are the strategies to improve the safe use of Moodle?
Theme 4: Communication Opportunities	Moodle communication tools Communication tools beyond Moodle	Question 4: What impact does the use of Moodle at NUST have on students' communication?
Theme 5: Strategies to Improve the Effective	• Course design considerations • Strengthening of technical support structures:	Question 6: What are the strategies to improve the effective use of Moodle?

use of Moodle as an LMS	o Afterhours support opportunities; o Deployment of technical skillset across faculties/units • Strengthening Moodle orientation and training • Governance	

The following concept map visualises the main themes and sub-themes that emerged from the interview findings.

Figure 32

Concept Map to Guide the Presentation of Interview Findings



Theme 1. Availability of Human Capital to Provide Technical Support

Participants were asked to comment on the availability of human capital to offer timely technical support at NUST. The availability of human capital to provide technical support relates to the number of people to provide technical support, the competencies of technical support staff and the psychological impact of the staff shortage. The findings on these categories are presented next.

Sub-theme 1.1 - Number of People to Offer Technical Support. There was a general agreement that the number of staff responsible for offering technical support to Moodle users at NUST is insufficient. Regarding the offering of technical support, it was commented that: '*The only centre or learning unit that is responsible for the technical support at NUST, is actually TLU… there's only three people full time employed, which makes it very difficult for them to give technical support in time.' (Academic Coordinator 1).*

From a lecturer's viewpoint, the following was commented: *'The human capital available is far too low. There is only two people. When you try to contact them, they only respond hours after the fact.*' An educational technologist based at the Teaching and Learning Unit and responsible for offering technical support to lecturers commented as follows: *'Our unit is understaffed. We only have two full-time staff members.' (Educational technologist)*

One participant was convinced that the staff shortage could have been resolved already, as he believed that the decentralised Moodle support was a request already tabled. It was explained that COLL requested TLU to transfer some skills to critical people outside TLU to alleviate the pressure from the TLU support team. If skills could be transferred over to other colleagues within sub-departments of the university, every section would be able to do minimal work without contacting the TLU section for support. Such a move would allow COLL to deal with technical issues themselves. Administrative Coordinator 2 commented:

'So, Uhm, there's a time that we had requested from that unit certain functions of e-learning; how they operate, how they can set up so that we were able to do certain things on our own without really necessarily having to depend and rely on their availability…' (Administrative Coordinator 2)

Thus, the COLL team's desire to transfer technical skills to other departments could relieve the duties of TLU. At the same time, knowledge is stretched wide enough to cater to the entire university quickly. Even though an invitation was issued to TLU, the request to decentralise services was never realised.

On a brighter tone, the systems analyst confirmed that the staff complement at DICT is sufficient to solve any issue on the back-end system and at the operating system level of Moodle where a specific task needs to be performed. Once a problem is met, it is usually sorted within hours due to sufficient knowledge of the back-end system and related technical expertise to run a learning management system. He commented:

'For example, last week, there were some issues on Moodle where some files consumed the disk usage space. We were therefore tasked to increase the size of the file system. We worked until seven o'clock in the evening to fix the issue.'

Sub-theme 1.2: Level of Competency of Technical Staff. Although all participants agreed that TLU has a staffing shortfall, an interesting statement was made about the support team's degree of proficiency.

Lecturer 1 commented: '*Although they are very committed, the staff is overworked. They are always willing to help us lecturers, but they cannot independently run the entire e-learning platform.* However, lecturer 2 held an opposing view and commented:

'... even if you reach the person, they might not always be able to help you with the problem ...actually, in most cases, if I have a technical issue, they had to go and play around and still look for how, how, how the error could be corrected. And in my view, they do not always have enough knowledge…' (Lecturer 2.)

The response of Lecturer 2 revealed unmet expectations. In addition, she is of the opinion that technical staff did not always have the solutions to problems which may be construed that technical support staff lacking sufficient technological know-how to solve issues promptly. The interview brought up another fascinating observation, and the Instructional Designer commented: *'The Teaching and Learning Unit has the technical knowledge and expertise to provide effective support. Nevertheless, their main responsibilities lie with lecturers, and not directly with students.'*

Supporting evidence was provided that the technical support team does not have direct responsibility for students; their responsibility is towards lecturers. While the distance education unit, COLL, has employed several student support officers, it came to light that the available student support staff lack the necessary technical expertise to provide technical support to students on Moodle-related matters. Nonetheless, an agreement was reached that a dedicated student support team provide general student support. At the same time, the lecturers took on the role of offering student support to both full-time and part-time students at NUST.

It was discovered that human capital includes the number of individuals available to give technical help and the essential skills to provide technical support to Moodle users. The instructional designer agreed about the importance of timely technical support being available to online students. She mentioned that:

'...human capital is still lacking. Human capital does include the number of staff employed and the expertise and knowledge of these

employees to provide effective technical support. NUST does not have a dedicated unit that only deals with technical support.'

There was a general agreement about the shortage of staff at the TLU to offer timely technical support to all Moodle users at NUST. It is difficult for two people to serve the entire university to provide technical support to staff and students. It is worth mentioning that the third person attached to the Teaching and Learning Unit was the acting director. Although he had a management position, he also offered training to staff and technical support, depending on his availability. When it comes to the availability of human capital, the number of people and the expertise and knowledge of these people to offer technical support effectively are both vital.

Another challenge identified as a significant issue as experienced by one participant and transpired from the interview findings had been identified as 'role conflicts.' Due to a shortage of technical skills to work on Moodle, the examination department's responsibilities were added to the administrative coordinators' responsibility at COLL. Concerns were raised that the examinations department lacked experience and knowledge on how Moodle works, and the following were commented:

'Uhm, they have no slightest clue on how to access or how to retain marks for capturing, and that is an examination function, not a COLL function per se unless agreed otherwise. The examination department really needs to get on the Moodle boat.'

Furthermore, the systems analyst was asked whether he was aware of challenges students were facing regarding Moodle technical support; he commented:

'We, from the back-end side, are not that involved in the assistance of students. Yet, I have heard of certain instances. For example, last year, the emergence of

COVID had forced the suspension of formal face-to-face classes in favour of Moodle as the primary learning tool.'

Both responses by the systems analyst provided evidence that working overtime may sometimes be required from his department as well. However, due to their expertise and sound knowledge of the back end of Moodle, issues were addressed immediately and usually solved within a few hours. He confirmed that the outbreak of Covid during 2020 resulted in a forced shift to accept Moodle as the primary learning tool.

The next sub-theme that emerged from the data was categorised as the psychological impact of a shortage of staff and is discussed in the following section.

Sub-theme 1.3: Psychological Impact of a Shortage of Staff. The challenges faced by TLU regarding offering timely support to staff and students affected the human resources in various ways. Participants were asked to share their experiences regarding technical assistance after hours. The following sub-sub themes emerged as direct consequences of a staff shortage: Health issues due to a demanding workload. The next section provides evidence of the lack of staff on health, particularly the psychological impact of staff shortages.

Sub-sub-Theme 1.3.1: Health Issues. The educational technologist was asked how she coped with such high demands of technical support on a daily basis, and she commented:

'Last year, I was so inundated by work that I had to work after-hours and had to attend to calls outside working hours, such as at home or over weekends. I, therefore, got very sick at times and even had to work till all odd hours of the morning.' (Educational technologist)

It came to light that the university did not have a strategy to avail after-hours technical support on the Moodle LMS to Moodle users. The educational technologist was unaware of any plan to serve Moodle users after hours. The following comments were made:

'Honestly, I really don't know, because last year, myself and other colleagues just did it on our own. It was too overwhelming, and people are still complaining… It is unfair to expect the same two people to work during the day and after-hours.'

Findings revealed high demands of ongoing technical support were required for after-hours during the week and weekends. This phenomenon, however, resulted in health issues. As a member of the support team, she complained that her demanding workload impacted her health negatively. Moreover, as one of the members to provide Moodle technical support, the educational technologist felt that she had already gone the extra mile to provide after-hours support, but the expectations of Moodle users were not met due to the high demand for work. She found the experience of non-stop work overwhelmingly.

In addition to the high demands of ongoing technical support and subsequent health issues the support staff was battling, the interview finding revealed that the heavy workload led to exhaustion and frustration. The findings of the topics, exhaustion and frustrations as implications of a demanding workload are presented next.

Sub-sub-Theme 1.3.2: Exhaustion. Participants were asked to comment on their current workload. Coordinator 1 indicated that she was responsible for coordinating assessments and uploading course tutorial letters on behalf of tutor markers in their unit.
Another responsibility that occupied administrative coordinators' time was ensuring the availability of Moodle quizzes/tests. It appeared that tutor marker would email quizzes to the administrative coordinator, who then uploaded such assessments on Moodle. It transpired that the workload of the administrative coordinators at COLL seemed to be too demanding. Consequently, employees were exhausted and thought about the option of leaving the department. She proclaimed:

'Ya workload is too much. The workload is too much. One person cannot handle 100 courses…And this is only in the hands of two people. It's 200 courses. Yeah, we experience exhaustion. That's why I'm gonna leave…' (Administrative Coordinator 1)

Coordinator 2 remarked that he did not have a life anymore due to his ongoing office responsibilities and proclaimed: '*So, we've had sleepless nights, working over weekends, where you do not have a life anymore, but because you need to perform this function on behalf of the examinations department…'*

Interview findings revealed that the technical support team at TLU suffered phycological effects in the form of ill-health and being overwhelmed due to a demanding workload. In addition to this, frustration emerged as a second consequence of a demanding workload. Findings on the topic of frustration are presented next.

Sub-sub-Theme 1.3.3: Frustration. Workload-related frustrations were detected during the engagement with the instructional designer, who commented that student support officers and instructional designers alone were in charge of offering technical support amidst their various other responsibilities. There was often a delay in delivering aid to the students due to role conflict and described as:

'Students are most inclined to sidestep their lecturers to contact these support officers or instructional designers. However, these people are committed and willing to assist. I believe technical support is lacking on the side of the lecturers. A lot of us also lack the critical skills to provide this support.' (Instructional Designer)

The following response provided evidence regarding the consequences of not having the desired technical support on time, and Administrative Coordinator 1 commented:

'They also don't work over weekends. And at times then, we had to, for example, cancel an assessment because of that issue. Or we just could not assist the student. Um, actually online support, as we've seen during the past year. Actually, and the technical support thereof is actually a 24-hour thing.'

The responses of the two administrative coordinators provided traces of frustration, which was emphasised by the pitch of their voices when they expressed themselves. Furthermore, Lecturer 2 said the need and the expectation that after-hours support was welcomed, despite her decision not to seek support after hours.

'I personally try only to seek support during office hours… sometimes you know we work on a Sunday afternoon to prepare for something on Monday because it's the teaching profession and it is not like from eight to five always…it would be very useful if our technical staff could also be available after-hours.' (Lecturer 2)

Due to the nature of the lecturer's job, she needed to work after hours and agreed that technical support after hours would be helpful.

The excerpt above provides evidence of workload frustration and role conflict experienced by the lecturing staff, instructional designers, student support officers and administrative coordinators, who may lack the critical skills to provide students with the necessary technical support services.

Being involved in a technical or student support capacity, staff members at DICT, COLL, TLU and faculty needed to work after-hours. DICT needs to ensure that the system is always fully operational. TLU needs to provide technical support to Moodle users. Faculty requires to provide academic support to full-time and part-time students, and COLL has to

provide general student support (COLL) to distance students. The above warrants the availability of staff to work after-hours if required.

The next sub-sub theme that emerged from the interview findings was categorised as cancellations of assessments resulting from frustration, as presented in the next section.

Sub-sub-Theme 1.3.4: Cancellations of Assessments. The provision of technical support services was identified as a dire need since online assessments were conducted. As COLL was responsible for the learning needs of distance education students, examinations were scheduled after hours to create flexible opportunities for distance students to engage in such assessments. The unavailability of a dedicated technical support team to offer technical assistance during online examinations resulted in cancelled assessments if technical support staff could not be reached.

It was reported that: *'Most of our courses or assessments are running in the evenings. That's when the distance student is actually able to do these assessments.' (Administrative Coordinator 1).*

> *'...if not, when that phone call that I am now placing is not answered. Then the support is not rendered…it will then result in a trickle-down effect on my operations, being halted generally, or cancellations.' (Administrative Coordinator)*

A follow-up remark was made that confirmed that if the technical support team were not available to offer technical support services beyond regular work hours, assessments were cancelled as administrative coordinators lacked the expertise to deal with Moodle technical glitches.

The findings of Theme 2 are presented next and relate to the requirements for successfully delivering teaching, learning and assessment in a blended learning environment. The items pertaining to Theme 2 were categorised as course design, availability of instructional

materials, availability of on-campus computers, internet access and digital divide challenges. Additionally, items such as Moodle performance and submission challenges also emerged as categories under Theme 2. Interview findings regarding the design and structure of online courses are presented next.

Theme 2 – Course Design, Teaching, Learning and Assessment

Sub-theme 2.1: Design and Structuring of an Online Course. The following was commented: *'It looks like each faculty has their own template for online course designs. Every time we try to introduce a new template, some lecturers may not be comfortable moving forward therewith. They want to use old templates.' (Educational technologist)*

Interview findings revealed that resistance to change had been a challenge, as mentioned by Lecturer 1, who commented that an attitude of resistance to change was prevalent in the faculty. He proclaimed: '*There is a common resistance to change within the staff.'* Furthermore, it was revealed that the faculty mainly uploaded content using tools such as Files and Folders with little emphasis on the course structure as described by the instructional designer. *'Faculty provides students with entire contents at once. On the other hand, COLL structures their content of fully online courses into weekly divisions to allow students to keep up with the course'.* Furthermore, the findings revealed that the students were granted access to Moodle books, activities and discussions. The instructional designer commented that:

> *'This effective structure allows students to acquaint themselves with the unit outcomes and materials. We present our fully online courses in a weekly format accompanied by activities to ensure that students actually study and engage with the work instead of merely reading it. There is thus a definite difference between content structuring of the faculty and that of COLL.'*

Furthermore, the educational technologist commented: '*there is no strict enforcement regarding a specific design template. Basically, the lecturers are free to design whatever they want.'*

Interview findings revealed that the design and structure of Moodle courses differ from faculty to faculty. It also came to light that new templates for course design had been proposed, yet, the initiative was not well accepted by faculty, as it was preferred to keep to the old template. Adopting the new course design template was optional, allowing faculty to rely on their discretion in terms of the design and structure of Moodle courses. The stance faculty took not to adopt new course design templates revealed traces of resistance to change, according to Lecturer 1. Next, the findings on the availability of instructional materials as a requirement of teaching, learning and assessment in blended learning environments are presented.

Sub-theme 2.2: Availability of Instructional Materials. Participants were asked to comment on the institution's strategy to create and upload stimulating instructional materials on the Moodle platform. The instructional designer described the process and parties involved in developing instructional materials at COLL. She mentioned that NUST employed a course development team to develop effective instructional course material. This team consisted of coordinators and instructional designers with the knowledge and expertise required for course development. They used the team approach and relied on the services of course writers, content editors, language editors and quality assurers. She proclaimed:

> *'Our team always ensures that the courses are aligned with the syllabus. Material is never outdated as it is revised every three years. The best writers are recruited for a specific course, in terms of knowledge and expertise.' (Instructional Designer)*

The COLL placed great emphasis on the capacity to ensure the availability and expertise of instructional designers, course writers (subject matter experts) and content editors. She proclaimed:

> *We need to train them to be able to design and develop these online materials specifically for Moodle. Then again, we have our facilitators or our instructors or our marker tutors. They're also supposed to be trained on how to upload material...' (Coordinator 1).*

It was reported that the instructional design team at COLL and the TLU engaged in several workshops that facilitated the design of instructional material. Such interventions equipped the academic staff with the skills and knowledge needed to create quality materials and stimulate Moodle students. Lecturer 1 reported that he integrated YouTube videos with his online teaching via Moodle to promote the learning process and commented:

> *'Personally, I use a YouTube video as an introduction, or I would let the students briefly present a topic before we begin with the class. This is done to build their self-confidence and interest in the subject matter. I allow them to work in groups and then subsequently assess each other.' (Lecturer 1)*

On the other hand, Lecturer 2 felt that she could present stimulating instructional material due to her experience gained through completing an online certificate offered through TLU.

> *'Okay, I know that TLU is offering Moodle short courses. I did an online certificate through TLU. And that is done through those courses, I would assume. And they usually offered every semester.' (Lecturer 2)*

The coordinators and the instructional designer agreed that quality and stimulating instructional materials were developed at COLL with the mandate to offer instruction*al* materials to distance education students. Lecturer 1, on the other hand, reflected on his approaches to ensure that lessons were stimulating. However, no reference was made to any strategy used by faculty to ensure that enabling instructional materials are created and uploaded on the Moodle platform. Clear evidence was presented that efforts employed by TLU to capacitate faculty in content development through training and short courses were appreciated.

The third theme as a requirement for a blended learning offering has been identified as access to learning resources, which emerged due to concerns that students dropped out of courses during the 2020 academic year when the institution migrated to Moodle. During this period, face-to-face teaching was halted directly due to the coronavirus disease of the 2019 (COVID-19) pandemic outbreak.

Sub Theme 2.3: The Use of On-Campus Computers to Access Learning Resources. Participants were asked to comment on the university's strategy to provide access to online learning resources. Participants agreed that several laboratories and ICT rooms could be found on the university premises. Still, the usage of those facilities was a problem, especially considering who would be liable for any damage or loss of equipment to those laboratories. It was reported that the campus control kept tight surveillance on access to those facilities. Regarding the availability of labs, Coordinator 2 raised the concern: '…*because of historical background loss or damage within these facilities, the campus control or faculties responsible for these venues that have those facilities really try to only make them available to students within faculty*.'

Labs were not easily accessible to students, except for students who were part of the faculties attached to those facilities. Distance education students did not have access to those facilities at all. During library hours, students were allowed to use computers available in the

library. However, only a certain percentage of computers were available to students at the library. Coordinator 2 explained: '*The library…It's a pity that most of the time, uh, a number of…almost 30 to 40% of these computers are not functioning well or students have to struggle with logging on to those devices.'*

The reason for the unavailability of library computers was ascribed to technical and login issues. Next, the category that emerged under Theme 2 was identified as access to the internet.

During the interviews, it came to light that issues such as internet access, lack of devices, the digital divide and e-learning readiness contributed heavily to students being deprived of accessing learning resources.

Thus, staff members at NUST were aware of students being exposed to situations where they did not have access to resources due to internet access challenges and issues related to the digital divide. Interview findings relating to internet access and the digital divide are presented next.

Sub-theme 2.4: Access to the Internet. A general perception was that some students were challenged with access to the internet when accessing learning resources, assignments and tests. Access to the internet had unanimously been indicated as a matter of concern. The interview findings revealed that the university entered into a deal with Telecom Namibia to provide wireless internet modems to students at an affordable price of N$300. Such devices were loaded with data every month. Namibia Students Financial Assistance Fund (NSFAF) loan holders' accounts were debited with the agreed amount for all first-year students. Students not funded by NASFAF had to purchase the device at the agreed amount. However, it came to light that the available data loaded onto such devices were insufficient to guarantee stable and reliable internet access throughout a given month. Consequently, students could not connect to the internet to access online learning resources and assessments.

In general, staff members appreciated the initiative taken by the university to negotiate with Mobile Telecommunications Limited (MTC) as an internet provider to avail affordable internet to students. However, students still had to wait for pages to load. This situation was reported to be cumbersome. Students may run out of data, or the time duration for online assessments may lapse due to the extremely poor connectivity influencing Moodle performance when accessing the platform off-campus or in remote areas where internet connections are not stable.

Despite deals concluded with MTC to provide students with the necessary off-campus access to the internet, a gap persisted due to insufficient data provision, the digital divide and online learning readiness. Coordinated 1 commented as follows:

> *'Some students said they never used their student Webmail. They never used um Microsoft Teams, and they hardly go onto Moodle. You know, so yeah, so that's why I'm saying I don't think we are ready because our students are not ready.'*

Coordinator 1 commented: '*I just wanna say that not all our students have access to online learning.'*

> *'We left out a lot of students last year, and we also had to return students, and even with the returning students, there were still some of those students that didn't have access to all the resources on e-learning…' (Coordinator).*

Evidence was provided that during the first and second semesters of 2021, students were challenged with not having access to the internet and reliable devices. Next, findings on the topics of the digital divide challenges are presented.

Sub-sub-theme 2.4.1: Digital Divide. The theme of the digital divide experienced by some students emerged. Despite students having been provided with affordable (albeit insufficient) wireless internet modems, they still did not have access to a device, such as a computer or a

laptop, to connect to the internet. The following excerpts provide evidence of the digital divide amongst students at the university.

> *Uhm, I think the university, after making a deal with Telecom to offer Internet devices, and that was assumed that all students could have access to the internet now. But if we are generally being honest, the digital divide is an invisible enemy. (Coordinator 2)*
>
> *I still believe that there is a lack of actual computer devices to allow internet access. The institution does make labs available to students on campus in various regions. Still, I suggest that NUST further looks into this problem, such as providing affordable laptops or devices to carry out schoolwork. (Instructional Designer)*

Staff members agreed that access to the internet and the digital divide deprived students of Moodle access at NUST. Interview findings on frustration with assessment submissions are presented in the next section.

Sub-sub-theme 2.4.2: Frustrations with Assessment Submissions. Online submission of assessments took the form of online tests and quizzes, online discussions and assignment submission. However, interview findings revealed frustrations in terms of online assignments or test submissions. With the use of the Turnitin plugin, the system ought to pick up plagiarism. However, it was reported that the system's settings only allowed submissions in Portable Document Format (PDF) and Word documents. The coordinator explained that students suffered psychologically when handwritten tests were submitted via Moodle as Turnitin Assignments but rejected by the system. He explained that students who reside in remote areas, such as Opuwo, a town located deep in the northern parts of Namibia, do not have any device that could connect to the internet. Such students had to borrow a smartphone from their neighbour to access the test questions. Once the student had access to the question, the

questions were answered by writing down the answer using pen and paper. Supposed the student took a picture of the response and uploaded it onto Moodle, the system would not pick up the submission; consequently, the assessment of the student would not be graded as the lecturer was unable to view such tasks and Coordinator 2 commented:

> *'The student remains adamant that he has submitted, so it's quite a frustrating issue with Moodle that it does not pick up or recognize picture submissions. And picture submissions have been a common thing. Um, over the past semester, because the students find themselves under really difficult circumstances. And for Moodle to not have a function to allow for such submissions to date, I think for me it's quite poor.'*

It was reported that handwritten assignments as test submissions via Turnitin created challenges both for students and lecturers. As such, the system does not recognise projects, and students' submissions cannot be graded. The following section discusses the category labelled as Moodle performance that emerged from interview findings.

Sub-sub-theme 2.4.3: Moodle Performance. The systems analyst explained that most performance issues with Moodle were associated with poor network access from the outside. Due to unstable or slow internet connections experienced by off-campus Moodle users, most students experienced problems loading pages. He commented: '*The online system requires internet access. Even if the system runs on the fastest hardware possible, poor network access from the outside will inevitably slow down performance.* Another response regarding the poor performance of the system was described as:

> *'My only concern relates to the tests on Moodle. The system can't carry our online assessments in an effective and timely manner.*

Assessments will sit in a queue for days until they are finally uploaded.' (Lecturer 1)

The issue of non-enrolled students was also brought up as another frustration caused by Moodle. Only when marks need to be submitted is it picked up that a student had access to the course through Moodle function 'non-enrolled.' Non-enrolled students' assessments are not accessible by the lecturer. He commented: *'I think it's a useless function on Moodle. Because what purpose does it serve if you're non-enrolled? Why are you there in the first place? Your academic advancement is halted somewhere because of Moodle*.'

Submission challenges emerged as a category under Theme 2, dealing with the frustrations with assessment submissions, the issue of the non-enrolled students and Moodle Manager's role clashes.

Assessment Submissions of Non-Enrolled Students. This issue was detected when students were already halfway through the course. It was reported that the function of Moodle allowing non-enrolled students into a class had created challenges for marker tutors and administrative coordinators.

Manager's Role to Multiple Support Staff Members. A final issue brought up regarding challenges with Moodle and described as a matter of concern by the administrative coordinators was the issue of assigning the role of Manager to specific team members, who generally assisted with the uploading of content. He commented:

...it's very puzzling that there is no control over those systems. Uhm, because of the number of individuals with the same managerial access to those courses, especially when most of them what their role would have been, was to just enrol students, for example.'

It was explained that the coordinators are responsible for uploading tests and then found out that a test date was changed by someone else. He commented:

> *'…change a date of a test or whatever really contradicts the work you've done because somebody else might have access to perform the same functions you have. So, it's really a problem if the coordinators and six other people have the same functions on the same course.'*

Furthermore, the interview findings showed that administrative coordinators and student support officers clashed in roles, functions and responsibilities. He commented:

> *'My colleague was completely baffled later on to find that, you know, the test was reopened, and sometimes this can be a really, really dangerous thing…or anybody else who has the same high-level function and have their brothers or cousins or whatever involved for those subjects. It's very, very simple to manipulate and have access to some of the functions that we would not want to have. So, some functions really, especially those managerial and tutor ones, need to be centralised, and they need to be seriously defined and assigned to a maximum of two individuals, not six.'*

The administrative coordinators raised three major concerns in the excerpts above (1) the frustrations of students who are not allowed to submit handwritten tests, (2) the issue of non-enrolled students in courses, and (3) the concern of an uncontrolled 'Manager' role assigned to an entire team of officers. Next, findings are presented regarding security issues experienced by Moodle users at NUST. This item emerged as Theme 3.

Theme 3: Security Vulnerabilities in Moodle

Participants were asked to comment on the effective and safe use of Moodle as an LMS at NUST in terms of data losses, the SQL Injection security risk and Cross-Site Scripting (XSS). The SQL Injection security risk is a high-risk vulnerability that allows attackers to perform SQL queries in the Moodle databases due to inadequate sanitisation of data supplied by users. The XSS attacks are responsible for common application-layer web attacks and target scripts embedded in a client's server page. The systems analyst described Moodle from the back-end as safe and free from security vulnerabilities: '*Along with every update we perform on the system, Moodle installs security updates. Backups are thus made of the Moodle instance to avoid the loss of data.'* Although no data loss had been experienced from the back-end, it was mentioned that data loss by a lecturer had been reported in the past. It was reported that:

> *'On the front end, I know of one instance where a lecturer installed a course from a backup and thereby lost the history of the course. We cannot do much about this because the system's configuration settings allow for overwriting of course material.' (Systems analyst)*

To avoid data loss, the TLU copies all courses and saves copies on the system as a form of the archive when course content is copied from one semester to the next. As such, a new course is then created with the old course material. It was mentioned that DICT had opposed the above strategy of the TLU as a significant number of resources inundated the system. He further commented: *'We make sure that we have sufficient backup capabilities available. We make sure we make backups before making upgrades and system movements.'* He suggested that the university could instead move to a total new instance of Moodle every few years. This way, the old system would then be kept as an archive system, accessible only to staff.

Sub-theme 3.1: Common Security Vulnerabilities for Tests and Assessments.

In addition to the vulnerabilities of Moodle as an open source, a new category, Common security vulnerabilities for tests and assessments, emerged as a sub-theme. This sub-theme relates to the interview question linked to the effective and safe use of Moodle as an LMS at NUST. Interview findings revealed security issues students experienced while they were taking online tests. Results related to unauthorised access to Moodle and logging-in challenges are presented next.

Unauthorised Access to Moodle Accounts. The university had been dealing with questions about a test that had been reserved for a particular student but had already been attempted by the time the account's rightful owner accessed the test. Several instances were reported where one student accessed a classmate's Moodle account to acquaint themselves with test questions. It was reported that if a student takes a test on behalf of another student, the test is never complete. He commented: *'There's never a mark. There's never a mark, and it's one of those where they are able to navigate through the system to retrieve the questions being asked in the test.'* Such queries were generally reported to the TLU to investigate the affected students' Moodle accounts. In such cases, the student was asked whether he/she had their password changed. Administrative Coordinator 2 commented: *...we are trying to be very cautious against the manipulation from the students. Our students also are pretty slick and try to manipulate the system as best as they can.'*

The interview findings brought to light that the unauthorised access to students' Moodle accounts led to students suffering psychologically due to panic and uncertainty on how the issue would be resolved.

Theme 4: Communication Opportunities

Interview findings revealed that staff and students used various communication media to maintain effective communication in a blended learning environment. The communication

media used had been classified into Moodle communication tools and communication tools beyond Moodle. Interview findings on Moodle communication tools have been identified as the Announcement tool of Moodle and the Moodle Messaging tool. It came to light that administrative coordinators found Moodle communication tools helpful. The team relied on the announcements tool and the Moodle messages tool to communicate with students. It was found that communication between the administrative coordinators and staff was done entirely off the Moodle platform, mainly via email. Administrative Coordinator 2 commented:

> *'Our department, we make use of Moodle. Let's say 90% of our communication is based on Moodle, and the functions that Moodle make available to us come in the form of the Announcements section that we can make use of.'*

It came to light that there was agreement amongst the majority of the participants about the popularity of Moodle communication tools as media of communication. However, it is worth mentioning that it was only during and after the outbreak of COVID-19 that the use of Moodle tools intensified. Administrative Coordinator 2 commented: *'Um, I must say that this was underutilised, until most recently actually, COVID actually forced us to start making full use of Moodle.'*

Furthermore, it was reported that they had never communicated with staff members on Moodle in terms of communication. Before the outbreak of COVID-19, the team mainly relied on the NUST website to communicate with students via the Announcements page of COLL. In addition to depending on the NUST website to communicate with students, the section also relied on the COLL Facebook page, SMS communication, MS Teams Chat tool, or a memo that can be going out via bulk emails of announcements made daily. The team described the bundles from MTC as an effective means of SMS communication and commented:

> *'...the one we primarily use as a means of communication that serves as a reminder to students, so we don't really allow our students to depend on SMS on the SMS line. Uhm, with staff, the overarching communication channel would then be an email. We use the telephones as well and announcements from the Communications Department.'*

The findings showed that to communicate effectively with students, various communication tools, on and off Moodle, were found helpful to communicate with students. Since the outbreak of COVID, the data revealed that the use of communication media via Moodle, the Announcement tool, and the Personal Messaging tool had increased significantly to communicate information with students only. Email communication remained the preferred type of communication media with staff members.

Financial Implications of SMS Communication. It was reported that the COLL had a budget for 50,000 credits for the second semester spent on SMSs. The SMS budget for the past three academic years was: 2019 (N$50,000.00), 2020 (N$87,000.00) and 2021 (N$27,000.00). The SMS budget for the academic year 2020 was extremely high (N$87,000.00). However, the 2021 budget for SMS services is even lower than the 2019 budget. This figure shows that alternative media were used to communicate urgent messages with students. Thus, using Moodle as an LMS considerably decreased the SMS budget, especially during the 2021 academic year.

The fifth and final theme emerged as strategies to improve the effective use of Moodle at NUST. This theme was linked to the final research question, Research Question 6: What strategies can NUST adopt to increase Moodle's effective and safe use as an LMS?

Data collected during the semi-structured interview provided suggestions for improving the effective use of Moodle as an LMS.

Suggestions provided during the interview are presented in the following categories: Course design considerations, improvement of technical and student support structures, Moodle orientation, Moodle training and governance

Theme 5: Strategies to Improve the Effective Use of Moodle as an LMS at NUST

Sub-Theme 5.1: Suggestions to Improve Course Design. Interview participants were asked to provide suggestions regarding the design and structure of courses at NUST. It was suggested that the Course Development Team (CDT) of COLL, TLU and faculty try to work in an interrelated manner. This means that all departments could use the same strategies to develop course content. Course development strategies could be shared to identify the best method, such as the structuring approach used by COLL. The instructional designer commented: '*The course development team has more expertise in developing course content, whereas TLU is more specialised in the teaching and learning aspects.'*

The educational technologist suggested that every department could follow a course design template by saying:

> *'In my own humble opinion, I'd suggest we follow a certain template of criteria that could be followed by every department. I suggest that the -learning committee looks into that.'*

Sub-Theme 5.2: Suggestions to Improve the Quality of Online Teaching with Moodle. Participants were asked to suggest strategies to improve the quality of online teaching with Moodle. It was suggested that the online engagement with students on Moodle might be assessed, and provisions for the necessary course evaluation by students might be encouraged regularly as the university did not have any formal methods to ensure quality teaching. It was commented that:

'…lecturer evaluation is rarely done, and only on paper…There is no form of verbal communication between the students and the lecturers regarding the quality of their courses.' (Lecturer 1)

It was suggested that students could be provided with a platform to communicate the quality of courses verbally.

Furthermore, it was suggested that lecturers could give access to HODs to assess their online classes by saying: '*I personally give HODs access to my classes at the beginning of the semester so that they may assess the quality of the class.' (Lecturer 1)*

Staff could be equipped with the skill to teach online effectively by relying on pedagogies that stimulate active online learning by saying: '*Bringing in humour'*. Lecturers could ensure that the process of online education is indeed very entertaining, and in some cases, class presentations may contain a humoristic element. The latter is possible by embedding funny pictures onto the platform.

It was stressed that full-time, part-time and distance education students could access the same quality of information. A distance student ought to have the same level of commitment from the lecturers as the full-time students. It was suggested to involve students in the teaching process through the use of student presentations. He commented: '*I let the students briefly present a topic before we begin with the class. This is done to build their self-confidence and interest in the subject matter.'* It was mentioned that students' presentations could be recorded and uploaded on Moodle. He commented: *'We record such presentations and classes and upload them to Moodle to make them available to all students. Visual material motivates the students much more effectively than boring reading material.'*

It was suggested that lectures could motivate students and know the profiles of students. He commented: *'motivating one's students' requires knowledge of their various strengths and weaknesses, i.e., their profile.* Students could also be allowed to participate in group work and

peer assessment of group work. He commented: '*Furthermore, to stimulate the students, I allow them to work in groups and then subsequently assess each other.'*

It was mentioned that group work stimulates active learning and positive reinforcement. The benefits of group work were described as:

> *This motivates the lazier students to make an effort to contribute toward group marks. It not only allows for active engagement and equal steps towards completing a task, but the students can learn from each other. This is much less stressful than a formal class. Another form of stimulation may take the form of positive reinforcement. I believe that students could be rewarded for any achievements, no matter how small. (Lecturer 1)*

It was suggested that effective commutation in blended learning environments could include the involvement of lecturers in student WhatsApp groups:

> *'It is important for lecturers or course coordinators to be part of the groups for direct communication. A class representative is significant and beneficial, as they facilitate communication between students and staff. For example, let's say a student has a certain problem with a lecturer but is afraid of voicing this issue directly to the lecturer for fear of being victimised. This student will then air his/her issues to the class representative so that they can take it up with the lecturer.' (Lecturer 1)*

It was suggested that effective communication media in a blended learning environment could include communication media beyond Moodle. It was commented:

'One must be creative to communicate with students beyond the limitations of Moodle. As for Moodle, I send messages and make announcements on the platform. I personally use "Podio" to communicate with my research students.' (Lecturer 1)

It was suggested that one lecturer per department could be trained by the TLU, who would then be responsible for training faculty in each of the departments, depending on the size of the respective departments. It was commented:

'This person will be the in-service trainer. One often feels less intimidating than when dealing with the TLU department, so I feel people will be more open to training if a fellow lecturer does it.' (Lecturer 1)

All students have access to all resources, and it was commented: '*I believe that all courses could include these finer aspects so that students have access to any resources.'*

All students could receive orientation on the proper use of academic language and the technical issues of an academic paper. '*Furthermore, advise the students on the proper use of academic language and table of contents, etc.' (Lecturer1)*

Benchmarking with other universities was suggested as a way to improve the filtering choices in Turnitin assignment submissions:

'I believe that Moodle does not have the appropriate mechanisms in place to filter out certain similar areas of assessments that could be picked up as plagiarism. For example, the table of contents or the statement of a topic is often picked up as plagiarism because they are essentially the same for all students. This must be introduced at NUST, like other universities.' (Lecturer 2)

The suggestions above were dominated by Lecturer 1, who transpired to be passionate about teaching and aimed to maintain a good rapport with his students.

Sub Theme 5.3: Suggestions Regarding the Safe Use of Moodle. Interviewees were asked to provide recommendations to improve the safe use of Moodle as an LMS at NUST for the effective delivery of blended/online learning. *'Moodle users could cultivate the habit of always logging out when they have used the Moodle platform.' (Instructional Designer)*

It was reported that when it comes to students sharing devices, often, students have access to the work of the student on whose laptop they are working. The instructional designer suggested:

> *'I, therefore, suggest that students rather make use of a USB stick instead of directly saving information and work on the interface of another student. Additionally, the institution might want to warn students on Moodle against the theft of schoolwork.' (Instructional designer)*

Interview findings revealed that students were given a username and password combination that consisted of their student number and a default password. Therefore, it was likely that a student could log in to the platform of another student if they could get a hold of someone else's details. As such, students ought to change their details immediately. Furthermore, students often forget to log out of their platforms when using on-campus computer facilities, such as labs or the library. Another student could then access the platform and work on this student account when they use the same computer. The instructional designer suggested:

> *'I, therefore, suggest that students be educated on how to exercise safe online practices.*

Suggestions for Safe tests on Moodle. The systems analyst explained that the lecturers generally schedule different time slots for various groups for tests. For the sake of security, all students have to write the test at the same time. Other universities, in this regard, create a

separate instance of Moodle that looks similar to the original. All students are then allowed to write the test on this secondary platform simultaneously. Effectively, a mirror is created specifically for that course at that moment only. He commented:

> *'This reduces the access load on the original Moodle by removing that batch of students from the online traffic. This is not done at NUST, but I suggest that we look towards it.'*

The systems analyst was asked whether such an intervention would be labour-intensive. It was explained that once the technical team knows how the system works and what to look for, creating that type of instance may take a couple of hours at most. He commented:

> *'You need to have the technical know-how of how Moodle operates. Between TLU and DICT, we have sufficient knowledge and experience in this regard.'*

It was further reported that a lot of technical aspects in Moodle were lacking at NUST. A lot of tasks were still being performed manually. He commented:

> *'At the moment, there is no level whatsoever of automation between Moodle and our ITS system (student records system). The ITS system is supposed to automatically "feed" Moodle, but this is not the fact currently.'*

The systems analyst reported that the NUST Moodle system on the outside was secured with sufficient encryption. The university has not observed the e-learning system being compromised as of yet. The university had done enough to protect the system from any attacks. He commented: '*Upon any alert by Moodle that a security vulnerability has been identified, we see to it that we update the system as soon as possible.'*

Interview findings provided evidence that access to the server back-end is limited because only those who need to access those systems can access those systems. Additionally, it was explained that the system sits behind an encrypted SSL certificate, which limits access. Other security measures include regular system updates. It was further described that the

university usually kept the default plugins that Moodle came with, and then additional plugins were added based on the needs of the academics. One of such other plugins the university installed was the Turnitin plugin. It was commented: '*With every update and upgrade, we have to update specific plugins.'*

The systems analyst was asked to suggest alternative forms of security measures that can be used to prevent hackers from accessing our platform. It was recommended that a move to student numbers as a form of username, as opposed to the current system, may work. He explained:

> *'Nevertheless, a username and password are not the only security measure available. We are currently looking at two-factor authentication, whereby a user will have to type in a one-time PIN upon logging in to the platform. To move forward as a university, we have to implement more modern approaches to security.'*

It was asked whether there was anything on paper about a Moodle password policy at the university. He commented:

> *'I think, at the moment, we don't have any password policies for Moodle. We would like to integrate Moodle with our active directory. The password policies of our active directory will thus also be integrated into Moodle.'*

It appears that in the absence of a password policy, numerous challenges were faced resulting in cases where students could not access the platform when required.

Sub Theme 5.4: Suggestions to Strengthen the Technical Support Structure. It was reported that distance education and full-time/part-time students write the same examinations.

Furthermore, distance and full-time students had to write tests and online exams simultaneously. The most suitable time to take tests and online exams were during the evening and on Saturdays when working part-time or distance students would also be available. The

availability of people is crucial to address any technical issues immediately. Administrative coordinator 1 suggested:

> *'You can either have people working shifts or you must then appoint dedicated online or Technical Support staff to assist these students and also, of course, the administrators that are working with the assessments during that time.'*
>
> *'More people, perhaps one or two people per department to be able to help, because also sometimes issues are related to the pedagogy, and they could also have a little bit of knowledge of that.' (Lecturer 2)*

Comments from the educational technologist and administrative coordinator included the following:

'I, therefore, suggest hiring additional members to our unit staff. Therefore, I suggest at least two persons per faculty to allow for support even in the event of sick leave etc.' (Educational technologist)

'So, if skills could be transferred over to other colleagues within sub-departments of the university, every section would be able to do minimal work without really having to contact the TLU section for their human capital.' (Administrative Coordinator 2)

The responses suggested that shifts could be introduced to provide on-time technical support to Moodle users after hours. It was also recommended that two people be assigned to each faculty to provide pedagogical and technical support. More people could be employed to provide technical support, at least two per department. If one person is unavailable due to health issues, another could offer the necessary support. Furthermore, a request was made to transfer technical skillsets across faculties/schools/units/departments.

Sub Theme 5.5 Moodle Orientation to Students. The findings from the interviews were integrated with the open-ended survey questionnaire responses and presented in this section.

The open-ended section of the survey questionnaire required students to suggest ways the university could consider assisting students in using the MyNUST e-learning Platform/Moodle more effectively. A summary of the findings is offered with a graph to emphasise crucial areas the institution should address for ease of understanding.

Students' Questionnaires: Findings of the Open-ended Question

Suggestions to Assist with the Effective Use of Moodle. Figure 33 shows that more than 25 students suggested Moodle training/orientation and that the university could provide internet access and laptops/computers to access the Moodle platform from their homes. The top six requests were: (1) offering of training and orientation on Moodle to students, (2) provision of internet and devices (laptops) to access Moodle, (3) strengthening technical and student support structures at NUST, (4) improve general communication between lecturing staff and students via Moodle. It was reported that lecturers do not reply to students' email and Moodle messages. Additional findings included (5) provide more synchronous engagement opportunities. This item refers to the lack of web presence of both students and lecturing staff. Finally, (6) regular and on-time announcements of tests and sharing of information were suggested.

Furthermore, it is worth mentioning that it was reported that test schedules were not communicated on time, which created panic and frustration among students.

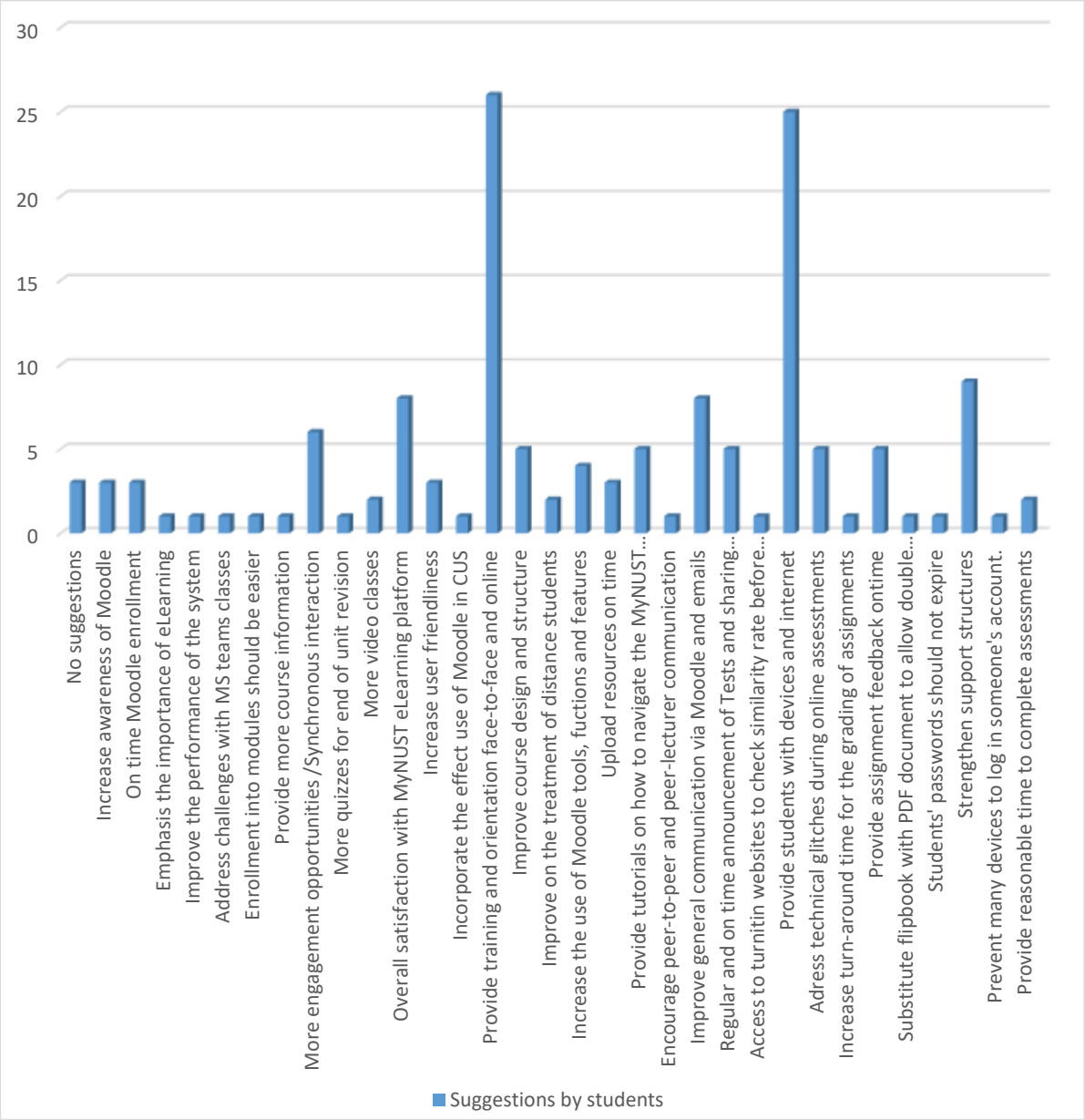
Between seven and nine of the respondents suggested that assignment feedback be provided on time, access to the Turnitin website to allow them to scan assignments beforehand, and request tutorials on navigating the Moodle platform. Out of the 113 respondents, eight respondents were satisfied with Moodle. Five of the respondents suggested that the design and

structure of Moodle courses could improve and requested that course resources were to be uploaded on time. Less than four students requested to increase their awareness of Moodle, on-time enrolment of students by the university staff and increase the user-friendliness of Moodle. Out of the 113 respondents, two students requested to following: (1) reasonable time to complete assessments, (2) more video classes, (3) prevention of more than one device to log in on the same Moodle account simultaneously, (4) students' passwords not to expire, (5) to treat distance education students better, (6) to increase the turn-around time for the grading of assignments. Other recorded requests addressed challenges with MS Teams accounts and provided peer-to-peer and peer-to-lecturer communication.

The following graph provides a visual presentation of the requests made by students.

Figure 33

Findings of Students' Suggestions through Open-Ended Responses



Lecturers' Questionnaires: Findings of the Open-ended Question

The final question in the online survey questionnaire provided data that suggested strategies to strengthen the effective use of Moodle at the research site. This item was included in the survey to mine rich data. They were prompted as participants to suggest strategies NUST may consider strengthening the effective use of Moodle at NUST based on the needs of

participants. This approach was included to acquire a basic knowledge of the respondents' demands for effective Moodle use as a learning management system and collect suggestions on how to meet those needs. Additionally, the open-ended questions also allowed the respondents to raise points beyond the scope of the survey questionnaire within the boundaries of the effective use of Moodle as a learning management system.

Lecturers' responses to the open-ended questions are reflected in Table 33.

Table 33

Lecturers' Responses to the Open-Ended Questions

	Frequency	%
Assigning mentors in the department and offering training in small groups.	1	2.9
By ensuring that students realise the importance of the platform. They need to not simply view it as a site for getting materials or writing tests. They need to explore other tools.	1	2.9
Compel all lecturers to make use of it and maintain consistency in student expectations in terms of task submissions and standards.	1	2.9
Compulsory departmental training based on department needs	1	2.9
Compulsory face-to-face training in small groups. First, do a needs assessment. Offer training according to levels of command. Basic, intermediate and advanced.	1	2.9
Compulsory face-to-face training. Smaller groups. Issue certificates for basic, intermediate and advanced levels of training.	1	2.9
Compulsory Training over a week every semester.	1	2.9
Demonstrations in a Lab by someone who is an expert.	1	2.9
Departmental orientation for students and Webinar training in smaller groups.	1	2.9
Departmental training, not bulk Webinars. Smaller groups of people for more intense training and to create opportunities to do more practical activities. A venue to go at all times with a technical assistant to provide immediate support	1	2.9
Face-to-face training in small groups for specific departments	1	2.9

Table 33 Continued

Table 33 Continued

	Frequency	%
Face-to-face training is offered in my department by a colleague to provide opportunities to ask questions.	1	2.9
Hands-on, face-to-face training in small groups more frequently. Webinars don't work because it does not allow to get practical experience while listening to the very long Webinars.	1	2.9
Hands-on one-week training. Smaller group training.	1	2.9
Hands-on training in small groups.	1	2.9
I need to build confidence in using technology. I am afraid to make mistakes on Moodle. I guess I need more intense training. I find it difficult to use Moodle.	1	2.9
If we can get the necessary technical support on time. We wait too long to get assistance.	1	2.9
Intense training.	1	2.9
It would be more efficient to have a Moodle contact person in each department so that challenges can be sorted out quicker and continuous training and learning can take place. Having technical Moodle support in the department would increase the effectiveness of teaching with Moodle as well as the optimum exploitation of the plethora of tools and the intrinsic way of setting them up correctly. The department could then also develop guidelines for optimum use of Moodle regarding their specific courses and programmes in order to provide training on the most useful Moodle tools.	1	2.9
More intense training and certificates to be issued on the basis of our command of using Moodle.	1	2.9
More one-on-one training	1	2.9
More training in the form of workshops.	1	2.9
On-time technical support and training in small groups.	1	2.9
On-time technical support. The availability of support staff is cumbersome.	1	2.9
One-on-one training.	1	2.9
Please train us in smaller groups. The Webinars for bulk training are too long. One cannot concentrate for 3 hours.	1	2.9
Second weekly training is small groups of not more than ten people from someone known to us in the department.	1	2.9
Shorter webinar training in smaller groups.	1	2.9

As seen in Table 33, out of the 35 respondents, 26 requested the university to provide Moodle training in small groups. It was further ordered that departmental training be offered. The excerpts below describe the suggestions offered.

'Please train us in smaller groups. The Webinars for bulk training are too long. One cannot concentrate for 3 hours.' (Lecturer 10)

'Training from someone in our own department. We are not confident to ask questions during bulk webinars. Training in small groups. Opportunity to practice in real-time.' (Lecturer 32)

'Regular supply updates of the various features of the platform.' (Lecturer 30)

> *'It would be more efficient to have a Moodle contact person in each department so that challenges can be sorted out quicker, and continuous training and learning can take place. Having technical Moodle support in the department would increase the effectiveness of teaching with Moodle as well as the optimum exploitation of the plethora of tools and the intrinsic way of setting them up correctly. '(Lecturer 19)*

'If we can get the necessary technical support on time. We wait too long to get assistance.' (Lecturer 17)

'There is a need to encourage students to participate in MS Teams lectures because most students do not attend and rely on recordings. The Moodle platform is, however, very effective, and everything is in order in the Department of Communication.' (Lecturer 24)

Hands on face-to-face training in small groups more frequently. Webinars don't work because it does not allow you to get practical experience while listening to very long Webinars. (Lecturer 13)

'Assigning mentors in the department and offering training in small groups.' (Lecturer 1)

'By ensuring that students realise the importance of the platform. They need to not simply view it as a site for getting materials or writing tests. They need to explore other tools.' (Lecturer 2)

'Compel all lecturers to make use of it and maintain consistency in student expectations in terms of task submissions and standards.' (Lecturer 3)

It is worth mentioning that lectures suggested that the strategy of offering training could be changed. They felt that the training sessions were too long and would want to have somebody assigned in their department to be trained and then offer the training at the departmental/faculty level. Furthermore, respondents felt that face-to-face training opportunities could enable trainees to engage in practical activities during the training. One of the lecturers felt that lecturers could be assigned to a mentor to assist with Moodle. It was also requested that technical issues with Moodle could be handled within the respective departments, and guidelines could be available for optimum use of Moodle regarding specific courses and programmes to provide training on the most useful Moodle tools.

Passwords. It was suggested that the university could address illegal access to students' assessments by encouraging the student to consider stronger passwords.

I think we could instead introduce another form of security, such as a PIN, to avoid this. I, nevertheless, do not have much experience and information in this regard. (Lecturer 1)

Governance. It was suggested to minimize illegal access/enrolment to courses - Lecturing staff to do the enrolment themselves, as students reported too many issues with self-enrolment. *'The technical team could provide the lecturer with a class list to avoid the issues associated with self-enrollment (by the students)'. (Lecturer 2)*

Management intervention in terms of access to online learning was suggested to improve access to online education with wireless modem: It was recommended that specific sites be blocked.

'Yes, recently, I've become aware of wireless modems for purposes of internet connection. I still believe that certain sites must be blocked so that only the e-learning platforms are accessible. I am aware of situations where students have run out of data because I believe that they are using the modem for purposes other than for that which it was supplied.'

The final question on the interview guide was to suggest how Moodle can be used in a more effective manner. Lecturer 1 said the following:

'I believe that people must be trained to use it effectively, or, alternatively, trained persons must be integrated into staff. New appointees must be assessed in this regard on a probationary basis.'

Furthermore, it was suggested that the university could prioritise addressing the issue of staff shortage at TLU and that the technical department could improve Moodle's performance as the system could not carry the weight of all assessments submitted by all students simultaneously. It was also suggested that attention could be given to the research filters lacking in Moodle Turnitin Assignment submission plugin. In the next section, the findings are evaluated and justified by theory from the literature.

4.12 Evaluation of Findings

In this section, the findings are discussed and justified by theory from the literature.

Research Question 1

What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

Theoretical frameworks that underpinned this mixed-method case study were (1) Orbital E-education Framework of Elameer and Idrus (2012), Khan's (2001) Octagonal Framework and The Community of Inquiry (CoI) Framework (Garrison et al., 2000). The Orbital E-Education Framework of Elameer and Idrus (2012) guided the evaluation of Moodle as an LMS at NUST. Khan's (2001) Octagonal Framework provided direction to evaluate matters concerning the course design, delivery, implementation and evaluation of e-learning. The Community of Inquiry Framework has been used widely in educational settings to gain knowledge on course design, delivery and evaluate the online learning experiences of course participants (Garrison, 2009).

Awareness

Awareness refers to how the students became aware of the existence of Moodle at NUST. According to Figure 15, one-third of the respondents (students) indicated that they were informed about the existence of the MyNUST e-learning platform by course lecturers.

Furthermore, about one-third of the students learned about the existence of Moodle by attending a Moodle orientation session (Figure 15). Firstly, these findings showed that the awareness of Moodle at NUST was promoted by course lecturers and, secondly, by Moodle orientation sessions.

Type of devices used to access Moodle

Students' survey findings showed that 72.6% of the respondents (see Figure 16) used their personal computers or laptops to access the My NUST e-learning platform. About 25%

of the respondents used a cellphone to access the MyNUST e-learning platform, and 2.7% of the respondents used a computer at the library, a laboratory or a regional centre to access the Moodle platform.

Survey findings correlated closely with the open-ended survey responses, which indicated that 22.1% of the respondents (students) requested assistance from the university to provide devices and internet to enable Moodle access. This finding is supported by the views of Nawas and Khan (2012), arguing the productive integration of blended learning in educational settings revolves around specific infrastructural requirements, which include access to on-campus computers and reliable internet connections. Nevertheless, Bielefeldt (2006) reports that higher education institutions do not always comply with the formulae of one computer to one learner.

Responsiveness of Course Participants to Use Moodle Tools

Regarding students' responsiveness to capitalise optimally on existing features of Moodle, according to Table 9, respondents (students) mostly used the MyNUST e-learning platform to download assignments and course materials. The second most frequent usage of Moodle by respondents (students) was to take Moodle quizzes and submit assignments, whereas the third most often used feature of Moodle was writing online tests. From the lecturers' survey (see Tables 14 and 15), the most frequently used Moodle tools were the creation of assignments, quizzes and uploading resources in the form of files and folders (Table 15). These findings correspond with the student survey result, confirming that students (see Table 9) mainly used Moodle to download assignments and course materials, take Moodle quizzes, submit assignments and write online tests. These findings show that Moodle's most popular usage was downloading assignments and course material (Costa et al., 2012; Zainuddin et al., 2016). The findings of the student survey questionnaires provided contradictory results regarding the view of the Announcements Forum/News. The present study showed this tool

was least often utilised (see Table 16). However, previous studies confirmed that using the Announcement tool is quite popular in blended learning settings (Zainuddin et al., 2016). A possible justification for this contradiction might be that only 14.3% of lecturers, as shown in Table 16, used the Announcement function of Moodle every time. According to Elameer et al. (2011), online learning requires access to various learning resources to guarantee effective online teaching and learning delivery.

Upload of Videos

The respondents (lecturers) indicated in Table 14 that the upload of videos on Moodle courses had been the least utilised feature. This finding is contradicted by literature. According to Kabassi et al. (2016), blended learning allows students access to videos on the LMS, enabling them to catch up with lectures they might have missed.

Lesson Activity, Wiki, Choice, Survey Feature and Shareable Content Object Reference (SCORM)

The Lesson activity, Wiki, Choice, Survey feature and Shareable Content Object Reference (SCORM) were the Moodle tools hardly used by respondents (lecturers) (see Table 19). It is argued that Moodle offers several features at the disposal of lectures and students that may increase learning and teaching experiences with the assumption that the necessary training and orientation are provided to Moodle users on using such tools (Elameer & Idrus, 2012).

Grading of Assignments

According to Figure 26, more than 70% of the respondents (lecturers) indicated that they used the Moodle platform to grade student assignments every time. Literature suggests when assignments are graded online, facilitators also need to share constructive feedback with course participants to create a feeling of appreciation for efforts invested by students to complete and submit tasks online (Bernstein & Isaac, 2018).

Moodle tools are mainly nestled around downloading assignments and course content, submitting assignments, taking online quizzes and writing online tests. Opportunities to engage with interactive tools, such as Wikis and online discussion forums, are not always available to students. As such, students hardly engage in Moodle Wikis. Only a third of the students benefit from engaging in online forum discussion opportunities. Table 16 shows that respondents (lecturers) do not frequently utilise interactive and networking features, such as forums and wiki.

Furthermore, Tables 15 and 16 show that respondents (students) do not optimally use the interactive and networking features available in Moodle, as they were not provided with the opportunity to use such features. According to Ulker and Yilmaz (2016), the availability and use of forums and wikis promote interactivity and social networking in Moodle. Elameer and Idrus (2012) claim that the availability of a wide variety of Moodle tools does not guarantee that users can use the various tools effectively. Consequently, continuous training and technical assistance are critical for the effective use of this open-source.

Availability of Instructional Materials

The semi-structured interview findings revealed that full-time students primarily depended on textbooks at NUST. In contrast, distance education students enjoyed access to quality-assured instructional materials, available in the form of a flipbook uploaded in each Moodle course. A concern was raised that the development of instructional material for distance students is costly and involves the services of instructional designers, course writers, content editors, language editors and quality assurers. Although the Centre of Open and Lifelong Learning (COLL) relied on a dedicated and competent team of full-time instructional designers, additional financial resources were needed to hire course writers, content editors and language editors. Sadly, it was reported that instructional materials developed by COLL were not automatically accepted and used by some of the departments at NUST. Time, effort and

money were invested in the development of instructional materials. While some faculty members appreciate and welcome instructional material designed by COLL, some departments do not use the materials produced by COLL. It is worth reporting that fully-fledged online courses developed by COLL did not use flipbooks.

The course materials of fully-fledged online courses are available to students on Moodle in a weekly format. Content is presented in Moodle books that can be downloaded and printed easily. According to Lonn and Teasley (2009), the responsiveness of students and lecturers in an online course depends on the availability of quality instruction, quality instructional materials and quality online course design. Moreover, Servidio and Cronin (2018) agree that academics must invest ample time in creating instructional material to foster students' responsiveness and promote active course engagement (Servidio & Cronin, 2018).

Although most respondents (students) indicated that they have access to devices (Figure 16) and the Internet (Table 10), this study found that the level of students' and lecturers' responsiveness to using Moodle tools and features was relatively low.

The following section evaluates the findings related to the second research question.

Research Question 2

What signifying factors affect blended learning using Moodle at NUST?

Research Question 2 was answered by quantitative survey findings and conclusions from qualitative semi-structured interviews. This section discusses the results of the second research question and links findings to theory from the literature.

Signifying Factors that Affect Blended Learning

Several factors affected blended learning at NUST, as indicated by students. These factors were grouped and discussed as factors that promote blended learning at NUST and factors that hamper blended learning at NUST. Firstly, the most prominent factors that promoted blended learning at NUST are identified, and, secondly, findings are justified with literature.

Student Views on Prominent Factors that Promote Blended Learning at NUST

The most prominent factors that promote blended learning at NUST are illustrated in Table 10, and 78.8% of the respondents (students) indicated that they take ownership of their studies. Regarding flexible opportunities to learn self-directedly, 75.2% of the respondents' noted agreement, and 69% stated e-learning readiness. Furthermore, Table 10 shows that 59.3% of the respondents stated they were motivated to study online, and 54% stated they were afforded ample time to complete online tasks.

Lecturers' Views on Prominent Factors that Promote Blended Learning

The most prominent factors that promote blended learning at NUST, according to Table 18, 94.3% of the respondents (lecturers) indicated that students were allowed to submit assignments after the due date with the necessary permission. Table 18 revealed that 82.9% of the respondents agreed that blended learning affords flexible opportunities for students to learn self-directedly, and 77,1% indicated that they have open access to reliable internet at home (lecturers). Furthermore, Table 18 shows that 68.6% agreed that facilitating online teaching

provides opportunities to manage courses better, and 65.7% agreed that they were motivated to teach online through the MyNUST e-learning platform/Moodle.

Management of Studies

According to Table 16, 58.8% of the respondents (students) strongly agreed that using the MyNUST e-learning platform allowed them to manage their studies better. This result is 9% lower than that published by Firdaus et al. (2020), who found that 67% of participants (students) agreed that studying online helped them manage their studies better.

E-learning Readiness

Table 10 shows that 69% of the respondents (students) were motivated to study online through the MyNUST e-learning Platform/Moodle and ready to engage with online learning at the beginning of the semester. This finding supports multiple views of scholars that the motivation level of online students and facilitators and the readiness of students for the adoption of blended learning are crucial factors for the successful implementation of blended learning (Halverson & Graham, 2019). A comparison between students' and lecturers' readiness for online learning at the beginning of the semester showed that a more significant percentage of students than lecturers were ready to engage in learning. While 69% of students said they were inspired to learn online, only 56% of lecturers said they were driven to teach online. Previous studies confirm that students' and online facilitators' levels of motivation and readiness are critical requirements for the successful integration of blended learning in higher education (Kurt & Yildirim, 2018; Rosenberg & Rannelluci, 2017).

Level of Computer Literacy

According to Table 10, 69% of the respondents (students) indicated that studying online requires a certain level of computer literacy to navigate through the platform, which supports the viewpoint of Yulia (2016) that readiness for e-learning is fundamental for the implementation of blended learning.

Factors that Hinder Blended Learning

The three significant challenges reported by students, according to Table 10, 59.2% of the respondents (students) felt lost and unsure about their abilities to manage online learning, 52.5% indicated that studying online creates a feeling of isolation from their peers, and 26.5% indicated challenges with access to the internet. These findings are supported by Winstead (2020), who agrees that the mental impact of relying on technologies is one of the disadvantages of blended learning. Alshammari et al. (2016) assert that students with reliable internet access are more likely to engage with course content.

Table 18 depicts the most significant barriers to teaching using Moodle. Around 83% of respondents (lecturers) agreed or strongly agreed that more training is needed to improve their confidence in using Moodle tools, and 74.3% said they had difficulty adapting to online teaching. About 69% said a heavy workload makes it difficult to use the MyNUST platform effectively. Furthermore, 62.9% of respondents said they are lost and unsure about their competence to manage and promote online teaching. Findings on demanding workload align with Winstead (2020), who confirmed that teaching using Moodle increases the workload of lecturers as they need to do some preparations to sustain 'hybridisation'. The findings on feeling confused and unsure about their ability to manage and facilitate online teaching align with Darling-Hammond et al. (2020) in their belief that 'social isolation' directly results from blended learning. However, this finding contradicts Liu et al. (2016), who reported that studying in blended learning settings is not associated with isolation or decreased interest in the subject content.

Communication Challenges

Another challenge that was recorded by lecturers and confirmed by the open-ended responses of students (Figure 33) concerned the communication challenges between students and lecturers via Moodle's messaging tool. Findings demonstrated that student respondents

communicated with lecturers via Moodle and emails through the university's webmail services. However, many lecturers seemed not to reply to requests from the students via the Moodle messaging tool. Literature confirms that the online communication abilities of students directly affect learning experiences in an online learning setting (Oblender, 2002; Wojciechowski & Palmer, 2005).

Workload Implications

A demanding workload was reported as a challenge by lecturers (Table 18) and administrative staff members (semi-structured interviews). It was further reported that a demanding workload resulted in psychological and health matters. The literature revealed that innovation in blended learning settings might lead to increased workload amongst academics and cause various psychological implications for students and academic staff (Elameer & Idrus, 2012; Galvis, 2018).

Course Design

Qualitative findings confirmed that students, lecturers and administrative staff members reported dissatisfaction with course design. Furthermore, it was reported that a variety of course design templates had been made available to academics over recent years. However, the findings of this study revealed that faculty did not welcome such initiatives, and they were described as 'being resistant to change.' Minh and Ngan (2019) suggest that staff members need to be involved in designing and implementing blended learning programmes.

Availability of Human Capital

Qualitative findings revealed the importance of having a dedicated technical team to provide technical assistance on Moodle during office hours and after-hours. The availability of only two full-time staff members to assist with Moodle technical support university-wide resulted in several issues, including workload, physiological and health issues. Not having access to technical support after hours caused frustration for students and academic coordinators, which

led to the cancellation of tests if technical glitches on Moodle could not be resolved on time after hours. According to Elameer and Idrus (2012), continuous technical assistance is vital for the effective use of an LMS.

On-Campus Computers to Access Learning Resources

Interview and survey findings confirmed that some students at NUST are challenged with little or no access to devices and internet connectivity. In the absence of reliable devices, students may visit The NUST library to access computers; however, it was reported that not all computers in the library were in working condition. Consequently, students without devices were seriously challenged with access to the Moodle platform. Interview findings confirmed that although students could access the library to use computers to access Moodle, not all the computers were always in working condition.

In addition, the availability of ICT rooms on campus did not secure automatic access to such facilities. The entrance to ICT rooms was faculty bound, and students who did not belong to a specific faculty were not allowed to enter certain computer laboratories and ICT rooms.

These findings are supported by Mässing (2017), who claimed that the academic achievement of students with open access is better than those challenged with internet access. The following section evaluates the findings related to the third research question.

Research Question 3

What impact does the use of Moodle at NUST have on students' course engagement?

Findings from the quantitative survey provide answers to Research Question 3. This section discusses the results related to the third research question and links findings to theory from the literature. Findings from the quantitative survey provided answers to Research Question 3.

Discussion Forum Engagement Opportunities

Table 11 indicated that about 61% of the student respondents agreed or strongly agreed that adequate opportunities were available in their courses to engage in online forum discussions. When asked whether the topics provided for online forum discussions were interesting, more than 48% of the respondents agreed or strongly agreed that the topics provided for online forum discussions were interesting. This finding supports the view of Moffat (2015), who underscored the importance that Moodle instructions select thought-provoking and stimulating topics for online forum discussion.

Timely Feedback

Regarding the provision of timely feedback from lecturers associated with online discussion forum contributions, only 36.3% of the respondents agreed that online course facilitators promptly provided online discussion feedback. This finding corresponds with a study by Akakandelwa and Mkulama (2017), where participants were dissatisfied as course facilitators did not provide timely feedback on discussion forums. Hossain and Rahman (2017) found that the provision of assignment feedback on time increases the effective use of Moodle.

The Use of Moodle Toward Increased Course Engagement

Finally, more than 50% of the respondents agreed or strongly agreed that using the MyNUST e-learning platform had led to increased course engagement opportunities. Several previous studies agreed that adopting a blended learning approach results in positive learning

experiences. Consequently, students enjoy online interaction with course content which increases course engagement (Kabassi et al., 2016; Kintu & Zhu, 2016; Yeou, 2016)

The section to follow evaluates the findings related to the fourth research question.

Research Question 4

What impact does the use of Moodle at NUST have on students' communication?

This section discusses the results related to the fourth research question and links findings to theory from the literature. Findings from the quantitative survey provided answers to Research Question 4.

Survey results confirmed that multiple communication media were used to maintain effective communication between lecturers and students. Regarding the Moodle Messaging tool for communication between students and lecturers, most of the respondents (students) 65%, indicated they use the MyNUST e-learning Platform/Moodle messaging feature to contact lecturers. More than 60% of the student respondents agreed or strongly agreed that access to the MyNUST e-learning Platform/Moodle makes communication with lecturers easier. About 51% of the respondents (lecturers) agreed or strongly agreed that the messaging tool in Moodle is an effective manner to communicate with students. Contradictory findings were recorded regarding whether the use of Moodle has led to increasing communication between lecturers and students. More than 60% of the respondents (lecturers) agreed or strongly agreed that using the e-learning platform/Moodle at NUST has increased communication between their students. These findings show agreement with the view of Lopes (2014) that Moodle as an LMS promotes flexible learning and improves communication opportunities.

On the contrary, 38.9% of the respondents (students) agreed or strongly agreed that using the MyNUST e-learning platform had led to increased communication opportunities. Akakandelwa and Mkulama (2017) agree that using Moodle as an LMS may create opportunities for effective communication. However, due to internet connectivity challenges and restricted access to Moodle, participants in their studies failed to effectively use Moodle for communication purposes. Study results indicated that communication tools beyond Moodle

were more popular than the messaging tool in Moodle. Table 19 revealed that more than 85% of the respondents (lecturers) indicated using the MS Teams Chat tool to maintain effective communication with their class group.

Additionally, respondents (lecturers) indicated that they use the MS Teams call tool to maintain effective communication with their class group. Furthermore, most respondents (lecturers) (71%) agreed or strongly agreed to use WhatsApp to communicate with their class group. Table 19 revealed that 71% of the respondents (lecturers) email students to communicate effectively with their class group. The majority of the respondents (lecturers) (71.1%) disagreed that they make use of Telecom's Short message services (SMS), and about 57% disagreed that they use Facebook as communication media in their courses. Dixson (2010) suggests that online facilitators employ various approaches to maintain effective communication in an online setting to bolster the course engagement of students. The same study found that the more communication between students and between instructors and students, the higher the students' involvement. In agreement with Dixson (2010), the present study recorded a significant positive correlation between increased communication opportunities in Moodle and increased course engagement. The following section evaluates the findings related to the fifth research question.

Research Question 5

What impact does the use of Moodle at NUST have on the development of students' problem-solving skills? Findings from the quantitative survey provided answers to Research Question 5. This section discusses the results related to the fifth research question and links findings to theory from the literature

Rational Thinking, Independent Thinking and Seeking Multiple Paths to Analyse Problems

The development of problem-solving skills using Moodle was evaluated, and lecturers were asked whether online tasks submitted for grading showed evidence that Moodle at NUST has promoted student rational thinking. Table 20 shows that 71.4% of the respondents (lecturers) and students (79.7%) (see Table 13) recorded an agreement that online tasks submitted showed evidence that the use of Moodle at NUST has promoted rational thinking. In terms of whether the use of Moodle at NUST has enabled students' independent thinking, most respondents (lecturers) (68.6%) and students (77.9%) agreed with the statement. According to Table 9, 19, 8% of the respondents (lecturers) and Table 10, students (66.4%) agreed that Moodle as an LMS at NUST capacitated students to seek multiple paths to analyse problems. These findings supported the view of Singh (2018) that online course facilitators are responsible for developing student critical thinking abilities by making opportunities available to promote rational thinking and independent thinking and allowing students to seek multiple paths to analyse problems.

Engagement of Students in Discussion Forums in Moodle and Critically Thinking

Respondents (lecturers) were asked whether student engagement in discussion forums in Moodle has developed their ability to think critically, and 47.7% of the respondents (lecturers) agreed with the statement. Previous studies revealed that technology integration still seemed challenging in the same educational environments (Johnson et al., 2016; Klein, 2019).

Singh (2018) claims that the development of critical thinking skills in students cannot be secured by technology; the role of the teacher is crucial in ensuring the development of critical thinking skills. Furthermore, Harrell and Wendt (2019) support the view that the online instructor plays a crucial role in developing critical thinking skills amongst students.

Use the Quick Messaging Tool to Promote Critical Thinking Skills

Table 20 reveals that 82.9% of the respondents (lecturers) indicated that they do not encourage students to use the quick messaging tool to share some thoughts and perspectives with online course participants. Student responses to the same statement indicated that 62% (see Table 13) of the respondents (students) indicated that they do not use the quick messaging tool to share some thoughts and perspectives with online course participants. Literature provides contradictory findings. According to Cole et al. (2015), the quick messaging tool available in Moodle allows course participants to reach out to fellow students and engage in discourse that may develop critical thinking among Moodle users. Thus, course facilitators could promote the use of the quick messaging tool and encourage students to use this tool to debate about certain course content and topics. Literature confirmed that students might share some thoughts, perspectives, and doubts with peers and the online teacher via the quick messaging tool (Al-Husban, 2020).

Solving Authentic Workplace-related Issues

Table 20 shows that 94% of lecturers agreed that assignments were designed in a way to challenge students in solving real-world problems. About 80% of lecturers and 67.2% of students (see Table 13) agreed that students are required to submit additional activities to promote real-time problem-solving based on selected units. Lackner (2014) suggests that student engagement in solving authentic problems may shape students to approach original workplace-related issues. Both findings align with Al-Husban (2020), who claims that online facilitators can instil the development of problem-solving skills by permitting students to

complete supplementary assignments. However, it is suggested that additional projects' focus should be on real-time problem-solving in selected units (Lackner, 2014).

Provision of Quality Assignment Feedback

According to Table 13, only 44.3% of the respondents (students) agreed they are provided quality assignment feedback to develop problem-solving skills. Table 13 revealed that 59.3% of the respondents (students) indicated that their engagement in online tasks had increased their ability to solve problems.

Videos on Real-life Scenarios to Develop Problem-Solving Skills

Table 20 shows that 68.6% of the respondents (lecturers) disagreed that their courses provide videos related to real-life scenarios to develop problem-solving skills amongst students. Al-Husban (2020) suggests that online facilitators need the necessary training to formulate online tasks to augment higher-order thinking to assist students in solving problems.

Weblinks and PowerPoint Presentations

According to Table 20, 54.3% of the respondents (lecturers) disagreed that their courses provide web links to articles related to real-life scenarios to engage students in solving problems. Of the 35 respondents (lecturers), 94.3% agreed that their courses provide PowerPoint presentations related to real-life scenarios to engage students in problem-solving. Khan (2016) suggests that ICT availability in higher educational settings ensures media use for text, graphics, animations, simulations, games and other audio and video tools. Integrating multimedia, such as audio-visuals and simulations, increases students' learning experiences in blended learning settings (Darling-Hammond et al., 2020; Mässing, 2017; Khan, 2016). These findings support the argument that access to computer technologies in higher education has contributed significantly to integrating multimedia content and multimedia communication in blended learning settings (Horton, 2006).

The Use of Moodle as an LMS Towards Increased Problem-solving Abilities

Figure 31 reveals that about 48,6% (the majority) of the respondents (lecturers) indicated that using Moodle as an LMS increased problem-solving abilities poorly among students in their classes. Literature confirms that problem-solving skills take time to develop and require various opportunities to practise such skills (Alsaleh, 2020).

The following section evaluates the findings related to the sixth research question.

Research Question 6

What strategies can be adopted by NUST to increase the effective and safe use of Moodle as a Learning Management System?

This section provides suggestions from students, lecturers and administrative staff on how the university may assist various stakeholders in using Moodle as an LMS effectively. Research Question 6 was answered by the findings from open-ended survey questions and conclusions derived from semi-structured interviews. This section discusses the results of the sixth research question and links findings to theory from the literature.

Strategies to Improve the Effective Use of Moodle at NUST

Students, lecturers and administrative staff were asked to suggest strategies to enhance the effective use of Moodle at NUST. The following approaches were proposed and linked to the literature.

Moodle Training and Orientation

About 23% of the students requested Moodle training and orientation to be offered face-to-face and online. Some of the students' responses regarding Moodle orientation and training included:

…providing a video streaming on how to use the platform (Student 73), Orientation must be compulsory (Student 67), Orientation opportunities (Student 68), Students need to attend all sessions that teach them how to use the platform effectively (Student 81), Students should attend the online orientation, and they should ask for help when they do not understand how to use the e-learning platform Moodle (Student 83), Students should be clarified more on the use of MyNUST e-learning platform, especially for the new students (Student 84)

In terms of Moodle training, the following suggestions were made by the faculty.

'Intense training (Lecturer 20), Departmental training not bulk webinars; Smaller groups of people for more intense training and to create opportunities to do more practical activities.' (Lecturer 10)

TLU has been offering training to lecturers for a long time. …the number of attendees has increased tremendously. There is just sometimes a challenge with regard to internet connectivity. Certain lecturers are in locations where they have a bad Internet connection. The training persists nevertheless… (*Educational technologist*)

The administrative coordinator was asked whether Moodle as an LMS was used in an effective manner by students and staff, and the following response was received:

'....No, they (students) don't know… they don't… because we don't know Moodle. We don't know how to use it effectively. When I go into Moodle now, you would see that I have 200 unread messages. Or let me rather say not don't know, we just don't have the capacity because it means you need to be 24 hours... That's why we need more people to be able to manage this.'

Requesting Moodle orientation and training were elements emphasised by Aljeeran (2016), who agrees that faculty members perceived using some Moodle tools as a challenge. Consequently, requests for Moodle training and orientation by students and lecturers align with the findings of previous studies. Winstead (2020) suggests that online facilitators and lecturers need technical training to persist as hybrid teachers.

A second suggestion by students was the provision of devices and the internet, which is discussed next.

Provision of Devices and Internet

About 25% of the students requested the university provide devices and internet to assist them in using the Moodle platform more effectively. Below are some of the suggestions made by students from data obtained in the open-ended survey question.

'The MyNUST e-learning platform (Moodle) cannot be used effectively at NUST until students have reliable and affordable access to the internet, as well as the necessary technological devices, whether that be personal computers or tablets. Using the platform on a smartphone (which, again, is not something all students have access to) is not effective.' (Student 91), 'Just provide better internet connection devices…' (Student 44), 'Provide reliable internet and personal computer to needy students upon registration, for easy access to e-learning.' (Student 69), 'Provide students with laptops…(Student 70), …provide wifi to all students and make sure that internet devices are of high speed…' (Student 71).

'Provision of devices and data bundles for us to use. Also, keep in mind geographical areas, as some students were depending on staying in the hostel as they stay in villages or places where it may be difficult to access these. Due to the COVID situation, they have to return (as paying money for this would be a waste). (Student 10).

Some of the students do not have access to the internet, and the university must offer sufficient data to students. …have guidance on the platform available for students to help in the functions.' (Student 42)

The above findings are supported by Mässing (2017), who agrees that the absence of devices and stable internet connectivity cripples blended learning. Furthermore, it was reported that one-fifth of the respondents (students) lacked access to learning devices (see Table 10 and Figure 16).

Strengthen Support Structures

Ranking third in importance was the request from students to strengthen support structures. This was the third important request made by students in assisting them in using the Moodle platform in a more effective manner. Some of the responses of students were:

'Support must be given to students to stimulate online teaching further easily and efficiently.' (Student 87), '…necessary support from lecturers is not there more especially for Accounting students…' (Student 46), 'support must be given on time…' (Student 66)

Requesting for a strengthened support structure aligns with the views of Boelens et al. (2018), as they accentuate the importance of student support in blended learning settings for the successful implementation of blended learning and online learning through the use of Moodle in higher education. It is further argued that the needs of students should be considered to ensure the effective use of an LMS. Furthermore, Boelens et al. (2018) argue for promoting access to professional support for staff and students to ensure the successful integration of blended learning in higher education and the effective use of an LMS.

General Communication

The fourth important request from students to the university was to improve available communication via Moodle and emails. Some of the responses of students were:

'Another scenario is for lecturers to reply to students' messages and emails on e-learning so that they provide the necessary feedback that the students require.' (Student 7)

'I personally think some lecturers ignore messages sent by students using e-learning message and I believe some even think it should only be lecturers using it to communicate to their students.' (Student 36)

Jakchaikul (2015) supports the request for improved general communication via Moodle and emails. It was stated that the effective use of an LMS depends on access to learning resources, learning activities, provision of opportunities to write examinations, allowing

students to evaluate lessons and promoting communication between course facilitators and students.

Performance of the System

In terms of the performance of the system, the following suggestions were made:

'Improve the system, sometimes we can't access the page (the system is down) and we have assignments or quizzes due…' (Student 41)

'There was a time when I remembered that when just after the break out of COVID when everything went online, our system could also not take all the traffic. It couldn't manage all the traffic' (Administrative Coordinator 1)

'There were instances where the performance of Moodle was a big issue. It became apparent that we were over-resourced; many resources were not used on the Moodle system. I personally fixed some of those issues. Therefore, most performance issues are associated with the Internet connectivity of outside users. This is where most students experience problems with the loading of pages.' (Systems Analyst)

Performance issues with e-learning systems are supported by Alameer and Idrus (2012) in their view that the low speed of the internet and bandwidth challenges hamper the performance of LMSs. The following section reports on the safe use of Moodle.

Safe Use of Moodle as an LMS

Participants were asked for suggestions to improve the safe use of Moodle as an LMS, and the following responses were recorded:

'Proper cyber security to prevent many devices from logging in to someone's account.' (Student 70), '…by keeping their passwords private…' (Student 9)

'And then there's a default password. Also, so many of our students don't know that they can actually change the password themselves. So, then you would find, and we found that last

year… even found this year also, that students go onto the system on behalf of each other and do assessments. So, it's something that we need to look into as well…' (Coordinator 1)

Findings of password challenges and illegal access to Moodle were supported by Gayoso et al. (2017). They underscore that Moodle users should consider implementing a password policy. As such, it will be mandatory for all Moodle users to change their passwords across the institution and prompt users to use strong passwords to prevent unauthorised access to Moodle accounts. Moodle (2020) urges Moodle users to change passwords regularly. Moodle users could be encouraged to change their passwords frequently to guarantee secure access to Moodle accounts.

Summary

This chapter presented the findings of this mixed-methods case study conducted at NUST, a public university in Namibia, to assess the effective use of Moodle as a learning management system at the research site. The case study relied on a sequential mixed methods research design. Quantitative data were collected through Google Forms, and survey questionnaires were designed and administered to lecturers and staff. One open-ended question was embedded in the survey questionnaires in both sets of questionnaires to assist with the collection of qualitative data. Semi-structured virtual interviews were conducted with academics and administrative staff to answer the second and sixth research questions. The first part of this chapter provided an overview of the research setting, which was the main campus of NUST and extended to ten regional offices as distance education centres. Probability sampling was used to draw a representative sample. Quantitative data were collected by administering survey questionnaires to students and lecturing staff as study respondents.

In contrast, non-probability sampling was used to draw twelve participants, of which seven participated participated in the semi-structured virtual interviews. This chapter provided a synopsis of the trustworthiness of data by integrating various techniques, including

triangulation, member checking and an audit trail. A pilot study was conducted to test the suitability of both quantitative and qualitative data collections. Cronbach's alpha reliability tests were computed to ensure content consistency in both sets of quantitative data collection tools. Quantitative data were collected from April 2021 to July 2021, while qualitative data were collected from July 2021 to August 2021. The analysis of quantitative data was possible using SPPSS 27. NVivo 13 was used to assist with qualitative data management and the thematic analysis technique to analyse qualitative data. This chapter presented the descriptive analyses of quantitative data, followed by inferential statistics using Spearman's correlations and Pearson's chi-square test. Five themes emerged from the study of qualitative data, viz. Theme 1: Availability of Human Capital to offer technical support, Theme 2: Course Design, Teaching, Learning and Assessment, Theme 3: Security Vulnerabilities on Moodle, Theme 4: Communication opportunities and Theme 5: Strategies to improve the effective use of Moodle as an LMS. Although quantitative and qualitative data were analysed separately, findings were integrated to understand the research questions better.

The second part of this chapter provides details on the evaluation of results linked to the literature review. Quantitative data provided answers to all six research questions, while qualitative data confirmed the quantitative findings of research questions two and six. Chapter 4 concluded by comparing and contrasting study findings with results from the research literature. The next chapter discusses the conclusions related to the findings.

CHAPTER 5: IMPLICATIONS, RECOMMENDATIONS AND CONCLUSIONS

The Fourth Industrial Revolution has transformed the twenty-first century, and educational institutions must use current technologies best to improve student performance. Blended learning is a method of increasing student productivity by combining traditional teaching methods with existing educational tools. Learning is made more accessible by technology, which provides convenience and promotes the participatory nature of learning (Trines, 2018). Moodle is used effectively to provide optimal teaching and learning, which leads to improved student accomplishment and the development of the human capital needed to accelerate national economies (Francescucci & Rohani, 2018).

Despite the realisation that the effective use of educational technologies yields high student achievements, NUST is yet to reap the full benefits of Moodle as an LMS for online teaching and learning. The university has implemented the learning management system Moodle since 2011. Although Moodle as an LMS is functional at NUST, students' performance levels have not improved as anticipated, despite the assertion that educational technologies in teaching and learning improve student performance significantly (Mulhayatiah et al., 2019). Given the students' poor performance despite the university's use of Moodle, this study intended to understand the obstacles that NUST faced in implementing Moodle to devise methods to remedy the examined issues. Understanding identified challenges may assist the institution in using Moodle as an LMS, resulting in improved student performance as a result of teaching and learning.

This mixed-methods case study aimed to investigate the effective use of Moodle as an LMS at NUST. NUST is a public, non-profit university offering full-time, part-time and distance education learning opportunities through blended and full-fledged online learning.

Permission to conduct this study was obtained from the research review boards at Unicaf and NUST. Quantitative data was gathered using Google Forms and completed by students and lecturers. Qualitative data were collected from lecturers and administrative staff through semi-structured virtual interviews. In both sets of survey questionnaires, one open-ended question was included to obtain additional qualitative data. The study was conducted at the main campus of NUST and extended to ten regional offices that served as distance education centres across Namibia. Probability sampling was employed to draw a representative sample for the primary inquiry. Non-probability sampling, on the other hand, was utilised to select participants for the semi-structured interview.

This study integrated different methodologies, such as triangulation, member checking and an audit trail, to enhance data trustworthiness. The applicability of both quantitative and qualitative data collecting was investigated in a pilot study that preceded the primary investigation. Cronbach's alpha tests were computed to ensure internal and content consistency in the items included in the quantitative data collection tools. The researcher ensured that all ethical standards and principles were adhered to throughout this investigation. The data gathering methods did not require the respondent to reveal their name or other identifying information to ensure anonymity and confidentiality. Before any interview with the respondents was conducted, a brief description of the study's goal was given, followed by requests for informed consent.

The selection of the students' participants in this study reflected the opinions of second and third-year students only. The total number of academic staff, academic coordinators and instructional designers who took part in the semi-structured interviews was a limitation of the study. The study's goal was to include twelve participants in the semi-structured interviews, but only seven indicated an interest in participating. Perhaps with more interview participants included in the study, different conversation subjects and depth could have emerged. Another

limitation of the study was the exclusion of the Moodle administrator from the study due to unavailability. The participation of the systems analyst as an interviewee made up for the Moodle administrator's absence. The study had methodological limitations, as content analysis of the LMS would have added value to the findings. Conducting mixed-methods research took a long time. Quantitative data were collected and analysed over two months, and qualitative data collection and analysis took three months.

This chapter discusses key findings concerning the literature on the effective use of Moodle as an LMS at NUST. There is also an assessment of the study's connections to blended learning models in higher education. This chapter aims to assess the study's findings and consider the implications for a revised and improved e-learning strategy that fits the requirements and expectations of Namibian students. This chapter also discusses recommendations for future research and ends with a conclusion section.

5.1 Implications of the Study

This section discusses the study's implications and examines the implications for a modified and refined e-learning strategy that meets Namibia's students' needs and expectations.

Research Question 1

What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle?

Responsiveness

The level of responsiveness of NUST students and lecturers to capitalise optimally on the existing features of Moodle was relatively low. Most of the students learned about the existence of Moodle at NUST, mainly from course lecturers, and a smaller group of students learned about the existence of Moodle at orientation sessions. Moodle orientation had already been offered in the form of an open course to all students. However, study findings confirmed the urgency of availing both online and face-to-face Moodle orientation. It was an unexpected

finding; one would have expected that the Moodle orientation course should have assisted students in becoming familiar with Moodle and its features.

Students and lecturers were challenged to use Moodle tools effectively in the absence of a clear-cut e-learning strategy to promote the awareness of Moodle at NUST. Study results confirmed a low activity level of engagement regarding the use of Moodle teaching tools.

Assignment Tool

Though various Moodle tools and features are available, students' usage of Moodle was limited to downloading and submitting assignments and engaging in online quizzes and online tests. On the other hand, lecturers mostly used Moodle to create assignments and quizzes and upload resources in files and folders. Regarding the responsiveness of students and lecturers to use Moodle tools optimally, study results served as a gauge to inform faculty and Moodle administrators about the urgency to rethink and adapt the Moodle orientation/training programme. The latter action aligns with the training and orientation needs revealed in the findings. A possibility for students' and lecturers' low responsiveness regarding the use of Moodle tools and features is that Moodle users only use the tools to complete assessments. Students mostly used the Assignment tool to access, download and upload their assignments.

Quiz Tool

The second frequently used feature of Moodle was the Quiz tool/features, also a tool used for Moodle assessments. The Moodle tool, ranking third place, was the Discussion Forum feature, an assessment tool. Consequently, Moodle was not used effectively in terms of teaching and communication between students and lecturers.

Assessments

Regarding assessment, Moodle tools were mainly used for assignment downloads and submissions, test submissions, quiz submissions and discussion forum contributions. The lecturers mainly used the Moodle feature to create assignments, quizzes and tools to upload

resources in folders and files. It was expected that the most frequent tool used would be the announcement tool. Indeed, results show the most used communication tool on the course's home page is the announcement feature (Kraleva et al., 2019; Wichadee, 2015).

Communication Tools

Teachers use the announcement tool to provide one-way communication with course participants, make course announcements or share information (Padayachee, 2017). However, it was found that a significantly low number of lectures indeed made use of the announcement tool. Consequently, this communication tool was the least often used at NUST. The upload of videos in Moodle courses was also one of the least used capabilities of Moodle. A study conducted by Gomez (2015) shows significant similarities with the present study. The latter research found that the most frequently used Moodle features included managing course assignments, communicating with the student outside the classroom, accessing resources, accessing the grade book and submitting online tasks. It is worth mentioning that accessing or using the grade book was beyond the scope of this study. Four of the five top features most utilised in the study conducted by Gomez (2015) fall within the six top uses of Moodle as an LMS in the present study. Although blended learning leans toward availing videos of missed lecturers, results confirmed that this feature had been under-utilised.

Teaching Tools

The teaching tools least frequently utilised were the chat feature, glossary, and workshop tool (see Table 14). Equally labelled as the least prominent interactivity tools used at NUST were the lesson activity, wiki, choice, survey feature and Shareable Content Object Reference. The latter tools were hardly used by respondents (lecturers) (see Table 13). It is argued that Moodle offers several functionalities at the disposal of lecturers and students that may increase learning and teaching experiences with the assumption that the necessary training and orientation are provided to Moodle users on using such tools (Elameer 2012).

Access to devices and Internet Connectivity

The level of responsiveness using Moodle was influenced significantly by the limited access to devices and the lack of reliable internet connectivity, given the requests from students to avail devices and data to needy students.

Technical Support Services

Although the university had been using Moodle for the past twelve years, a great deal of confusion existed regarding offering technical support services to students and lecturers, especially in the absence of a clear-cut e-learning strategy aligned to students' and lecturers' needs. Several theorists agree that the successful integration of an LMS in institutions depends heavily on the acceptability of the tool by the faculty, as lecturers have a significant influence on the way students use the system (Al-Busaidi & Al-Shihi, 2010; Elkaseh, 2015; Saleem et al., 2016).

Research Question 2

What signifying factors affect blended learning using Moodle at NUST?

Factors that Affect Blending Learning

This study found two categories that affected blending learning: factors that promote blended learning in higher education and those that hinder blending in higher education in a Namibian context.

The following factors promoted blended learning at NUST

- students' taking ownership of their studies,
- students' e-learning readiness and motivation to study online,
- being afforded ample time to complete online tasks,
- communication opportunities,
- the level of competency of technical staff (Moodle hosting team and Moodle support team),

- availability of quality instructional material in the distance Moodle courses,
- access to on-campus devices (library and ICT laboratories),
- access to on-campus internet,
- regular Moodle security updates and upgrades,
- competent instructional design team,
- multiple communication opportunities, and
- affordable data packages for students for off-campus use (see Tables 10 and 18).

The factors that hindered the effective use of Moodle at NUST were:

- the lack of human capital to provide technical support to students and staff,
- the psychological impact of the shortage of staff,
- exhaustion due to demanding workload and role confusion,
- course design issues and the poor structuring of online courses,
- communication challenges,
- limited access to on-campus computers,
- slow off-campus internet connectivity,
- digital divide challenges,
- frustrations with assessment submissions,
- Poor Moodle performance,
- Turnitin assignment submissions of non-enrolled students,
- manager's role assigned to multiple support staff members,
- unauthorised access to students' Moodle accounts, and
- logging in challenges.

The responsiveness using Moodle tools and the signifying factors that affect blended learning in higher education appeared to share overlapping roots in this study. As much as limited or no access to devices impacted the students' responsiveness to benefit fully from

using Moodle features, these two variables also hindered the students' online learning experiences.

Shortage of Staff

Awareness of the factors that hinder blended learning at NUST requires courseware developers and student support staff to rethink their roles and responsibilities at TLU and COLL. Relying on the services of two employees to provide Moodle support to the entire university resulted in numerous issues, amongst other workload demands, psychological and health problems at TLU. Employees at COLL also reported workload issues. In the case of COLL, it came to light that much of the services of the examinations department had become the responsibility of COLL administrative coordinators, which was incredibly overwhelming and led to increased workload demands.

Demanding Workload

The study found that COLL, TLU and academics reported issues of demanding workload. In contrast, DICT confirmed that their department had an appropriate staff complement. The systems analysts commented that:

> *'There is sufficient staff on our side. We worked until seven o'clock in the evening to fix the issue. Therefore, once an issue is met, it is usually sorted within hours. We have sufficient knowledge of the back-end system and the other technical aspects of running an LMS system.'*

However, it was reported that the technical team at DICT needed to work overtime to attend to the necessary Moodle updates and upgrades from time to time. DICT also did not offer support to students and staff, as their responsibilities were focused on the hosting and maintenance of the Moodle server. The systems analyst proclaimed: *'We, from the back-end side, are not that involved in the assistance of students.'*

According to Dangwal (2018), the planning, learning design, management and administration of the learning process and delivery of learning content are impacted when e-learning technologies are adopted at institutions.

Research Question 3

What impact does the use of Moodle at NUST have on students' course engagement?

Course Engagement

Although the study found adequate opportunities for students to engage in online forum discussion, most did not find forum discussion topics stimulating. Additionally, the lecturing staff did not provide timely feedback on students' online discussion posts. Finally, to answer whether the use of Moodle had led to increased course engagement, most students indicated that the use of Moodle at NUST had led to increased course engagement. The finding of the third research question was complemented by several studies, stating that students enjoy online interaction with course content, which increases course engagement (Kabassi et al., 2016, Kintu & Zhu, 2016; Yeou, 2016). Moodle instructors are also responsible for creating quality and stimulating instructional material that emboldens students to optimise available resources (Yeou, 2016). Consequently, teachers must invest ample time in designing instructional material to foster students' responsiveness and promote active course engagement (Servidio & Cronin, 2018).

Research question 4

What impact does the use of Moodle at NUST have on students' communication?

Most of the students indicated that the use of Moodle had not led to increased student communication opportunities. In contrast, lectures suggested that using Moodle had led to increased communication opportunities. It was expected that both the lecturing staff and students would agree that using Moodle led to improved communication. No studies were found to either support or refute this finding. Students believed that lectures seemed to be the sole users of the Moodle messaging tools. If students used the Moodle messaging tool or tried to contact lecturing staff via email, students never received any replies to such emails or messages. Students were concerned that communications sent to faculty via Moodle messaging tools and emails were generally ignored.

Research Question 5

What impact does the use of Moodle at NUST have on the development of students' problem-solving skills?

The study found that both students and lecturers believed Moodle at NUST has promoted rational thinking and independent thinking and capacitated students to seek multiple paths to analyse problems. While most of the students thought that using Moodle at NUST had led to developing problem-solving skills, lecturers disagreed. Most of the lecturers believed that students' engagement in discussion forums in Moodle did not develop students' ability to think critically. Finally, lecturers were asked to indicate the extent to which the use of Moodle as an LMS had led to increased problem-solving skills among students in their classes. Most of the lectures noted (Figure 31) that the use of Moodle at NUST had contributed to a poor extent towards increased students' problem-solving skills. Figure 31 shows that 48.6% of the respondents reported that using Moodle as an LMS led to increased problem-solving abilities among students to a poor extent in their classes. It is also

claimed that despite the many efforts of scholars to investigate critical thinking theories and pedagogies, getting students to an acceptable level of solving problems remains a challenge (Hatcher, 2013).

Research Question 6

What strategies can NUST adopt to increase Moodle's effective and safe use as an LMS?

Strategies to Increase the Effective and Safe Use of Moodle

In terms of an approach to increase the effective and safe use of Moodle, students, lecturing staff and administrative staff came up with different suggestions depending on the needs of the participants.

The top six requests from students were:

- Improvement of Moodle training/orientation to students,
- Provision of internet and devices (laptops) to access Moodle,
- Strengthening of technical and student support structures at NUST,
- Improvement of the general communication between lecturing staff and students via Moodle,
- Allowance for more synchronous engagement opportunities between course participants, and
- Regular and on-time announcement of tests and sharing of information.

Hossain and Rahman (2017) found that students from their studies needed to enhance their internet usage and further suggested that the university provide internet facilities and an internet connection. It implies that the university should offer both the internet and the device to access online learning.

Additional strategies to put in place to increase the effective use of Moodle were:

- test schedules should be communicated on time to reduce panic and frustration,

- the design of Moodle courses and the quality of online teaching with Moodle needs improvement,
- the performance of the system should improve significantly for off-campus usage,
- assignment feedback to be provided on time,
- allow students access to the Turnitin website to scan assignments beforehand,
- suggestions for tutorials on how to navigate the Moodle platform
- recommendations that course resources need to be uploaded on time,
- increase the awareness of Moodle,
- on-time enrolment of students by the university staff,
- improve the user-friendliness of Moodle,
- reasonable time to complete assessments,
- more video classes,
- prevention of more than one device from logging in on the same Moodle account simultaneously,
- treat distance education students better,
- prompt grading of assignments, and
- MS Teams accounts and students' passwords are not to expire.

Furthermore, study results informed that Moodle administrators and technical and student support teams at NUST must work together to improve the quality of online support to students and lecturers. University management must employ additional skilled staff to offer timely Moodle support across all faculties. Such an initiative may alleviate workload challenges from the Moodle technical support team of two employees tasked to serve the entire university. Additionally, feedback shows it is advisable to curtail the psychological impact of a skeleton

Moodle technical support team, facilitate capacity building to reskilling the available student support staff at COLL, and faculty could alleviate workload demands.

Although most students had access to Moodle using their own devices, the digital divide persisted. Some students accessed Moodle tasks and tests using the laptops and cellphones of friends and family members. Using smartphones to type and submit Turnitin assignments had been described as inconvenient, which warrants additional actions from the university to meet the needs of students. This study also concluded that students continued to use the default passwords issued when they accessed Moodle for the first time. Consequently, fellow students may illegally access Moodle accounts if passwords are not updated. Finally, more controlled measures should be adopted to secure the confidentiality of the assessment of students on the MyNUST e-learning platform, as only designated admin staff should be allowed access to Moodle's online tests and examinations. The following section discusses the suggested e-learning strategy for NUST.

Suggested E-learning Framework for NUST

Figure 34 illustrates a suggested e-learning strategy for NUST. The proposed approach is a merger of research conducted by Khan (2001) and Elameer (2012). The strategy contains twelve dimensions: institutional, monitoring and evaluation, content control, interface and course design, technological human resources capacity building, wireless technology, standardisation and stability, management, time, pedagogical, ethical, and technical.

Institutional Dimension

The institutional dimension is the first dimension, constituting four categories: administrative affairs, academic affairs, student services and e-learning support services. The first three items were inherited from Khan (2001), and an additional item, ‘e-learning support services, was added to the original model. The new item was included in response to the urgent need for a solid e-learning support framework for students and faculty in the current

study. The adapted institutional dimension seems promising. From the moment students and academics join the institution, a support team will be readily available to provide for all e-learning needs of all LMS users – the entire NUST Moodle community.

Monitoring and Evaluation

The second dimension, monitoring and evaluation, was labelled as a factor that hindered the effective use of Moodle as an LMS in the present study and described as:

> *I give HODs access to my classes at the beginning of the semester to assess the quality of the class. Therefore, I would suggest surprise visits to identify any possible problems and training in this regard. There is a common resistance to change within the staff, so I suggest that staff be trained with the skills necessary to effectively carry out online teaching. Lecturers are still stuck in the old ways of reading from a book. (Lecturer 2)*

Khan's original model only mentioned 'evaluation'. This study found that 'monitoring' was a lacking criterion to evaluate the effective use of Moodle as an LMS at NUST. Consequently, merging monitoring and evaluation was necessary to create an opportunity to monitor staff before an evaluation commenced. As such, the suggested strategy aims at monitoring and evaluating the following areas associated with content development, e-learning environment, e-learning programme/course and institutional elements. Successful online teaching needs to be monitored closely before an evaluation commences. Therefore, the suggested strategy advocates for the inclusion of 'monitoring' as a criterion.

Content-Control

The third dimension, content control, was not included in the original e-learning framework suggested by Khan. However, this dimension was an item added by Elameer (2012) and indicates that course content should be constructive, cooperative, collaborative and interactive. The present study found that the interactive tools of Moodle were hardly used at

NUST. Thus, a high premium was placed on the interactivity of course content in blended learning and e-learning settings.

Interface and Course Design

The fourth dimension of the suggested strategy refers to the interface and course design elements (Elameer, 2012; Khan, 2001). Interface and course design should contain aspects of simplicity and user-friendliness. The open-ended survey responses from students (see Figure 33) refer to the suggestions from students that they would like to see some interface and course design changes. It was, however, essential to merge the two criteria due to the relativeness of the two concepts. Dixson (2010) suggests incorporating meaningful and ample methods to interact with students constantly and promote active learning. Thus, course designers must revamp and redesign online components to increase the online courses' effectiveness and ensure quality instruction (Estacio, 2017).

Technological Human Resources Capacity Building

The fifth dimension involves technological human resources capacity building, which was also lacking in the present study. Administrative Coordinator 2 proclaimed:

> *... the problem is the transfer of the skills that they have to make it work in terms of it being able to cater to everybody. 'So, there's a time that we had requested from that unit certain functions of e-Learning, how they operate, how they can set up so that we were able to do certain things on our own without really necessarily having to depend and rely on their availability, which at most times it's not the case. Uhm, so, if those skills could be transferred over to other colleagues within sub-departments of the university, every section would be able to do minimal work without really having to contact the TLU section for their human capital in instances where they generally are able to do the work themselves.*

An ideal situation would be to transfer e-learning competencies to all departments university-wide, which will add to the advantage that each department will operate independently, adhering to students' and lecturing staffs' needs. As such, e-learning support will be available almost immediately, and students and staff will not need to wait hours or days to get the desired assistance. Also, students and staff would no longer queue to get the necessary support.

Wireless Technologies

The sixth dimension refers to wireless technologies inherited from Elameer (2012). This dimension includes the items of Wi-Fi infrastructure, hardware and software. According to Khan (2003), access to wireless technologies enabled organisations to improve and redesign their educational settings.

Standardisation and Stability

The seventh dimension refers to standardisation and stability. These two items were also lacking in the present study, as interviewees complained about the absence of a standardised course design and layout approach. The present study reported that when students write online tests and examinations, especially during peak hours, the NUST e-learning system collapses and cannot handle the traffic.

Management Element

The eighth dimension refers to the management element, also inherited from Khan (2001) and contains (1) people, process and product, (2) the management team for general management, (3) managing facilities, (4) purchasing and distribution of devices and data packages and (5) managing the e-learning environment. Item (3), managing facilities and item (4), purchasing and distributing devices and data packages, were not part of Khan's original e-learning Framework. However, for NUST to succeed in offering e-learning, a need exists to provide items (3) and (4) as additional management services at NUST. The

management of facilities links to reports made about facilities that are difficult to access on campus, such as access to ICT rooms. The issue reported that several of the computers in the library are not functional.

Time Element

The ninth dimension refers to the importance of time for multiple stakeholders to perform responsibilities. These include availability and allowing time for students and facilitators to optimise learning, teaching and assessment. Additionally, the organisation should make time available to perform updates and upgrades. This item was absent in the global e-learning framework of Khan but included in Elameer's e-learning framework.

Pedagogical Element

The tenth dimension refers to pedagogical aspects, including content analysis, audiences and goals, design approaches, instructional strategies, organisation and blended learning strategies. During the semi-structured interview, academics indicated the necessity for pedagogical advice and assistance, especially when using an LMS as a teaching enabler. Also, during the semi-structured interview, Lecturer 1 referred to incorporating elements of humour during lectures. He also adopted an active learning approach where students are involved in the lesson by allowing them to present specific topics and peer review students' involvement. Furthermore, the educational technologist strongly believed that a uniform and agreed course design approach should be considered. However, such an initiative requires the involvement of lecturers and Moodle support staff to share their best practices regarding possible course design ideas before implementation.

Ethics

The eleventh dimension refers to ethics and encapsulates seven items: social and cultural diversity, geographical diversity, learner diversity, digital divide, LMS access control, etiquette and legal issues. Items referring to challenges related to the digital divide

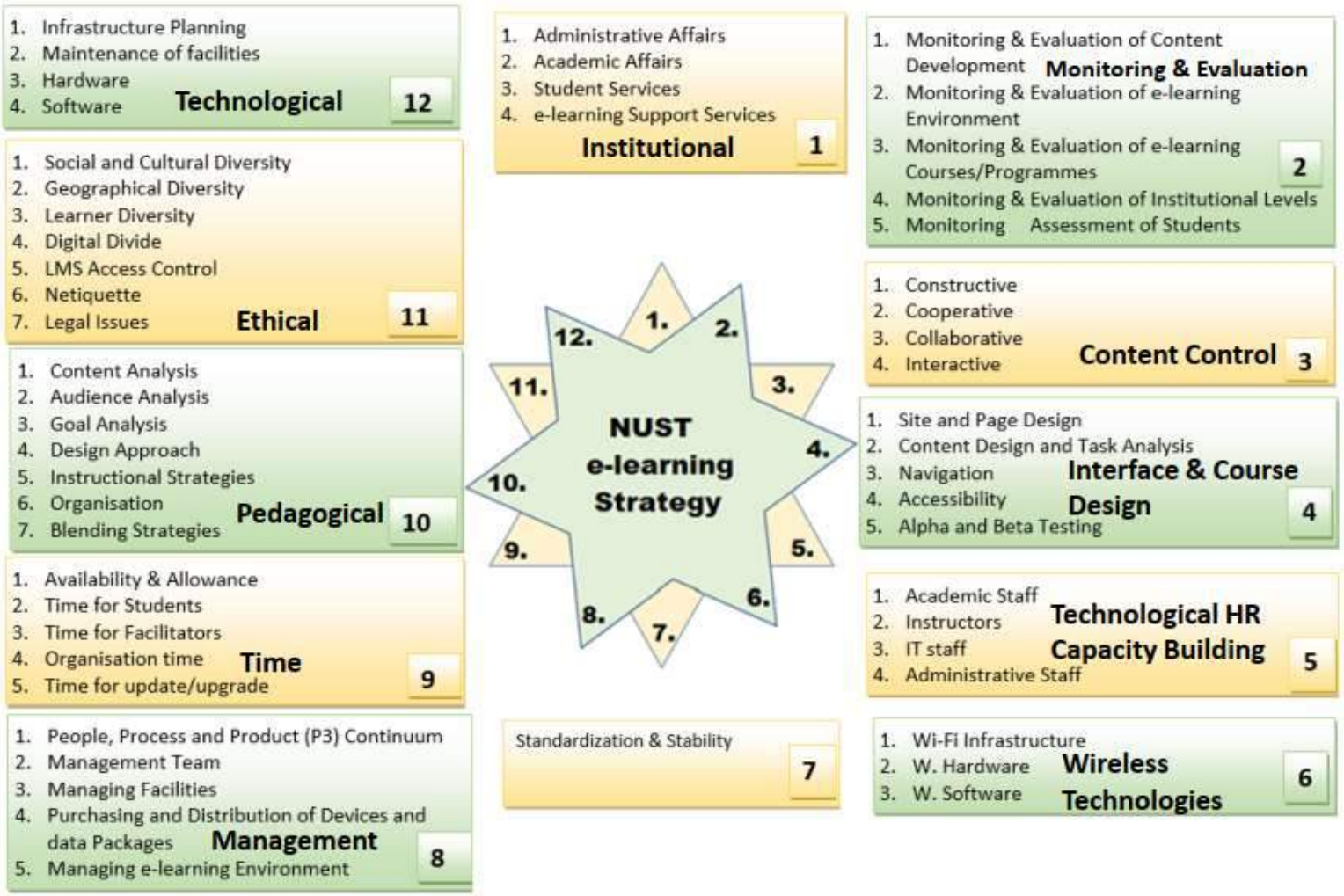
of students and LMS access control irregularities were also reported as factors that hinder the effective use of Moodle as an LMS in the present study. There was also a need to add the 'LMS access control' as an item for discussion. The last item refers to the issue that Moodle assessments at NUST are not confidential and that too many staff members have access to such items on the LMS. It was argued that access to Moodle assessments should be exclusively restricted to the examination department and academic coordinators.

Technical

The twelfth dimension is 'technical' and encapsulates four items: infrastructure planning, facilities maintenance, hardware and software. Without these three items, no organisation can render effective e-learning services. According to Amalou (2006), the technological component highlights the demand for obtaining the most appropriate LMS. Literature confirms that the technology dimension relates to technical infrastructure, hardware, software, the learning environment and the tools required to deliver the course successfully (Khan, 2003; 2010; Singh, 2003).

Figure 34

Suggested E-learning Strategy

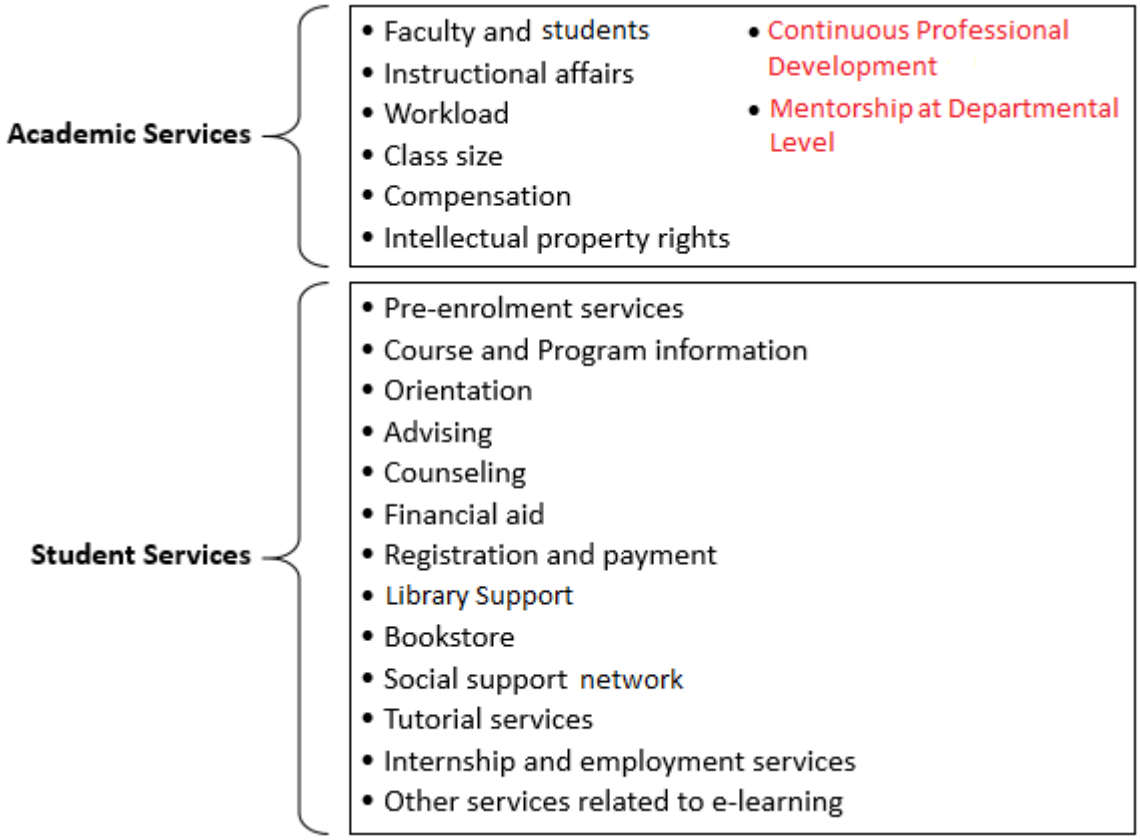


Note. Adapted from B. Khan (2001) and Elameer (2012)

Figure 35 presents an adapted version of Khan's Institution Dimension, illustrating academic and student services in higher education (Khan, 2001). The suggested e-learning strategy added two additional items to the academic services dimension: continuous professional development and mentorship at the departmental level. The study found that if an organisation aims to use Moodle as an LMS effectively, ongoing professional development and mentorship at the departmental level are inevitable to the supply of academic services.

Figure 35

Institutional Dimension



Note. Academic and Student Services. Adapted from B. Khan, 2001.

5.2 Recommendations for Application

The recommendations are based on what this study considers essential to increasing the effective use of Moodle as an LMS at NUST. Based on the findings and conclusions of this study, the following recommendations are suggested.

Increase Responsiveness

While some success has been achieved regarding the effective use of Moodle as an LMS at NUST, the results discussed in the previous chapter raise many pertinent recommendations for the improvement of the effective use of Moodle as an LMS.

Since a low level of activity in the usage of Moodle teaching tools was found, qualifying staff at COLL and TLU at NUST should consider the urgency of availing online and face-to-face Moodle orientation to faculty, support staff and students. Although the institution offers Moodle orientation in an open online course, alternative actions are required to improve the current Moodle orientation course. In collaboration with the instructional designers at COLL, staff at the TLU should design and provide effective face-to-face and online Moodle orientation and training to students.

A compulsory face-to-face Moodle orientation programme should be offered over two days at the beginning of each semester to all first-year and interested senior students. Moodle tutorials should be provided to students, and a series of videos will help students gain familiarity with the MyNUST e-learning platform (Moodle). Such an intervention will introduce students to the different interactive tools they may use throughout their study journey at the university. Some functionalities of Moodle are complicated to use, according to Aljeeran (2016), who researched the influence of socio-cultural aspects on faculty members' acceptance of Moodle at GUST. Thus, the complexity of Moodle makes it difficult for course participants to use some of the Moodle functionalities successfully. As a result, faculty members become irritated and discouraged from using certain Moodle features.

Faculty members require further training to improve their skill set in using Moodle's more complicated features.

The following areas should be covered during the Moodle orientation:

- A general overview of Moodle as an LMS;
- Overview of Moodle password policy to increase the safe use of the LMS;
- Logging in;
- Accessing courses;
- Using enrolment keys;
- Students' ICT support;
- Completing activities;
- Watching videos;
- Downloading items,
- Uploading assignments,
- Uploading Media;
- Editing your profile,
- Bookmarking links;
- Changing the default PDF viewer;
- Internet Connection Notice; and
- Logging out.

The Moodle orientation programme needs to be evaluated continuously to establish whether the courses' objectives align with students' needs.

TLU should offer separate Moodle training to faculty, administrative coordinators and student support staff in smaller departmental/unit level groups to increase opportunities for practical involvement during training sessions. Such sessions should be scheduled for two days per semester. Training sessions should be available at various levels of

competencies, viz. basic, intermediate and advanced levels of competencies. A needs assessment should be conducted at departmental levels to establish additional needs of students to be included in the orientation programme. Moodle orientation should be offered both face-to-face and virtually. According to Khan (2000), conducting a needs analysis is one technique to determine the needs of online course participants. Face-to-face engagements can be offered, making use of on-campus venues. Recordings of the Moodle orientation programme should be available on the open Moodle orientation online course, accessible to students across all faculties and study years at NUST.

Acquisition of Human Capital to Provide Technical Support

Recommendations in this section should be implemented within three months. Relying on the services of two individuals to provide Moodle assistance to the entire institution at the TLU resulted in a slew of problems, including increased workload, psychological and health concerns. The interview findings revealed that staff members at DICT, COLL, TLU and faculty need to work after hours. A dedicated support team should be established to provide on-demand technical support to Moodle users after hours. Each faculty should have at least two technical specialists to provide pedagogical and technical support.

To cut operational costs, recruiting interns to provide after-hours technical support may also provide relief to the full-time Moodle support staff members. If one individual cannot provide the desired assistance due to illness, another may be available.

COLL should forward a request to TLU to transfer technical skillsets to faculties/schools/units/departments. Upon approval of such a request, TLU may finalise training resources and dates to offer the desired training to qualifying COLL staff and faculty. The above recommendations aim to address the staff shortage's psychological impact. A Moodle skill needs assessment should be conducted to establish the needs of

Moodle users at departmental/school/unit levels. Training should be offered that aligns with the needs of Moodle users. Such an intervention may address the challenges related to the exhaustion of staff members due to demanding workload and role confusion. Extensive training should be offered to the examinations department to equip the team with the required skill set to take full responsibility for the administration and coordination of Moodle assessments and examinations. Such an action may be beneficial as the confidentiality of all assessments conducted at NUST will be strengthened.

Course Design Improvement

Within six months, the e-learning committee should spearhead the adoption of an approved course design template to be used by all departments to ensure consistency and quality in course design and the delivery of online teaching. COLL's courseware development team, TLU and faculty should collaborate. All faculties should consider designing course content using similar pedagogies and methodologies. Course creation strategies, such as COLL's structural approach, could be exchanged amongst COLL and various faculties to find the optimal solution.

Improvement of the Quality of Online Teaching

As the institution did not have any formal measures to assure quality teaching, the online engagement with students on Moodle should be examined to create opportunities for course evaluation by students regularly. A forum should be established for students to communicate the quality of their classes. By depending on pedagogies that drive active online learning, faculty could effectively teach online by bringing humour to their online courses. Lecturers can ensure that the online learning process is enjoyable; in certain situations, class presentations may include a humorous element. Full-time, part-time and distance education students should all have access to the same high-quality information. The instructors should be just as committed to distance students as they are to full-time students.

Student presentations were suggested to include students in the educational process. Before a lecture, students should be allowed to present a topic briefly. The latter should be done to boost students' self-esteem and enthusiasm for the subject. Galvis (2018) observed that relying on practical managerial commitment allows management to recognise lecturers' efforts to devote time to developing course material and their roles as course facilitators and moderators.

Students' presentations may be recorded and uploaded to Moodle. It was explained that "motivating one's students" necessitates understanding their unique strengths and limitations or profile. Students may also be permitted to participate in group work and peer evaluations. Moodle instructors could be responsible for developing high-quality, engaging instructional materials that encourage students to use available resources best. The above suggestions should be tabled to various heads of departments for immediate consideration. According to Khan (2007), pedagogy is linked to teaching and online learners' learning needs. Students must engage within an online setting, and a proper means of engagement must be considered to meet their learning objectives (Khan, 2010). According to Elameer (2012), lecturers should be rewarded for contributions to e-learning or blended learning programmes beyond their instructional responsibilities. Furthermore, departmental heads should be linked to MS Teams classes and Moodle courses to monitor the implementation of the above suggestions. In blended learning environments, successful online learning is judged not by the number of hours students spend online but by the quality of teaching and resources provided in online modules (Estacio, 2017).

Efficient Communication Opportunities

Heads of departments should address the reluctance of lecturing staff to respond to students' requests via email and the Moodle messaging tools at the departmental levels. The following short-term considerations should be implemented within three months. Lecturing

staff should be trained to use the communication tools available in Moodle effectively. It is worth mentioning that Moodle messages are also received via the staff webmail services. However, lecturers should log in to the Moodle platform to respond to students' requests. Thus, the university should develop a Moodle communication policy to provide a framework for faculty and administrative staff to communicate via Moodle across all faculties.

Lecturers should be included in student WhatsApp groups for efficient communication in blended learning environments. Lecturers and course coordinators should also be members of the groups to promote direct communication. A class representative is vital and beneficial because they foster communication between students and the lecturer. In this case, the student may vent grievances with the class representative, which can be discussed with the lecturer later. It is suggested that sectional heads be linked as managers on Moodle courses to monitor Moodle communication between students and lecturing staff. DICT should introduce the ticketing system for the student helpdesk. AN LMS is especially beneficial for administering and facilitating content, designing learning activities, creating online assessments and exams, assessing classes, and improving communication between lecturers and students (Jakchaikul, 2015).

Improvement of Moodle Performance from the Outside

Moodle performance difficulties were caused by inadequate network access from the outside. Most students had issues loading pages due to unreliable or sluggish internet connections experienced by off-campus Moodle users. Using Moodle requires internet access, and even if the system runs on the fastest hardware available, slow network connectivity from the outside will inevitably slow it down. Consequently, to address the abovementioned challenges, the university management should communicate the inefficiency of the current data packages with the existing internet service providers. Moodle

pages take time to load with the recent data bundle packages, and students risk running out of data while taking a test.

The university management should renegotiate for improved data bundles supplied by the current internet service provider, as the performance of internet packages was unsatisfactory and did not suit the needs of students. Such an intervention may allow off-campus Moodle users access to stable and reliable internet. The above short-term recommendation should be implemented within one year. Having access to the internet, increased possibilities for online participation, readily available technical help, a high level of self-discipline, confidence in spoken communication and teaching abilities are essential in enhancing instructors' responsiveness to Moodle (Alshammari et al., 2016).

Adequate Access to On-campus Computers

Allowing students to submit handwritten assignments poses real threats to any educational institution. The current digital age increases the possibility of academic dishonesty and plagiarism. Students without a reliable computer should be encouraged to use the facilities at the writing centre, library or ICT venues. The following actions are suggested for implementation within one year.

- Sectional heads should make a list of needy students, forward a request via the Office of the Dean of Students to the Director of Facilities, and ask permission to allow the identified students access to on-campus facilities.
- An additional service, a 24/7 university internet venue, should be established to allow students who face challenges submitting tests or assignments to access devices and the internet.
- The Dean of Students may consider tabling a request to purchase affordable computers directly from wholesalers and avail such computers to needy students at a reasonable

price. The university should provide internet access or devices to disadvantaged students to access the Moodle platform from home.

- The university should consider providing internet access and devices (laptops) to increase access to Moodle and narrow the digital divide challenges. The ethical component includes socioeconomic and cultural diversity issues, digital divide concerns, and ethical concerns such as [n]etiquette (Khan, 2010).

Turnitin Assignment Submissions of Non-enrolled Students

The following are short-term considerations for implementation within three months. The university should provide clear guidelines to faculty and administrative coordinators to pave the way in dealing with non-enrolled students regarding Turnitin assignment submissions. Non-enrolled students were also mentioned as a source of irritation caused by Moodle. When it is time to submit grades, it is discovered that a student had access to the course as a non-enrolled student. Non-enrolled students cannot view their submissions, and Moodle does not keep records of students' grades falling into this category.

Consequently, assignment submissions are neither shown in the Moodle grade book nor on the downloaded Moodle grade lists. Before grading assignments and online tasks commences, lecturers should ensure that all students in a specific class group are legitimately enrolled Turnitin users. Special efforts should be made to ensure that the same student does not have two Turnitin accounts. It was established that the issue of non-enrolled Turnitin status is rooted in the fact that one student has been enrolled double on Turnitin, which confuses the system. Students should be encouraged to accept Turnitin license agreements to illuminate the matter of unenrolled student assignment submissions. Alternatively, lecturers should keep records of the grades of non-enrolled students. Students with non-enrolled Turnitin status may fail, as Moodle does not record the assignment grades of non-enrolled students in the grade book.

Unauthorised Access to Students' Moodle Accounts

Students suffered mentally due to the worry and uncertainty about the management and consequences of unauthorised access to their Moodle accounts. The following are short-term considerations for implementation within one month. Deans and heads of departments should develop a policy to provide faculty and administrative coordinators guidelines on managing situations where students' Moodle accounts are accessed illegitimately by fellow students to access online tests and examinations. Moodle users should be urged to update their passwords regularly to ensure the platform's security.

Password Policy

Introducing a password policy that mandates all Moodle users across the institution to change their passwords regularly is encouraged. Password policies require all Moodle users to use strong passwords to prevent unauthorised users from accessing the site (Moodle, 2020). Restrictions should be implemented to protect the confidentiality of student assessments, such as allowing only designated administrative employees access to Moodle online tests and exams. Access to Moodle tests and exams should be limited to the course facilitator, administrative coordinator and the examination officer.

Increased Opportunities to Promote the Effective Use of Moodle

Chances should be increased for students to use Moodle more effectively. As such, with immediate effect, the following actions should be considered by the faculty:

- Assignments should be graded on time, and feedback on assignments should be supplied as soon as possible,
- Course materials should be uploaded on time,
- Course announcements should be made on time,
- The university staff should ensure that students are enrolled on time,

- A reasonable amount of time should be given to students to complete and submit assessments,
- More recorded video classes should be availed to students on Moodle,
- Distance education students should be treated in a similar fashion as full-time and part-time students are treated,
- The grading turn-around time of distance students' assignments should be improved,
- Test announcements and information sharing should be made on a regular and timely basis,

Furthermore, course facilitators should allow for increased synchronous participation amongst course participants. This item refers to students' and lecturers' lack of online presence. The CoI paradigm assumes that higher-order learning in any educational context necessitates the formation of a community based on active collaboration between study participants (students) and the teacher (Garrison et al., 2000).

TLU and DICT should take the following actions to increase the opportunities for students to use Moodle more effectively.

- Students should be prevented from logging in to the same Moodle account simultaneously time using multiple devices,
- Students should have access to the Turnitin website so that they can scan assignments ahead of time, and
- Moodle's user-friendliness should be improved.

Heads of departments should take the following actions to increase the opportunities for students to use Moodle more effectively.

- Monitoring and evaluation reports should be completed and discussed with lecturing staff to uncover any potential difficulties or training shortages to improve teaching, learning and assessments using Moodle as an LMS,

- Because staff members are often resistant to change, they should be taught to deliver online instruction properly, and
- Lecturers should be encouraged to adopt 21st-century pedagogies.

Before an institution chooses a specific LMS, the following criteria must be carefully considered (Ulker & Yilmaz 2016).

- The number of users who will make use of the software,
- The status of people's encounters with the software,
- The availability of human resources to train staff on how to use open-source software,
- Project requirements and scope considerations,
- The number of employees who will benefit from training on how to utilise the LMS successfully,
- Future capacity requirements,
- The applicability of the open-source LMS feature,
- The degree to which customisation is necessary,
- The cost of setting up the LMS,
- Meaningful discussions about technical support, given the scarcity of technical support services in an open-source LMS,
- The capacity of the IT unit to combine their expertise and knowledge with documentation and forums to solve problems,
- Considerations in terms of the LMS's sustainability,
- The timeline for addressing any security vulnerabilities, and
- Considerations of the time frequencies required for new hardware and web technologies incorporated in the LMS.

Given the extensive planning process and initial talks that precede the selection of a specific LMS, the relevance of technical specialists and available information technologies

during the deployment and management of LMSs cannot be overstated (Elameer, 2012; Khan, 2000; 2010).

5.3 Recommendations for Future Research

Continuous research in educational technology and the use of LMS is required. As the LMS tool becomes more integrated into the teaching and learning process, more credible academic research on its impact on academic achievement should be conducted. Table 9 lists that 59.2% of the students agreed or strongly agreed they feel lost and unsure about their ability to manage online learning, and 53.1% agreed or strongly agreed that studying online creates a feeling of isolation from peers. The items above refer to students' psychological threats using learning technologies in a blended learning setting. Moreover, the interview findings revealed that handwritten assignments are rejected by the university, despite serious internet challenges and the impact of the digital divide in remote areas.

In addition to the difficulties mentioned above, it was reported that the performance of the Moodle server at NUST is disappointing during peak hours when vast numbers of students take tests simultaneously. Worse, technical support is not always available on time, forcing administrative coordinators to cancel tests and online exams. New tests and examinations must be set in case tests have been withdrawn. Such a decision adds to the demanding workload of administrative staff and academics who must invest additional time and effort to reset and reschedule assessments. For future research, it is recommended to conduct a qualitative study to investigate how teaching, learning and assessment through Moodle influence students psychologically in remote areas. It would be prudent to conduct a comparative analysis with other higher education institutions to identify parallels and variations in participants' perspectives on Moodle's utilisation in the teaching-learning and assessment at their various universities.

The present study found that about 39% of the participants (students) agreed that accessing the MyNUST e-learning Platform/Moodle makes communication with lecturers easier. Equally, the open-ended responses embedded in the survey questionnaire revealed

disappointment in how distance students were treated. Concerns were raised that the lecturing staff was reluctant to respond to email communication from students. Consequently, a quantitative study in a similar context should be conducted to establish the relationship between using Moodle's communication tools and increasing students' academic performance.

According to the findings of this study, an ideal situation would be to transfer e-learning competencies across the university, which has the advantage of allowing each department's independent blended learning operations while meeting the needs of students and staff. As a result, e-learning support will be available almost immediately, and students and staff will not have to wait hours or days for assistance. Students and faculty will no longer have to wait in line to receive help. The present study provides a list of recommendations from students, academics and administrative staff. This investigation may provide direction for future research to improve students' and academics' learning and teaching experiences at the research site and similar institutions to implement stakeholders' recommendations.

The absence of facilities and amenities in higher education institutions, such as high-speed internet connections, affects learning experiences in blended and online learning environments, according to Panyajamorn et al. (2018). Further studies need to be conducted to establish the impact of internet speed in higher education settings and students' motivation levels. Future research can be conducted to compare first-year students' online learning experiences using an LMS in science, technology, engineering and mathematics fields to those of senior students. A related study revealed that when it came to online test scores, it was clear that students living off-campus thought their online test results were better than traditional paper tests (Tshabalala et al., 2014). Surprisingly, a similar study found that good test scores are linked to collaborative cheating, in which off-campus students coordinate with

on-campus students to achieve higher grades (Basitere & Ivala, 2017). The latter study demonstrates that institutions must be aware of the possible obstacles students may experience while employing educational technologies to facilitate blended learning, particularly in developing countries where resources are scarce. Future research is encouraged in which leading online universities share best practices for dealing with academic dishonesty while taking online tests.

Academic leaders must understand how and why their faculty members use the LMS. They should be eager and able to deliver targeted professional development to faculty. The research is significant because it provides an overview to university executives of how instructors use the Moodle LMS in blended learning settings in a Namibian context. The present study's findings are essential to the Ministry of Higher Education, university management, and higher education internet service providers to underscore the physical and psychological challenges students are experiencing due to poor and unstable internet connection. Although academic leaders at NUST had already negotiated with internet service providers to provide students with data bundles and internet modems at reasonable prices, this study demonstrated that much more action is required to ensure stable, reliable off-campus internet connectivity.

Interview findings revealed that internet access and reliable devices are crucial to sustaining a blended learning environment. The feasibility of providing students with internet access and devices to access Moodle off-campus is an area for future investigation at the research site and similar settings. This study provided data on factors that promote and hinder blended learning in higher education. Academic leaders, faculty and administrative staff might find this study of significant value, especially to become aware of the factors that hinder blended learning.

The study outcomes are of particular value to NUST management to alert the e-learning centres to utilise Moodle effectively and securely to ensure the smooth integration and sustainability of blended learning using Moodle at NUST. The study may also be significant to instructional designers to be aware of any strengths and weaknesses associated with online course design, delivery and development to promote blended learning at NUST.

Furthermore, using Moodle in higher education helps improve course administration and reduces content cost, time and delivery (Byungura et al., 2016). Consequently, findings may prompt innovative skills among NUST information technology experts to devise new technologies and software to improve blended learning through Moodle institution-wide.

5.4 Conclusion

The study evaluated the effective use of Moodle as an LMS at NUST by the adoption of a mixed-methods study approach. The study results revealed a low activity level in Moodle tools, limited to downloading resources, submitting assessments and engaging in discussion forums. In the absence of a clear e-learning plan to enhance Moodle understanding at NUST, students and academics were challenged to utilise Moodle tools successfully. Regarding students' and lecturers' responsiveness to use Moodle tools, the study's findings might be significant for faculty and Moodle administrators to rethink and adjust the Moodle orientation/training programme. The study identified factors that promote and hinder blended learning settings in higher education. The obstacles faced by students and academics were slightly different. Study findings reiterated the crucial importance of adequate human capital displaying the required technical competencies to offer on-demand technical support to Moodle users to lessen the phycological impact of using Moodle as an LMS. The challenge of technical support was reported as experienced by students and academics. The non-availability of a dedicated technical support structure makes online learning extremely challenging to Moodle users.

The notion of students taking ownership of their studies, flexible chances to learn self-directedly, e-learning preparedness, being encouraged to study online, and adequate time to finish assignments were the most critical aspects that supported blended learning at NUST. On the contrary, the most significant barriers to blended learning at NUST for academics were a lack of training in small groups, difficulties adapting to online teaching, a heavy workload, and lecturing staff who were doubtful about their abilities to manage and support online education.

The results of the study indicate that factors which hinder successful blended learning include:

- lack of adequate Moodle training/orientation;
- challenges with internet connectivity and devices (laptops);
- challenges in accessing Moodle;
- inadequate technical and student support mechanisms, and
- ineffective communication between staff and students.

There was widespread concern that lecturers were hesitant to respond to emails and Moodle messages from students. Therefore, asynchronous interaction between course participants was low. Test announcements and information sharing on a regular and timely basis remained a challenge.

The results of the study suggested five themes related to the effective use of Moodle as an LMS: (a) availability of human capital to offer technical support, (b) course design, teaching, learning and assessment considerations, (c) security vulnerabilities on Moodle, (d) communication opportunities and (e) strategies to improve the effective use of Moodle as an LMS.

The use of Moodle at the research site mainly included downloading and submitting assignments, downloading course resources, and submitting online quizzes/tests. Each

faculty needs to have available technical, student and academic support structures to minimise frustrations associated with the latter challenges. The competency level of the support team is critical to supporting academics with pedagogical and technical issues. Staff shortage to deliver online technical support led to an increased workload that was already demanding as well as psychological and emotional problems, including frustrations, health issues and panic amongst Moodle users. It is recommended that a dedicated technical support team should be available to attend to Moodle technical glitches while students engage in online tests.

The safe use of Moodle as an open-source project depends on frequent server updates, upgrades and robust password policies. Students and staff need to know the importance of using strong Moodle passwords to prevent unauthorised access to Moodle accounts. Simplicity and user-friendliness are common goals for both interface and course design. Instructional designers, course writers, content editors, language editors, and quality assurers should collaborate at COLL to design and develop instructional materials for distance students. The development of instructional materials for distance students' usage is preceded by a rigorous training process spearheaded by a competent instructional design team.

Using Moodle as an LMS at the research site has increased course engagement opportunities. There was a low positive statistically significant association between students' level of communication using Moodle and students' level of course engagement. On the contrary, communication through Moodle has been heavily criticised by students. The association between students' responsiveness using Moodle tools and increased communication was assessed. The study could not establish a statistical relationship between students' responsiveness using Moodle tools and increased communication. However, a low positive statistical significance could be established between the lecturers' responsiveness

using Moodle tools and increased communication opportunities with students. Utilising Moodle as an LMS did not improve communication between students and lecturers.

Furthermore, the study established that Moodle promoted independent and rational thinking as an LMS but increased students' problem-solving abilities to a poor extent. Finally, the study results paved the way for an opportunity to develop a suggested strategy for NUST to encourage the effective and safe use of Moodle as an LMS. The proposed e-learning approach has been a merger of the Orbital E-education Framework and Khan's Octagonal Framework to evaluate Moodle as an LMS at NUST. Khan's Octagonal Framework allows educators to choose the right ingredients for adaptable learning environments (Khan, 2001). The Orbital E-Education Framework is especially beneficial for creating and developing e-learning platforms and performances in mixed-learning environments (Elameer et al., 2011). One distinguishing feature is its capacity to handle the sustainability challenges that other modern e-learning and blended learning models lack (Elameer, 2012).

The study's findings were highly satisfying to the researcher, who is delighted to have introduced an e-learning approach to NUST. Higher education institutions with a cultural and geographical background similar to the NUST may find the suggested e-learning strategy significant. Adequate Moodle orientation and training opportunities in e-format and face-to-face, provision of devices and internet, strengthening of technical student and academic support structures, an improvement in general communication between students and faculty and improved performance of the e-learning management system are amongst the suggestions for the effective use of Moodle in blended learning settings.

Providing enough training opportunities for course participants in blended and online learning contexts is critical to ensuring the effective use of Moodle technologies. In blended learning environments, the lack of training for online teachers and course participants

continues to be a problem (Mbuva, 2015; Raphael & Mtebe, 2016). Creating and delivering high-quality teaching and learning in Moodle takes time, but one of the essential components of using Moodle as a learning management system (Estacio, 2017).

The study also demonstrated that the effective use of Moodle as a learning management system depends on access to a stable internet connection, reliable devices, adequate support technical structures for Moodle users, and sufficient and continuous Moodle training/orientation. Access to stable internet and laptops/computers to access learning resources, the design of Moodle courses and the development of learning resources is a collective responsibility of all higher education stakeholders at different positions and levels of autonomy at NUST.

This research adds to the conversation about how to use Moodle effectively for blended and fully-fledged online learning. This study comprehensively explains the elements that support and inhibit blended learning in higher education. The study also adds to the knowledge of the challenges Moodle users at NUST experience. The researcher was excited to perform an analysis that looked at how well Moodle was used at NUST in a blended learning scenario. Being part of this study was an experience that all the participants proudly embraced.

REFERENCES

Acunetix (2022). *What is SQL Injection (SQLi) and how to prevent it.* https://www.acunetix.com/websitesecurity/sql-injection/

Austin, Z., & Sutton, J. (2014). Qualitative research: getting started. *The Canadian Journal of Hospital Pharmacy*, *67*(6), 436-440. https://doi.org/10.4212/cjhp.v67i6.1406

Adekola, J., Dale, V., & Gardiner, K. (2017). Development of an institutional framework to guide transitions into enhanced blended learning in higher education. *Research in Learning Technology*. *25*. https://doi.org/10.25304/rlt.v25.1973

Adeola, F. O. (2018). WEEE generation and the consequences of its improper disposal. *Woodhead Publishing Series in Electronic and Optical Materials*. 13-31. https://doi.org/10.1016/B978-0-

Aguti, B., Walters, R. J., & Wills, G. B. A. (2013). A framework for evaluating the effectiveness of blended e-learning within universities. In R. McBride & M. Searson (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference*. (pp. 1982-1987). Chesapeake, AACE. https://pdfs.semanticscholar.org/44a6/68eef218e8b89a0fee183fcbd5886926f095.pdf

Akakandelwa, A., & Mkulama, A. (2017). Students' acceptance, experiences and satisfaction of online Learning: a case of study of Library and Information Science Students at the University of Zambia. *International Journal of Scientific Research and Innovative Technology*, *4*(12), 37-49. https://www.ijsrit.com/uploaded_all_files/3173494536_d4.pdf

Al-Ayed, S., & Al-Tit, A. (2021). Factors affecting the adoption of blended learning strategy. *International Journal of Data and Network Science*, *5*(3), 267-274. http://doi: 10.5267/j.ijdns.2021.6.007

Al-Busaidi, K. A., & Al-Shihi, H. (2010). Instructors' acceptance of learning management systems: A theoretical framework, IBIMA. *Publishing Communications of the IBIMA, 2* 1-10. https://pdfs.semanticscholar.org/f547/b4c77629e7752bd8a121e097085edcc926f5.pdf

Al-Husban, N. A. (2020). Critical thinking skills in asynchronous discussion forums: A case study. *International Journal of Technology in Education (IJTE), 3*(2), 82-91. https://doi.org/10.46328/ijte.v3i2.22

Aljeeran, R. K. (2016). *The role of socio-cultural factors in faculty members' acceptance of Moodle at GUST* (Order No. 10390700). https://www.proquest.com/dissertations-theses/role-socio-cultural-factors-faculty-members/docview/1874562453/se-2?accountid=188730

AlJeraisy, M. N., Mohammad, H., Fayyoumi, A., & Alrashideh, W. (2015). Web 2.0 in education: the impact of discussion board on student performance and satisfaction, TOJET: *The Turkish Online Journal of Educational Technology, 14*(2), 247-258. https://files.eric.ed.gov/fulltext/EJ1057329.pdf

Allen, I. E, & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States. The Online Learning Consortium.* http://online-learningconsortium.org/publications/survey/chang ing_course_2012

Allen, M. (2017). *The sage encyclopedia of communication research methods* (Vols. 1-4). Thousand Oaks, CA: SAGE Publications, Inc. https://doi.org/10.4135/9781483381411

Alsadhan, A. O., Alhomod, S., & Shafi, M. M. (2014). Multimedia based e-learning: Design and integration of multimedia content in e-learning. *International Journal of Emerging Technologies in Learning, 9*(3), 26-30.

Alsaleh, N. J. (2020). Teaching critical thinking skills: Literature review. *The Turkish Online Journal of Educational Technology*, *19*(1), 22-39. https://files.eric.ed.gov/fulltext/EJ1239945.pdf

Alshammari, S. H., Ali, M. B., & Rosli, M. S. (2016). The influences of technical support, self-efficacy and instructional design on the usage and acceptance of LMS: A comprehensive review. *The Turkish Online Journal of Educational Technology, 15*(2), https://search.proquest.com/docview/1807692484?accountid=188730

Amalou, D. (2006). *Technical and pedagogical comparative study of e-learning platforms for open and distance learning*, JYVÄSKYLÄ University of Applied Sciences. https://www.theseus.fi/bitstream/handle/10024/20419/TMP.objres.528.pdf?sequence=1

Amandu, G. M., Muliira, J. K., & Fronda, D. C. (2013). Using Moodle e-learning platform to foster student self-directed learning: Experiences with utilization of the software in undergraduate nursing courses in a Middle Eastern University. *Procedia-Social Behaviour Science*, *93*, 677-683. https://core.ac.uk/download/pdf/82485754.pdf

American Psychological Association (APA). (2017*). Ethical principles of psychologists and code of conduct.* https://www.apa.org/ethics/code

Anderson, T. (2017). *The theory and practice of online learning* (2nd ed.). Edmonton, AU Press.

Anney, V. C. (2014). Ensuring the quality of the findings of qualitative research: Looking at trustworthiness criteria. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS), 5*(2), 272-281. http://repository.udsm

Antonis, K., Daradoumis, T., Papadakis, S., & Simos, C. (2011). Evaluation of the effectiveness of a web-based learning design for adult computer science courses. *IEEE Transactions on Education*, *54*(3), 374-380.

Aristovnik, A., Tomaževič, N., Keržič, D., & Umek, L. (2017). The impact of demographic factors on selected aspects of e-learning in higher education. *International Journal of Information and Learning Technology, 34,* 114-121. https://doi.org/10.1108/IJILT-09-2016-0045.

Armellini, A., & De Stefani, M. (2015). Social presence in the 21st century: An adjustment to the Community of Inquiry framework. *British Journal of Educational Technology, 47*(6), 1202-1216. https://doi.org/10.1111/bjet.12302

Arum, R., & Roksa, J. (2011). *Academically adrift: Limited learning on college campuses*. University of Chicago Press.

Ary, D., Jacobs, L. C., & Sorensen, C. (2010). *Introduction to research in education* (8th ed.). Belmont, CA: Wadsworth, Cengage Learning.

Astleitner, H. (2002). Teaching critical thinking online. *Journal of Instructional Psychology, 29*(2), 123-138. https://www.researchgate.net/publication/239584097_Teaching_Critical_Thinking_Online

Atchley, T. W., Wingenbach, G., & Akers, C. (2013). Comparison of course completion and student performance through online and traditional courses. *The International Review of Research in Open and Distributed Learning, 14*(4), 104-116. http://www.irrodl.org/index.php/irrodl/article/view/1461/2685

Avazmatova, M. (2020). Significance of blended learning in education system. *The American Journal of Social Science and Education Innovations 29,* 507-511. https://doi.org/10.37547/tajssei/Volume02Issue08-82

Babbie, E. R. (2016). *The basics of social research.* Boston, Cengage Learning.

Badia, A., Martín, D., & Domingo, M. (2018). Teachers' perceptions of the use of Moodle activities and their learning impact in secondary education. *Technology, Knowledge and Learning.* http://doi: 10.1007/s10758-018-9354-3

Basitere, M., & Ivala, E. (2017). Evaluation of an adaptive learning technology in a first-year extended curriculum programme physics course. *South African Computer Journal, 29*(3), 1–15. https://doi.org/10.18489/sacj.v29i3.476

Basitere, M., & Ivala, E. N. (2015). The effects of Wiley PLUS web-based homework system on student performance in the chemical engineering extended curriculum program: Introductory Physics course. *International Conference on e-Learning, Academic Conferences International Limited.* http://www.scielo.org.za/pdf/sacj/v29n3/02.pdf

Basitere, M., & Ivala, E. N. (2017). An exploration of students' experiences of blended learning in a physics course at a University of Technology. *Journal of Social Development in Africa, 32(*1), 23-43. https://search.proquest.com/central/docview/2135050369/30DBD476591740F0PQ/2?a

Baškarada, S., & Koronios, A. (2018). A philosophical discussion of qualitative, quantitative, and mixed methods research in social science. *Qualitative Research Journal, 18*(1), https://doi.org/10.1108/QRJ-D-17-00042

Bassa, S. (2019). *The origin of Moodle learning analytics and its evolution so far*. https://e-learningindustry.com/origin-of-moodle-learning-analytics-evolution

Baturay, M. H., Gökçearslan, Ş, & Ke, F. (2017). The relationship among pre-service teacher's computer competence, attitude towards computer-assisted education, and intention of technology acceptance. *International Journal of Technology Enhanced Learning, 9.* 1-13. https://doi.org/10.1504/IJTEL.2017.10003119

Beckmann, J., & Weber, P. (2016). Cognitive presence in virtual collaborative learning: Assessing and improving critical thinking in online discussion forums. Interact.

Technology Smart Education, 13, 52-70. https://pdfs.semanticscholar.org/da0f/74a7dcb78b4743b0384163205d003fd90863.pdf?_ga=2.41983525.1235129339.1596998474-1881496042.1596998474

Bell, J. (2005). *Doing your research project: A guide for first-time researchers in education and social science.* http://lst-iiep.iiep-unesco.org/cgi-bin/wwwi32.exe/[in=epidoc1.in]/?t2000=027124/(100)

Benatar, S. R., & Singer, P. A. (2010). Responsibilities in international research: A new look revisited. *Journal of Medical Ethics, 36*(4), 194–197. https://doi.org/10.1136%2Fjme.2009.032672

Bergland, C. (2016). *How does your brain learn through trial and error?* https://www.psychologytoday.com/us/blog/the-athletes-way/201603/how-does-your-brain-learn-through-trial-and-error

Bernard, H. R. (2002). *Research methods in anthropology: Qualitative and quantitative approaches* (3rd ed.). CA: Walnut Creek, Alta Mira Press.

Bernstein, A. G., & Isaac, C. (2018). Critical thinking criteria for evaluating online discussion. *International Journal for the Scholarship of Teaching and Learning, 12*(2), 1-8. https://www.researchgate.net/publication/326618533_Critical_Thinking_Criteria_for_Evaluating_Online_Discussion

Bertram, C., & Christiansen, I. (2014). *Understanding research: An introduction to reading research.* Van Schaik Publishers.

Bhardwaj, P. (2019). Types of sampling in research. *Journal of the Practice of Cardiovascular Sciences, 5*, 157-163. https://doi.org/10.4103/jpcs.jpcs_62_19.

Bielefeldt, T. (2006). Teaching, learning, and one-to-one computing. In *International Society for Technology in Education National Educational Computing Conference*. San Diego,

https://sfs1to1laptopcommittee.pbworks.com/f/NCIS%2Blaptop%2Bresearch%2B2006.pdf.

Biesta, G. (2010). Pragmatism and the philosophical foundations of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Sage handbook of mixed methods in social & behavioral research*, pp. 95-118. Thousand Oaks, CA: Sage.

Bigelow, S. J. (2019). *Definition - information technology* (IT). https://searchdatacenter.techtarget.com/definition/IT

Bitsch, V. (2005). Qualitative research: A grounded theory example and evaluation criteria. *Journal of Agribusiness, 23*(1), 75-91. 2-21.

Blikstein, P. (2011). Using learning analytics to assess students' behaviour in open-ended programming tasks. *Proceedings of the 1st International Conference on Learning Analytics and Knowledge, ACM, Alberta*, pp. 110-116. http://dl.acm.org/citation.cfm?id=2090132

Boelens, R., Voet, M., & De Wever, B. (2018). The design of blended learning in response to student diversity in higher education: Instructors' views and use of differentiated instruction in blended learning. *Computers & Education, 120*, 197–212.

Boyce, C., & Neale, P. (2006). *Conducting in-depth interviews: a guide for designing and conducting in-depth interviews for evaluation input.* https://www.pathfind.org/site/DocServer/m_e_tool_series_indepth_interviews.pdf?docID=6301

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology, 3*(2), 77-101, https://doi.org/10.1191/1478088706qp063oa

Broadbent, J. (2017). Comparing online and blended learner's self-regulated learning strategies and academic performance. *The Internet and Higher Education, 33*, 24-32. https://doi.org/10.1016/j.iheduc.2017.01.004

Bryant, M. (2011). *20 years ago today, the world wide web opened to the public*. https://thenextweb.com/insider/2011/08/06/20-years-ago-today-the-world-wide-web-opened-to-the-public/

Byungura, J. C., Hansson, H., Mazimpaka, O., & Thashmee, K. (2016). Exploring teacher adoption and use of an upgraded e-learning platform for ICT capacity building at University of Rwanda. *IEEE. In IST-Africa Week Conference, 2016 IST-Africa Week Conference*, 1-11. https://doi10.1109/ISTAFRICA.2016.7530697

Cabero-Almenara, J. Arancibia, M. L., & Del Prete, A. (2019). Technical and didactic knowledge of the Moodle LMS in higher education. Beyond functional use. *Journal of New Approaches in Educational Research, 9(*1), 25-33. https://files.eric.ed.gov/fulltext/EJ1202917.pdf

Carr, W., & Kemmis, S. (1986). *Becoming critical: Education, knowledge and action research.* Deakin University Press. https://doi.org/10.4135/9781506335193.n4

Carvalho, S., & White, H., (1997). Combining the quantitative and qualitative approaches to poverty measurement and analysis. *The Practice and the Potential*, *366*, World Bank - Technical Papers. https://doi.org/10.1596/0-8213-3955-9

Castro, R. (2019). Blended learning in higher education: Trends and capabilities. *Journal of Education Information Technology*, *24*, 2523–2546. https://doi.org/10.1007/s10639-019-09886-3

Cavus, N., & Zabadi, T. (2014). A comparison of open source learning management systems. *Procedia - Social and Behavioral Sciences, 143* (14), 521-526. https://www.sciencedirect.com/science/article/pii/S1877042814043584

Çelik, L. (2011). Evaluation of the views of pre-service teachers taught with Moodle during the course named ‘instructional technology and material design’ on the use of teaching,

Procedia Social and Behavioral Sciences, 9, 1793–1797. https://doi.org/10.1016/j.sbspro.2010.12.402

Centre for Technology Enhanced Learning (2020). *KEATS forums: Asynchronous communication.* https://www.kcl.ac.uk/teachlearntech/assets/keats-forums-asynchronous-communication.pdf

Chalmers, D. J., Manley, D. & Wasserman, R. (2005). *Metametaphysics: New essays on the foundations of ontology*. Oxford University Press.

Chandra, K. R., Tatte, E., Ramachandran, M., Saravanan, V. (2022). Understanding blended learning advantages and limitations. *Contemporaneity of Language and Literature in the Robotized Millennium, 4*(1), 10-18. doi.org/10.46632/cllrm/4/1/2

Cheung, S. K. S., Kwok, L., Ma, W. W. K., & Yang, H. (2017). *Blended learning: New challenges and innovative practices. Lecture Notes in Computer Science, 10399*. Springer International Publishing. http://doi10.1007/978-3-319-59360-9

Chew, E., Jones, N., Turner, D. (2008) Critical Review of the Blended Learning Models Based on Maslow's and Vygotsky's Educational Theory. In: Fong J., Kwan R., Wang F.L. (Eds.) *Hybrid Learning and Education. ICHL 2008. Lecture Notes in Computer Science, 5169*. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-85170-7_4

Chiromo, A. S. (2009). *Research methods and statistics in Education. A student's guide*. Gweru: Midlands State University.

Chopra, S., & Dexter, S. (2009). The freedoms of software and its ethical uses. *Ethics and Information Technology, 1*(4), 287-297. https://doi.org/10.1007/s10676-009-9191-0.

Ciobanu, C., & Ciobanu, N. (2012). E-learning security vulnerabilities. *Procedia - Social and Behavioral Sciences. 46*. 2297-2301. https://doi.org/10.1016/j.sbspro.2012.05.474

Cleveland-Innes, M., & Wilton, D. (2018). *Guide to blended learning.* http://oasis.col.org/bitstream/handle/11599/3095/2018_Cleveland-Innes-Wilton_Guide-to-Blended-Learning.pdf?sequence=1&isAllowed=y

Clinton, G. (2011). Educating for critical thinking: Thought-encouraging questions in a community of inquiry. *Higher Education Research & Development, 30*, 357-370. https://doi.org/1080/07294360.2010.499144

Coates, H., James, R., & Baldwin, G. (2005). A critical examination of the effects of learning management systems on university teaching and learning. *Tertiary Education and Management*, *11*(1), 19-36. https://doi.org/10.1007/s11233-004-3567-9

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). Canada: Routledge.

Cole, D. R., Ullman, J., Gannon, S., & Rooney, P. (2015). Critical thinking skills in the International Baccalaureate's "Theory of Knowledge" subject: Findings from an Australian study. *Australian Journal of Education, 59*(3), 247–264. https://doi.org/10.1177/0004944115603529

Constantin, L. (2017). *Flaws in Moodle CMS put thousands of e-learning websites at risk.* https://www.csoonline.com/article/3183533/security/flaws-in-moodle-cms-put-thousands-of-e-learning-websites-at-risk.html

Costa, C., Alvelos, H., & Teixeira, L. (2012). The use of Moodle E-Learning platform: A study in a Portuguese University, *Procedia Technology, 5*, 334–343. https://doi.org/10.1016/j.protcy.2012.09.037

Courtney, M., & Wilhoite-Mathews, S. (2015). From distance education to online learning: Practical approaches to information literacy instruction and collaborative learning in online environments. *Journal of Library Administration, 55*(4), 261-277, 2015.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori, & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research*, (pp. 209-240). Thousand Oaks, Sage

Creswell, J. W. (2013*). Research design: qualitative, quantitative and mixed method approaches.* Thousand Oaks: Sage Publications.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches* (4th ed.). Thousand Oaks, Sage.

Creswell, J. W. (2015*). A concise introduction to mixed method research*. Thousand Oaks: Sage Publications.

Creswell, J. W., & Clark, V. L. (2011). *Designing and conducting mixed methods research* (2nd ed.). Thousand Oaks, Sage.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Thousand Oaks, Sage.

Crotty, M. (1998*). The foundations of social research: Meaning and perspective in the research process.* Thousand Oaks, Sage.

Dakowska, D. (2017). Higher education in Poland: Budgetary constraints and international aspirations, In J. Nixon (Ed.), *Higher Education in Austerity Europe*, (pp. 79-91). Bloomsbury. https://halshs.archives-ouvertes.fr/halshs-01532977v2/document

Damman, E. J. (2007). *Communication apprehension, information technology fluency, and Internet access as factors affecting college students' participation in in-class and online discussion.* [Retrospective Theses and Dissertations]. https://lib.dr.iastate.edu/rtd/15901

Dangwal, K. L. (2018) Electronic learning technologies. *International Journal of Educational Technology*, *8*(1), 11-22. https://ndpublisher.in/admin/issues/TLv8n1c.pdf

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020) Implications for educational practice of the science of learning and development, *Applied Developmental Science, 24*(2), 97-140. https://doi.org/10.1080/10888691.2018.1537791

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science, 24*(2), 97-140. https://doi.org/10.1080/10888691.2018.1537791

De Oliveira, P. C., Cumha, C. J., & Nakayama, M. K. (2016). Learning management systems (LMS) and e-Learning management: an integrative review and research agenda. JISTEM *Journal of Information Systems and Technology, 13*(2), https://doi.org/10.4301/S1807-17752016000200001

Dembo, M. H., Junge, L. G., & Lynch, R. (2006). Becoming a Self-Regulated Learner: Implications for Web-Based Education. In H. F. O'Neil & R. S. Perez (Eds.), *Web-based learning: Theory, research, and practice* (pp. 185–202). Lawrence Erlbaum Associates Publishers. https://psycnet.apa.org/record/2006-07018-011

Denzin, N. K., & Giardina, M. D. (Eds.). (2008). *Qualitative inquiry and the politics of evidence*. Left Coast Press.

Denzin, N. K., & Lincoln, Y. S. (2013). *Strategies of qualitative inquiry* (4th ed.). Sage Publications.

Dhakal, B. P., & Sharma, L. (2016). Virtual learning environment (VLE) in mathematics education. *Education Journal, 5*(6), 126-135. https://doi.org/10.11648/j.edu.20160506.11

Ding, L., & Kim, C. & Orey, (2017). Studies of student engagement in gamified online discussions. *Computers & Education. 115*. https://doi.org/10.1016/j.compedu.2017.06.016

Ding, L., Er, E., & Orey, M. (2018). An exploratory study of student engagement in gamified online discussions. *Computers & Education, 120*(1), 213-226. Elsevier Ltd. https://www.learntechlib.org/p/200480/

Dixson, M. (2010). Creating effective student engagement in online courses: What do students find engaging? *Journal of the Scholarship of Teaching and Learning, 10*(2), 1-13. https://files.eric.ed.gov/fulltext/EJ890707.pdf

Dollah, S., Abduh, A., & Rosmaladewi, R. (2017). *Benefits and drawbacks of NVivo QSR application.* https://www.researchgate.net/publication/320893973_Benefits_and_Drawbacks_of_NVivo_QSR_Application

Driscoll, D. L. (2011). *Introduction to primary research: Observations, surveys, and interviews.* https://wac.colostate.edu/docs/books/writingspaces2/driscoll--introduction-to-primary-research.pdf

Duque, C. T. (2021). *You are probably making your Moodle upgrade harder than it should.* https://www.lmspulse.com/2021/moodle-update-upgrade-3-6-1-mua-release/

El Bahsha, R., Daoud, M. I., & Jordan, A. (2016). Evaluating the use of Moodle to achieve effective and interactive learning: A Case Study at the German Jordanian University. *IEEE.* https://pdfs.semanticscholar.org/e8b1/8cf44b09cd78540c47282feb3bccd352af08.pdf

Elameer, A. (2012). From Khan Octagon E-Learning to the Orbital E-Education - A new E-Education framework for Iraqi Higher Education (IHE). Special Issue of the International *Journal of the Computer, the Internet and Management, 19*(SP2), 23-24. https://www.researchgate.net/publication/273418987_From_Khan_Octagon_E-Learning_to_the_Orbital_E-Education_A_New_EEducation_Framework_for_Iraqi_Higher_Education_IHE

Elameer, A. S., Idrus, R. M., & Jasim, F. A. (2011). Elameer-Idrus Orbital e-education framework for the University of Mustansiriyah (UOMUST), *TOJET: The Turkish Online Journal of Educational Technology, 10*(4), https://files.eric.ed.gov/fulltext/EJ946623.pdf

Elameer, A., & Idrus, R. M. (2012). From Khan Octagon E-Learning to the Orbital E-Education - A new E-Education framework for Iraqi Higher Education (IHE). *Special Issue of the International Journal of the Computer, the Internet and Management, 19* No. SP2, 23-24. (PDF) From Khan Octagon E-Learning to the Orbital E-Education: A New E-Education Framework for Iraqi Higher Education (IHE) (researchgate.net)

El-Bahsh, R., & Daoud, M. (2016). Evaluating the use of Moodle to achieve effective and interactive learning: A case study at the German Jordanian University. In the *Proceedings of the 35th Annual IEEE International Conference on Computer Communications*. 1-5. https://www.semanticscholar.org/paper/Evaluating-the-Use-of-Moodle-to-Achieve-Effective-%3A-Bahsha-Daoudb/e8b18cf44b09cd78540c47282feb3bccd352af08

Elkaseh, A. (2015). The acceptance of E-learning as a tool for teaching and learning in Libyan Higher Education. *International Journal of Information Technology (IIJIT), 3*(4), 1-11. http://www.ipasj.org/IIJIT/IIJIT.htm

Estacio, R. R., & Raga Jr, R. C. (2017), Analysing students online learning behavior in blended courses using Moodle. *Asian Association of Open Universities Journal, 12*(1), 52-68. https://doi.org/10.1108/AAOUJ-01-2017-0016

Ethridge, B., & Russo, R. (2020). *Blocks: Quickmail.* https://moodle.org/plugins/block_quickmail

Fadhel, K. (2002). Positivist and hermeneutic paradigm: A critical evaluation under their structure of scientific Practice. *The Sosland Journal*, 21-28.

Faryadi, Q. (2019). PhD thesis writing process: A systematic approach - How to write your methodology, results and conclusion. *Creative Education, 10*, 766-783. https://doi.org/10.4236/ce.2019.104057

Fenton, W. (2018). *The best learning management systems (LMS) for 2019*. PCMag. https://www.pcmag.com/picks/the-best-lms-learning-management-systems

Fettahlıoğlu, P., & Kaleci, D. (2018). Online argumentation implementation in the development of critical thinking disposition. Journal of Education and Training Studies, 6(3), 127-136. https://files.eric.ed.gov/fulltext/EJ1171064.pdf

Firdaus, F., Muntaqo, R., & Trisnowati, E. (2020). *Analysis of student readiness for blended learning model implementation in industrial era 4.0.* https://doi.org/10.31002/IJOSE.V4I1.2309

Flick, U. (2018). *Introduction to quality research* (6th ed.). Sage Publications Ltd.

Foo, S. Y., & Quek, C. L. (2019). Developing students' critical thinking through asynchronous online discussions: A literature review. *Malaysian Online Journal of Educational Technology, 7*(2), 37-58. http://doi.org/10.17220/mojet.2019.02.003

Francescucci, A., & Rohani, L. (2018). Exclusively synchronous online (VIRI) learning: The impact on student performance and engagement outcomes. *Journal of Marketing Education, 41*(1), 60-69. https://doi.org/10.1177/0273475318818864

Fry, S., Ketteridge, S., & Marshall, H. (2009). *A handbook for teaching and learning in higher education*, Routledge. https://www.sun.ac.za/english/faculty/arts/Documents/HandbookTeachingLearningHigheEd.pdf

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). *Educational research: An introduction* (8th ed.). Pearson Education.

Galvis, A. H. (2018). Supporting decision-making processes on blended learning in higher education: literature and good practices review. *International Journal of Educational Technology in High Education, 15*(25), https://doi.org/10.1186/s41239-018-0106-1

Garrison, D., & Vaughan, N. (2008). *Blended learning in higher education: Framework, principles, and guidelines.* John Wiley & Sons https://doi.org/10.1002/9781118269558

Garrison, D. R. (1992). Critical thinking and self-directed learning in adult education: An analysis of responsibility and control issues. *Adult Education Quarterly, 42*, 136-148. https://doi.org/10.1177/074171369204200302

Garrison, D. R. (2003). Cognitive presence for effective asynchronous online learning: The role of reflective inquiry, self-direction and metacognition. In J. Bourne & J. C. Moore (Eds.), *Elements of quality online education: Practice and direction.* Volume 4 in the Sloan C Series. (pp. 29−38). Needham, MA: The Sloan Consortium.

Garrison, D. R. (2009). Communities of inquiry in online learning. In P. Rogers, G. Berg, J. Boettcher, C. Howard, L. Justice & K. Schenk (Eds.), *Encyclopedia of distance learning* (2nd ed., pp. 352–355). Information Science Reference. https://doi.org/10.4018/978-1-60566-198-8.ch052

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education model. *The Internet and Higher Education, 2*(2-3), 87-105. https://doi.org/10.1016/S1096-7516(00)00016-6

Gayoso M. V., Hernandez, E. L., Queiruga-Dios, A., Encinas, A., & Martin-Vaquero, J. (2013). Avoiding Sensitive Information Leakage in Moodle. *Literacy Information and Computer Education Journal 2.* 1422-1432. https://doi.org/10.20533/licej.2040.2589.2013.0190

Geng, S., Law, K. M. Y., & Niu, B. (2019). Investigating self-directed learning and technology readiness in blending learning environment. *International Journal of Educational Technology in High Education, 16*(17), https://doi.org/10.1186/s41239-019-0147-0

Gibson, W. J., & Brown, A. (2009). *Working with qualitative data.*: Sage Publication.

Gilbert, N (Ed.) (2008) *Researching social life* (3rd ed.). London: Sage.

Giraldo-García, R., Roy, M., & Alotebi, H. (2015). The interplay of technology and critical thinking skills in the 21st century blended classroom. *International Journal of Advanced Research in Education Technology (IJARET). 2.* 32-35. https://www.researchgate.net/publication/321934531_The_Interplay_of_Technology_andCritical_Thinking_Skills_in_the_21st_Century_Blended_Classroom

Goldenberg, J. (n.d.). *Rural energy in developing countries.* www.undp.org/.../Environment%20and%20Energy/Sustainable%20Energy/.../chapter10.pdf

Gomez, J. F. (2015). *Higher education faculty use of a learning management system in face-to-face classes.* [Doctoral dissertation], California State University, Stanislaus.

Graham, C. R. (2006). Blended learning systems: Definition, current trends, and future directions. In C. J. Bonk, & C. R. Graham (Eds.), *The handbook of blended learning: Global perspectives, local designs* (pp. 3-21). Pfeiffer. http://curtbonk.com/graham_intro.pdf

Graham, C. R. (2009). Blended learning models. In M. Khosrow-Pour (Ed.), Encyclopedia of Information Science and Technology (2nd ed., pp. 375–382). Hershey, PA: IGI Global. https://doi.org/10.4018/978-1-60566-026-4.ch063

Groff, J. (2013). *Technology-rich innovative learning environment.* http://www.oecd.org/education/ceri/Technology-Rich%20Innovative%20Learning%20Environments%20by%20Jennifer%20Groff.pdf

Grove, S. K. Burns, N., & Gray, J. R. (2013). *The practice of nursing research: Appraisal, synthesis, and generation of evidence* (7th ed). Elsevier Saunders.

Guba, E. (1990). *The paradigm dialogue.* Sage.

Guest, G., Emily, E. N., & Mitchell, M. L. (2013). *Collecting qualitative data: A field manual for applied research.* Thousand Oaks.

Harnish, R. J., Bridges, K. R., Sattler, D. N., Signorella, M. L., & Munson, M. (Eds.). (2018). *The use of technology in teaching and learning.* Retrieved from the Society for the Teaching of Psychology web site: http://teachpsych.org/ebooks/

Haworth, J. (2021). *Finders, cheaters: RCE bug in Moodle e-learning platform could be abused to steal data, manipulate results*. https://portswigger.net/daily-swig/finders-cheaters-rce-bug-in-moodle-e-learning-platform-could-be-abused-to-steal-data-manipulate-results

Haber, C. (2020). It's time to get serious about teaching critical thinking. https://www.insidehighered.com/views/2020/03/02/teaching-students-think-critically-opinion

Halverson, L. R., & Graham, C. R. (2019). Learner engagement in blended learning environments: A conceptual framework. *Online Learning, 23*(2), 145-178. https://doi.org/10.24059/olj.v23i2.1481

Hamilton, Z. (2019). Blended learning: Internal factors affecting Implementation. Masters Theses/Capstone Projects. 26. https://digitalcommons.otterbein.edu/stu_master/26

Hancock, M. E., & Amankwaa, L., Revell, M., & Mueller, D. (2016). Focus group data saturation: a new approach to data analysis. The Qualitative Report. 21. 2124-2130. https://doi.org/10.46743/2160-3715/2016.2330.

Harrell, K. B., & Wendt, J. L. (2019). The impact of blended learning on community of inquiry and perceived learning among high school learners enrolled in a public charter school, Journal of Research on Technology in Education, 51(3), 259-272, https://doi.org/10.1080/15391523.2019.1590167

Hartley, J. (1994). Case studies in organizational research. In Catherine Cassell & Gillian Symon (Eds.), *Qualitative methods in organizational research, a practical guide* (pp. 208-229). London: Sage.

Hartman, R. J., Townsend, M. B., & Jackson, M. (2019). Educators' perceptions of technology integration into the classroom: a descriptive case study. *Journal of Research in Innovative Teaching & Learning, 12*(3), https://www.emerald.com/insight/content/doi/10.1108/JRIT-03-2019-0044/full/html

Hatcher, D. (2013). The Halpern critical thinking assessment: A review. *Inquiry of Critical Thinking Across the Disciplines, 28,* 18-23. https://doi.org/10.5840/inquiryct201328315

Hawkins, M. (2019). MSA-19-0029: Reflected XSS possible from some fatal error messages. https://moodle.org/security/

Himmelsbach, V. (2019). Technology in the classroom in 2019: 6 pros & cons. https://tophat.com/blog/6-pros-cons-technology-classroom/

Holmes, B., & Gardner, J. R. (2006). E-learning: Concepts and practice. Sage Publications Ltd.

Horton, W. (2006). *E-learning by-design.* John Wiley & Son.

Hossain, M. A., & Rahman, M. H. (2017). Comparative study of internet usage among university students: A study of the University of Dhaka. *Bangladesh. European Scientific Journal, 13*(34), 134. https://doi.org/10.19044/esj.2017.v13n34p134

Howard, C. (2019). *Advantages and disadvantages of online surveys.* https://www.cvent.com/en/blog/events/advantages-disadvantages-online-surveys

Hrastinski, S. (2019). What do we mean by blended learning? *TechTrends.* https://www.researchgate.net/publication/330935647_What_Do_We_Mean_by_Blended_Learning/citation/download

Hsu, Y., Shiue, Y. (2017). Exploring the influence of using collaborative tools on the Community of Inquiry in an interdisciplinary project-based learning context. *Journal of*

Mathematics, Science and Technology, 14(3), 933-945. http://doi.org/10.1016/j.compedu.2018.02.009

Hunter, W. (2018). Critical thinking in asynchronous online discussions: A systematic review. Canadian *Journal of Learning and Technology, 44*(2), 1-25. https://doi.org/10.21432/cjlt27782

Idrus, R. M. (2008). Transforming engineering learning via technology. In *5th WSEAS/IASME International Conference on Engineering Education (EE'08).* https://www.academia.edu/227375/Transforming_Engineering_Learning_via_Technology

Ismail, I., Idrus, R. M., Ziden, A. A., & Fook, F. S. (2009). Students' perceptions of technical appliances in e-learning. In *5th WSEAS/IASME International Conference on Educational Technologies (EDUTE' 09), July 1-3.* http://www.tojet.net/volumes/v10i4.pdf

Jackson, E. A. (2017). Impact of Moodle platform on the pedagogy of students and staff: Cross-curricular comparison. *Education and Information Technologies, 22*(1), 177-193. https://doi.org/10.1007/s10639-015-9438-9

Jakchaikul, V. (2015). Application of learning management system for online learning modules. *Applied Mechanics and Materials, 804,* 347-350. https://doi.org/10.4028/www.scientific.net/AMM.804.347

Johnson, A. M., Jacovina, M. E., Russell, D. E., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. In S. A. Crossley & D. S. McNamara (Eds.), *Adaptive educational technologies for literacy instruction* (pp. 13-29). Taylor & Francis. https://files.eric.ed.gov/fulltext/ED577147.pdf

Johnson, B., & Onwuegbuzie, A. J. (2004); Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research, 1*(2), 112-133. https://doi.org/10.1177/1558689806298224

Johnson, P. (2018). *Top 3 open source risks and how to beat them - a Quick guide*. https://resources.whitesourcesoftware.com/blog-whitesource/top-3-open-source-risks-and-how-to-beat-them-a-quick-guide

Jones, N., Blackey, H., Fitzgibbon, K., & Chew, E. (2010). Get out of MySpace! *Computers & Education, 54*(3), 776-782. https://doi.org/10.1016/j.compedu.2009.07.008

Kabassi, K., Dragonas, I., Ntouzevits, A., Pomonis, T., Papastathopoulos, G., & Vozaitis, Y. (2016). Evaluating a learning management system for blended learning in Greek higher education. *SpringerPlus, 5*(1), 1-12. https://doi.org//10.1186/s40064-016-1705-8

Kamati, E. (2020, April 01). Students raise online learning concerns. *Namibian Sun.* https://www.namibiansun.com/main/print_post/students-raise-online-learning-concerns2020-04-01/

Karkar, A. J. M., Fatlawi, H. K., & Al-Jobouri, A. (2020). Highlighting E-Learning adoption challenges using data analysis techniques: The University of Kufa as a case study. *Electronic Journal of E-Learning, 18*(2), 136-149. doi.org/10.34190/EJEL.20.18.2.003

Kaur, K., & Abas, Z. W. (2004). An assessment of e-learning readiness at Open University Malaysia. *Proceedings of the International Conference on Computers in Education 2004*, (pp. 1017-1022). https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1090.894&rep=rep1&type=pdf

Ken Research (2018). *Turkey E-learning market size by revenue 2013-2018.* https://kenresearchreport.wordpress.com/tag/turkey-e-learning-market-size-by-revenue-2013-2018/

Kentnor, H. (2015). Distance education and the evolution of online learning in the United States United States. *Curriculum and Teaching Dialogue, 17*(1 & 2). https://digitalcommons.du.edu/cgi/viewcontent.cgi?article=1026&context=law_facpub

Keržič, D., Aristovnik, A., Tomaževič, N., & Umek, L. (2017). An assessment of the effectiveness of Moodle e-learning system for undergraduate public administration education. *International Journal of Innovation and Learning, 21*(165). https://doi.org/10.1504/IJIL.2017.10002132

Keskin, S., & Yurdugül, H. (2019). Factors affecting students' preferences for online and blended learning: Motivational vs. cognitive. *European Journal of Open, Distance and e-Learning, 22*(2), https://www.researchgate.net/publication/334626343

Khan, B. (2003). *A framework for E-learning.* Educational Technology Publication.

Khan, B. (2010). *Managing E-learning strategies, design, delivery, implementation, and evaluation.* Educational Technology Publications.

Khan, B. H. (2001). A framework for Web-based learning. In B. H. Khan (Ed.), *Web-based training. Educational Technology Publications.* https://www.academia.edu/259746/A_Framework_for_Web_Based_Learning?auto=download

Khan, B. H. (2007). Obstacles encountered during stages e-learning process. In B. H. Khan (Ed.), *Flexible Learning.* Educational Technology Publications.

Khan, B. H. (2010). E-Learning- The Global e-Learning Framework. (2010). In *STRIDE Handbook 8*, S. Mishra, Editor. the Indira Gandhi National Open University (IGNOU): New Delhi-110 068, MaidanGarhi, (pp. 42-52).

Khan, B. H. (2016). *Revolutionizing modern education through meaningful e-learning implementation*. IGI Global. https://doi.org/10.4018/978-1-5225-0466-5

Khan, B. H., & Ally, M. (2015) *International handbook of e-learning. Volume 1: Theoretical perspectives and research*. Routledge.

Khan, B. H., & Smith, H. L. (2007). Student evaluation instrument for online programs. In B. H. Khan (Ed.), *Flexible learning.* Educational Technology Publications.

Khan, Y. (2016). Emerging factors affecting blended learning in virtual learning environment framework (VLEF). *Sino-US English Teaching, 13*(3), 197-203 https://doi.org/10.17265/1539-8072/2016.03.004

Kiget, N. K., Wanyembi, G., & Peters, A. I. (2014). Evaluating usability of E-learning systems in universities. *International Journal of Advanced Computer Science and Applications (IJACSA), 5*(8), 96-102.

Kintu, M. J., & Zhu, C. (2016). Student characteristics and learning outcomes in a blended learning environment intervention in a Ugandan university. *Electronic Journal of E-Learning, 14*(3), 181–195. http://www.ejel.org/volume14/issue3/p181

Klein, A. (2019). *Does technology help boost students' critical thinking skills?* https://blogs.edweek.org/edweek/DigitalEducation/2019/06/technology-reboot-critical-thinking-NAEP-PISA.html

Kokoulina, O. (2020, January 27). The 15-minute guide for teachers on getting started with Moodle. *ISpring eLearning blog.* https://www.ispringsolutions.com/blog/getting-started-with-moodle

Kosuke, T., Ryosuke, I., Yoshiyuki, Y., Mihoko, K., & Kenichi, K. (2004). Blended learning model for multimedia production course. *Proceedings of the World Conference on Educational Multimedia. Hypermedia & Telecommunication, 20*(1), 11-16 https://www.researchgate.net/publication/328041424_Blended_Learning_Model_for_Multimedia_Production_Course

Kothari C. R. (2007). *Quantitative techniques.* UBS Publishers LTD.

Kraleva, R., Kralev, V., & Sabani, M. (2019). An analysis of some learning management systems. *International Journal on Advanced Science, Engineering and Information Technology, 9*, 1190-1198. https://doi.org/10.18517/ijaseit.9.4.9437

Kreijns, K., Van Acker, F., Vermeulen, M., & Van Buuren, H. (2014). Community of Inquiry: Social presence revisited. *E-learning and Digital Media, 11*(1), 5–18. https://eric.ed.gov/?redir=http%3a%2f%2fdx.doi.org%2f10.2304%2felea.2014.11.1.5

Kretzschmar, U. (2004). *Evaluation of the Moodle e-learning database at the Department of Information Technology*, Windhoek: Polytechnic of Namibia.

Kuhn, D. (1999). A developmental model of critical thinking. Educational researcher, 28(2), 16-46. https://www.researchgate.net/publication/250183277_A_Developmental_Model_of_Critical_Thinking

Kuhn, T. S. (1962). *The Structure of scientific revolutions.* Chicago: University of Chicago Press.

Kulkarni, P. (2013). *What is triangulation of data in qualitative research? Is it a method of validating the information collected through various methods?* https://www.researchgate.net/post/What_is_triangulation_of_data_in_qualitative_research_Is_it_a_method_of_validating_the_information_collected_through_various_methods

Kurkela, L. (2011). Systemic approach to learning paradigms and the use of social media in Higher Education. *International Journal of Emerging Technologies in Learning (IJET), 6*(2011), 14-20. https://www.learntechlib.org/p/45267/

Kurt, S., & Yildirim, I. (2018). The students' perceptions on blended learning: A Q method analysis. *Educational Sciences: Theory & Practice, 18,* 427-446. http://dx.doi.org/10.12738/estp.2018.2.0002

Lackner, E. (2014). *Instructional design for blended learning settings: Moodle & more.* https://ec.europa.eu/programmes/erasmus-plus/project-result-content/7dda4d72-bd7b-467d-b24f-0aba8e2ad904/2015_MArED_Instructional_Manual_final.pdf

Laigo, G., & Zafra, M. A. (2016) Factors affecting the use of blended learning in tertiary mathematics classes. *Intend 2016 Proceedings.* 6699-6708. https://library.iated.org/view/LAIGO2016FAC

Lawless, C. (2018, October 18). What is eLearning? *Digital Marketing Manager at LearnUpon blog*. https://www.learnupon.com/blog/what-is-elearning/

Leung, L. (2015). Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care, 4*(3), 324-327. https://doi.org/10.4103/2249-4863.161306

Lin, M. (2016). *Analysis of the use of course management systems in online courses at public 4-year institutions in the state of Texas* (Order No. 10123808). https://search.proquest.com/docview/1795525001?accountid=188730

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry.* Beverly Hills, CA: Sage.

Littlejohn, A., Hood, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *The Internet and Higher Education, 29*, 40- 48. https://doi.org/10.1016/j.iheduc.2015.12.003

Liu, Q., Peng, W., Zhang, F., Hu, R., Li, Y., & Yan, W. (2016). The effectiveness of blended learning in health professions: Systematic review and meta-analysis. *Journal of Medicine, 18*(1), e2. https://doi.org/10.2196/jmir.4807

LoBiondo-Wood, G., & Haber, J. (2018). *Nursing Research: Methods and Critical Appraisal for Evidence-Based Practice* (9th ed.) Elsevier.

Lonn, S., & Teasley, S. D., (2009). Saving time or innovating practice: Investigating perceptions and uses of Learning Management Systems. *Computers & Education, 53*(3), 686-694

Lopes, A. P. (2014). Learning management systems in higher education. In *14th Conference Proceedings of EDULEARN.* 5360-5365.

MacDonald, C. J., Stodel, E. J., Hall, P., & Weaver, L. (2009). The impact of an online learning resource designed to enhance interprofessional collaborative practice in palliative care: findings from the caring. *Journal of Research in Interprofessional Practice and Education 1*(1) https://doi.org/10.22230/jripe.2009v1n1a6

Macfadyen, L. P., & Dawson, S. (2010), Mining LMS data to develop an 'early warning system' for educators: a proof of concept. *Computers & Education, 54*(2), 588-599. https://pdfs.semanticscholar.org/66d9/eafd07ea90dd1796f35ed439016ab0f5a389.pdf

Mack, N., Woodsong, C., MacQueen, K., Guest, G., & Namey, E. (2005). *Qualitative research methods: A data collector's field guide.* Family Health International (FHI)

Marikar, F., & Jayarathne, N. (2016). Effectiveness of Moodle in education system in Sri Lankan University. *International Journal of Modern Education and Computer Science, 8*. 54-58. https://doi.org/10.5815/ijmecs.2016.02.07

Marsh, D. (2012). *Blended learning creating learning opportunities for language learners*, Cambridge University Press, New York.

Masadeh, M. (2012). Focus group: Reviews and practices. *International Journal of Applied Science and Technology. 2*. 63-68. https://www.researchgate.net/publication/313399085_Focus_Group_Reviews_and_Practices

Mässing, C. (2017). *Success factors and challenges for e-learning technologies in the Namibian higher education system: A case study of the University of Namibia*. https://www.diva-portal.org/smash/get/diva2:1111480/FULLTEXT01.pdf

Mbuva, J. M. (2015). Examining the effectiveness of online educational Technological tools for teaching and learning and the challenges ahead. *Journal of Higher Education Theory and Practice, 15*(2), 113-127. http://m.www.nabusinesspress.com/JHETP/MbuvaJM_Web15_2_.pdf

McKimmy, P. B. (2017). Free software and open source movements: From digital rebellion to Aaron Swartz - responses to government and corporate attempts at suppression and enclosure. In M. Callahan & J. Rogers (Eds.), *A critical guide to intellectual property*. London: ZED.

McMillan, J. H., & Schumacher, S. (2010). *Research in education: Evidence-based inquiry* (7th ed.). New Jersey: Pearson.

Melwani, U. (2019). *Open-source vs proprietary software - Which one is more secure?* https://www.srijan.net/blog/open-source-vs-proprietary-software-which-one-is-more-secure

Merriam, S. B. (1998). *Qualitative research and case study applications in education.* Jossey-Bass.

Mertens, D. (2010). Transformative mixed methods research. *Qualitative Inquiry, 16*(2). 469-474. https://www.researchgate.net/publication/249735933_Transformative_Mixed_Methods_Research

Mertens, D. M. (2003). Mixed-methods and the politics of human research: The transformative emancipatory perspective. In Tashakkori, A. & Teddlie, C. (Eds.). *Handbook of mixed method social & behavioural research* (pp.135- 164). Sage Publications.

Minh, D. D., & Ngan, L. H. (2019). An action research on applying a blended learning program to enhance students' TOEIC Listening Program. *International Journal of Scientific and Research Publications,* *9*(5) 806 – 811. https://doi.org/10.29322/IJSRP.9.05.2019.p89102

Mirmoghtadaie, Z., Kohan, N., & Rasouli, D. (2020). Determination and comparison of the factors related to effective blended learning in medical sciences from the viewpoints of

instructors and learners. *Advances in Medical Education and Practice, 11*, 205-214. https://doi.org/10.2147/AMEP.S239216

Moffat, J. (2015). Virtual learning environments: linking participation to evaluation, *International Review of Economics Education, 19*, 22-35, https://doi.org/10.1016/j.iree.2015.05.003

Moftakhari, M. M. (2013). Evaluating e-learning readiness of faculty of letters of Hacettepe. [Master thesis]. Ankara: Hacettepe University. http://www.openaccess.hacettepe.edu.tr:8080/xmlui/bitstream/handle/11655/1221/f6f4dcbb-4b42-4283-b16c-90f023bc2cfd.pdf;sequence=1

Mohottala, H. E. (2016). Improving critical skills using wikis and CGPS in a Physics classroom, *Institute of Education Sciences, 54*(7), 427-429.

Molenda, M. (2003). In search of the elusive ADDIE model. *International Society for Performance Improvement, 54*(2), https://doi.org/10.1002/pfi.4930420508

Moodle (2019). *Activities.* https://docs.moodle.org/39/en/Activities

Moodle (2020). *Forum activity*. https://docs.moodle.org/39/en/Forum_activity

Moodle (2020). *Getting started is easy*. https://moodle.org/

Moodle (2020). *Security announcement*. https://moodle.org/mod/forum/view.php?id=7128

Moodle. (2020). *Messaging.* https://docs.moodle.org/39/en/Messaging

Moodle.org. (2018). About Moodle FAQ. fromhttps://docs.moodle.org/34/en/About_Moodle_FAQ

Moodle.org. (2020). *Statistics*. https://stats.moodle.org/

Moore, J. L., Dickson-Deane, C., Galyen, K., & Chen, W. (2010). Designing for e-learning, online, and distance learning environments: Are they the same? *Paper presented at American Educational Research Association,* Denver, CO.

https://www.researchgate.net/profile/Camille_DicksonDeane/publication/233751524_Designing_for_E-

Moore, K., Hanfland, F., Shank, P., Young, L., Dublin, L., Watkins, R., & Corry, M. (2007). *eLearning Guild's handbook e-learning strategy.* https://theelearningcoach.com/wp-content/uploads/downloads/2010/06/strategy_ebook.pdf

Mouton, J. (2011). *How to succeed in your master's and doctoral studies: A South African guide and resource book.* Van Schaik Publishers.

Mulhayatiah, D., Kindi, A., & Dirgantara, Y. (2019). Moodle-blended problem solving on student skills in learning optical devices. In *Journal of Physics: Conference Series 1155*. IOP Publishing. https://doi.org/10.1088/1742-6596/1155/1/012073

Mylavarapu, L. (2016). *Moodle - The most popular LMS of 2017: What makes it so?* https://blog.commlabindia.com/e-learning-development/moodle-the-most-popular-lms

Namibia University of Science and Technology (NUST) (2020). *Phased return of students for face-to-face teaching and learning.* https://www.nust.na/?q=announce/phased-return-students-face-face-teaching-and-learning

Durlach, N. I., & Mavor, A. S. (1995). *Virtual reality: Scientific and technological challenges.* National Academy Press: https://www.nap.edu/read/4761/chapter/1

Nawaz, A., & Khan, M. Z. (2012). Issues of technical support for e-Learning systems in higher education institutions. *International Journal of Modern Education and Computer Science*, *4*. https://doi.org/10.5815/ijmecs.2012.02.06

Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology*, *3*(2), 56–77. http://umsl.edu/~wilmarthp/mrpc-web-resources/CA-analysis-method-to-measure-thinking-in-f2f.pdf

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*(1), https://doi.org/10.1177/1609406917733847

Nunnally, J. C., & Bernstein, I. R. (1994). *Psychometric theory* (3rd Ed.). McGraw-Hill.

NUST (2020, March 6). *Over 12 500 students registered...and counting.* https://www.nust.na/?q=news/over-12-500-students-registeredand-counting

Oblender, T. (2002). A hybrid course model: One solution to the high online drop-out rate. *Learning and Leading with Technology, 29*(6), 42-46. https://link.springer.com/chapter/10.1007/978-3-540-85170-7_39

Office of Technology (2017). *Reimagining the role of technology in education: 2017 national education technology plan update*. https://tech.ed.gov/files/2017/01/NETP17.pdf

Okeke, C., & Van Wyk, M. M. (2015). *Educational research: An African approach.* Oxford University Press.

Onghena, P., Maes, B., & Heyvaert, M. (2018). Mixed methods single case research: State of the art and future directions. *Journal of Mixed Methods Research, 13*(4), 461–480. https://doi.org/10.1177/1558689818789530

Osguthorpe, R. T., & Graham, C. R. (2003). Blended learning environments: Definitions and directions. *The Quarterly Review of Distance Education, 4*(3), 227-233.

OWASP Foundation, (2020). *Cross-site scripting (XSS).* https://owasp.org/www-community/attacks/xss/

Owston, R., York, D., & Murtha, S. (2013). Student perceptions and achievement in a university blended learning strategic initiative. *The Internet and Higher Education, 18*, 38-46. http://doi.org/10.1016/j.iheduc.2012.12.003

Ozkan, S., & Koseler, R. (2009). Multi-dimensional evaluation of E-learning systems in the higher education context: *An empirical investigation of a computer literacy course.*

Proceedings - Frontiers in Education Conference, FIE. 1 - 6. https://doi.org/10.1109/FIE.2009.5350590

Pallant, J. (2001). *SPSS survival manual - a step by step guide to data analysis using SPSS for windows (version 10),* Buckingham Open University Press.

Padayachee, I. (2017). Educator perceptions of virtual learning system quality characteristics. *South African Computer Journal, 29*(3), 95-126. /https://doi.org/10.18489/sacj.v29i3.418

Pankaja, N., & Mukund, R., P. K. (2013). Proprietary software versus open source software for education. *American Journal of Engineering Research, 2(*7), 124–130. http://ajer.org/papers/v2(7)/O027124130.pdf

Panyajamorn, T., Suthathip, S., Kohda, Y., Chongphaisal, P., & Supnithi, T. (2018). Effectiveness of design and affecting variables in Thai public schools. *Malaysian Journal of Learning and Instruction, 15*(1), 1-34. http://mjli.uum.edu.my/images/vol.15no.2/227-256new.pdf

Patton M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health services research, 34*(5 Pt 2), 1189–1208. https://pubmed.ncbi.nlm.nih.gov/10591279/

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage Publications.

Patton, M. Q. (2014). *Qualitative research and evaluation methods integrating theory and practice* (4th ed.). Sage Publications.

Phankokkruad, M. (2012). Implement of cloud computing for e-learning system. *2012 International Conference on Computer & Information Science (ICCIS)*. 7-11) https://doi.org/10.1109/ICCISci.2012.6297204

Phillips, D. C., & Burbules, N. C. (2000). *Philosophy, theory, and educational research. Postpositivism and educational research.* Rowman & Littlefield. https://psycnet.apa.org/record/2000-08253-000

Pima, J. M., Odetayo, M., Iqbal, R., & Sedoyeka, E. (2016). Assessing the available ICT infrastructure for collaborative web technologies in a blended learning environment in Tanzania: A mixed methods research. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 12*(1), 37-52. https://files.eric.ed.gov/fulltext/EJ1099579.pdf

Piskurich, G. M. (2003). *Preparing learners for e-learning*. Wiley.

Polit, D. F., & Hungler, B. P. (2004). *Nursing research: Principles and methods* (7th ed.). Williams & Wilkins.

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the horizon*, *9*(5), 1–6. https://doi.org/10.1108%2F10748120110424816

Professional Learning Board (2020). *What is the blended learning approach?* https://k12teacherstaffdevelopment.com/tlb/what-is-the-blended-learning-approach/?cv=1

Räisänen, M., Postareff, L., & Lindblom-Ylänne, S. (2016). University students' self- and co-regulation of learning and processes of understanding: A person-oriented approach. *Learning and Individual Differences, 47,* 281–288. http://doi.org/10.1016/j.lindif.2016.01.006

Ramesh, B. (2015). *Collaborative learning through Moodle*. http://blog.commlabindia.com/e-Learning-development/moodle-for-colloborative-learning-infographic

Ranjit, K. (2011). *Research methodology: A step-by-step guide for beginners* (3rd ed.). London: Sage Publications.

Raphael, C., & Mtebe, J. S. (2016). Tanzania Instructor support services: An inevitable critical success factor in blended learning in higher education in Tanzania. *International Journal of Education and Development using Information and Communication Technology, 12,* (2), 123-138. https://files.eric.ed.gov/fulltext/EJ1111468.pdf

Reddy, C. (2016). *In depth interview advantages and disadvantages.* https://content.wisestep.com/depth-interview-advantages-disadvantages/

Rezaei, M., Osam, U. V., & Manzari, E. (2015). Post-graduate students' perception of using *Moodle in a teacher education course: a focus on pros, cons and the role of technological pedagogical content knowledge (TPACK). Selt Sherif ELT Conference.* Sheriff University of Technology. https://www.researchgate.net/publication/322075585

Rodríguez, E. Pérez, C. R., & Machuca-Villegas, L. (2019). Analysis of the students' interactions and satisfaction during a collaborative Lab Project. Revista EIA, 16(31), 209-223. https://doi.org/10.24050/reia.v16i31.1256

Romiszowski, A. J. (2004). How's the e-learning baby? Factors leading to success or failure of an educational technology innovation. *Educational Technology, 44*(1), 5-27. 17-25. https://doi.org/10.12691/education-3-10A-3

Rosenberg, J., & Ranellucci, J. (2017, May 8). Student motivation in online science courses: A path to spending more time on course and higher achievement. *Michigan Virtual Learning Research Institute.* https://mvlri.org/blog/student-motivation-inonline-science-courses-a-path-tospending-more-time-on-course-and-higher-achievement

Rosenberg, M. C. (2005*). Beyond E-learning: approaches and technologies to enhance organizational knowledge, learning, and performance*. Pfeiffer.

Rosenberg, M. J., (2001). *E-learning: Strategies for delivering knowledge in the digital age.* (Volume 3). New York: McGraw-Hill.

Rossett, A., & Frasee, R. V. (2006). *Blended learning opportunities.* https://www.researchgate.net/publication/228669485_Blended_Learning_Opportunities

Rossman, G. B., & Wilson, B. L. (1985). Numbers and words: Combining quantitative and qualitative methods in a single large-scale evaluation study. *Evaluation Review, 9*(5), 627-643.

Rudestam, K. E., & Schoenholtz-Read, J. (2002). Overview: The coming of age of adult online education. In K. Rudestam & J. Schoenholtz-Read (Eds.), *Handbook of on-line learning: Innovations in higher education and corporate training.* (pp. 3–28). Sage Publications

Rushby, N., & Surry, D. (2016). *The Wiley handbook of learning technology* (Vol. 1). London: John Wiley & Sons.

Rymon, R. (2015). *3 reasons why open source software is more secure than commercial software.* https://resources.whitesourcesoftware.com/blog-whitesource/3-reasons-why-open-source-is-safer-than-commercial-software

Saccol, A. Z., Kich, M., Schlemmer, E., Reinhard, N., Barbosa, J. L., & Hahn, R. (2009). A framework for the design of ubiquitous learning applications. In *2009 42nd Hawaii International Conference on System Sciences*. (pp. 1-10). https://doi.org/10.1109/HICSS.2009.13

Saleem, N., Al-Suqri, M., & Ahmed, S. (2016). Acceptance of Moodle as a teaching/learning tool by the faculty of the department of information studies at Sultan Qaboos University, Oman based on UTAUT. *International Journal of Knowledge Content Development and Technology, 6.* 5-27. http://ijkcdt.net/xml/08901/08901.pdf

Salkind, N. J. (2010). *Encyclopedia of research design.* SAGE Publications, Inc. https://doi.org/4135/9781412961288

Salkind, N. J. (2017). *Exploring research*. Pearson.

Sanchez-Gordon, S., & Luján-Mora, S. (2014). Web accessibility requirements for massive open online courses. *Can MOOCs be really universal and open to anyone?, CAFVIR,* 1-6 https://rua.ua.es/dspace/bitstream/10045/41443/1/2014-CAFVIR-Web-Accessibility-Requirements-for-MOOCs.pdf

Sandelowski, M. (1993). Rigor or rigor mortis: The problem of rigor in qualitative research revisited. *Advanced in Nursing Science, 16*(2), 1–8

Sarantakos, S. (2013). *Social research* (4th ed.). Macmillan.

Saskar, S. H. (2016). Budgetary challenges of Higher Education: Evidence from Bangladesh. *Journal of Education and Practice, 7*(12), 32-41. https://files.eric.ed.gov/fulltext/EJ1099459.pdf

Sathian, R. (2016). *How to create an activity in Moodle the smart way!* https://edwiser.org/blog/create-activity-moodle/

Sathian, R. (2016). *How to use student communication tools in Moodle: An overview.* https://edwiser.org/blog/student-communication-tools-moodle/

Saunders, M., & Lewis, P., Thornhill, A., & Bristow, A. (2019). *Research methods for business students*. Pearson.

Scheuermann, M. (2014). *Today's high-wire act in higher education: Balancing innovation and budget constraints.* https://evolllution.com/opinions/todays-high-wire-act-higher-education-balancing-innovation-budget-constraints/

Schiavone, A. G. (2018). Is Moodle accessible? An analysis through experiences in scientific literature and a case study. *Proceedings of International Symposium on the Future of Education in Information Science*. 165-174. http://einfose.ffos.hr/feis-2018/proceedings

Schulze, S. (2000). Quantitative and qualitative approaches. Paper presented at the research seminar for MED and DED students. University of South Africa.

Sekaran, U., & Bougie, R. (2013). *Research methods for business* (6th ed.). John Wiley & Sons

Sekaran, U., & Bougie, R. (2010). *Research methods for business: A skill building approach* (5th ed.). John Willey & Sons Ltd.

Selim, H. M. (2007). Critical success factors for e-learning acceptance: Confirmatory factor models. *Computers & Education, 49*(2), 396-413. https://www.semanticscholar.org/paper/Critical-success-factors-for-e-learning-acceptance-Selim/074d89d97d90149e6dc5680cae1436e64115a008

Servidio, R., & Cronin, M. (2018). PerLE: An Open-source, E-Learning Moodle-based platform. A study of university undergraduates' acceptance. *Behavioral Sciences, 8*(63), 1-12. https://doi.org/10.3390/bs8070063

Shah, R. K., & Barkas, L. A. (2018). Analysing the impact of e-learning technology on students' engagement, attendance and performance. *Research in Learning Technology, 26.* 1-18. https://doi.org/10.25304/rlt.v26.2070

Shannon, L. Y., & Rice, M. (2017). Scoring the open-source learning management systems. *International Journal of Information and Education Technology, 7*, 432-436. https://www.semanticscholar.org/paper/Scoring-the-Open-Source-Learning-Management-Systems-Shannon-Rice/856d0519131c0dfc866f08a8784777ec89894e08

Shelton, K., & Saltsman, G. (2005). *An administrator's guide to online education*. Information Age Publishing.

Shilo, G., & Ragonis, N. (2019). A new approach to high-order cognitive skills in linguistics: problem-solving inference in similarity to computer science. *Journal of Further and Higher Education, 43*(3). 333-346. https://doi.org/10.1080/0309877X.2017.1361515

Silver, C., & Lewins, (2014). *Using software in qualitative research: A step-by-step guide* (2nd.). Sage Publications Ltd.

Singh, H. (2003). Building effective blended learning programs. *Educational Technology, 43*(6), 51-54. http://asianvu.com/digital-library//blended-learning-by_Singh.pdf

Singh, V. (2018). *A brief history of open source.* https://medium.com/gitcoin/a-brief-history-of-open-source-3928cb451767

Slife, B. D., & Williams, R. N. (1995). *What's behind the research: Discovering hidden assumptions in the behavioral sciences*. Sage Publications.

Smith, J. (1983). Quantitative versus Qualitative Research: An attempt to clarify the issue. *Educational Researcher, 12*(3), 6-13.

Spradley, J. P. (2016). *The ethnographic interview*. Waveland Press Inc.

Stake, R. (2005). Qualitative case studies. In N. K. Denzin & Y. S. Lincoln (eds.). *The Sage handbook of qualitative research.* (3rd ed.). Thousand Oaks, CA: Sage.

Stark, R., & Roberts, L. (1998). *Contemporary social research methods* (2nd ed.). Bellevue, WA: Micro Case Corporation.

Stefanovic, D. Marjanovic, U. Delić, M. Culibrk, D., & Lalic, B. (2016). Assessing the success of e-government systems: An employee perspective. *Information Management 53*(6), 717 - 726. https://doi.org/10.1016/j.im.2016.02.007

Shand, K., & Farrelly, F. S. (2018). The art of blending: Benefits and challenges of a blended course for pre-service teachers. *Journal of Educators Online.* 15. https://doi:10.9743/jeo2018.15.1.10

Smith, J., & Nobel, H. (2014). Bias in research. *Evidence Based Nursing, 17*(4). https://ebn.bmj.com/content/ebnurs/17/4/100.full.pdf

Stern, J. (n.d.). *Introduction to online teaching and learning.* https://www.wlac.edu/online/documents/otl.pdf

Surjono, H. D., Muhtadi, A., & Wahyuningsih, D. (2017). *International Journal of Information and Education Technology, 7*(10). 783-786. https://pdfs.semanticscholar.org/e3cf/4efb0a914934b98091be2fa7242938949cc4.pdf

Sutton, J., & Austin, Z. (2015). Qualitative Research: Data Collection, Analysis, and Management. *The Canadian Journal of Hospital Pharmacy, 68*(3), 226-231. https://doi.org/10.4212/cjhp.v68i3.1456

Synopsys (2020). *News Releases*. https://news.synopsys.com/2020-05-12-Synopsys-Study-Shows-that-Ninety-One-Percent-of-Commercial-Applications-Contain-Outdated-or-Abandoned-Open-Source-Components

Taherdoost, H. (2016). Sampling methods in research methodology: How to choose a sampling technique for research. *International Journal of Academic Research in Management 5*(2), 18-27. https://doi10.2139/ssrn.3205035

Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social & behavioral research.* Sage.

Tavakom, M., & Dennick, R. (2011). Making sense of Cronbach's alpha,. *International Journal of Medical Education*, 53-55.

Teddlie, A., & Tashakkari, C. (2003). Issues and dilemmas in teaching research methods course in social and behavior sciences: U.S. Perspective. *International Journal of Social Research Methodology, 6*(1), 61-77. https://doi.org/10.1080/13645570305055

Teddlie, C., & Tashakkori, A. (2003). Major issues and controversies in the use of mixed methods in the social and behavioral sciences. In A. Tashakkori & C. Teddlie (Eds.). *Handbook of mixed methods in social and behavioral research.* Sage Publications. (pp. 3-50).

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research.*: Sage Publications.

Tham, K., & Tham, A. (2011). Blended learning - A focus study on Asia. *International Journal of Computer Science Issues, 8*(2), 136-142. https://www.researchgate.net/publication/268414917_Blended_Learning_-_A_Focus_Study_on_Asia

Tobin G. A., & Begley, C., M. (2004). Methodological rigour within a qualitative framework, *Journal of Advanced Nursing, 48*(4), 388–396. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.136.7778&rep=rep1&type=pdf

Trines, S. (2018). Educating the masses: The rise of online education in Sub-Saharan Africa and South Asia. *World Education News and Reviews.* https://www.researchgate.net/publication/327790405_Educating_the_Masses_The_Rise_of_Online_Education_in_Sub-Saharan_Africa_and_South_Asia

Trochim, W. M. (2007). *The research methods knowledge base*. https://www.researchgate.net/publication/243783609_The_Research_Methods_Knowledge_Base

Trochim, W. M. (2022) *The research methods knowledge base.* https://conjointly.com/kb/

Tsai, C. W. (2010). Designing appropriate blended courses: A students' perspective. Cyberpsychology. *Behaviour, and Social Networking, 13*(5), 563-566. https://doi.org/10.1089/cyber.2009.0335

Tshabalala, M., Ndeya-Ndereya, C., & van der Merwe, T. (2014). Implementing blended learning at a developing university: Obstacles in the way. *The Electronic Journal of e-Learning, 12*(1), 101–110. http://files.eric.ed.gov/fulltext/EJ1020735.pdf

Ulker, D., & Yılmaz, Y. (2016). Learning management systems and comparison of open learning management systems and proprietary learning management systems. *Journal of Systems Integration, 7*. 18-24. https://doi.org/10.20470/jsi.v7i2.255

UNESCO (2020). *Information and communication technologies in teacher education: A planning guide.* https://unesdoc.unesco.org/ark:/48223/pf0000129533

University of Massachusetts Amherst. (2020). *An overview of communication tools in Moodle.* https://www.umass.edu/it/support/moodle/overview-communication-tools-moodle

Vaismoradi, M., Turunen, H., Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing Health Science Journal 15*(3), 398-405. https://doi.org/10.1111/nhs.12048

Vaughan, N. (2007). Perspectives on blended learning in higher education. *International Journal on E-Learning, 6*(1), 81-94. Waynesville, NC USA: Association for the Advancement of Computing in Education (AACE). https://www.learntechlib.org/primary/p/6310/.

VCE Details (2020). *Serious security announcements in Moodle, 20 September 2021 to 24 January 2022*. https://moodle.org/security/index.php?o=3&p=2

VCE Details (2022). *Number of browse vulnerabilities of Moodle by date for the past 22 years.* https://www.cvedetails.com/browse-by-date.php

Vogel, S., Draper-Rodi, J. (2017). The importance of pilot studies, how to write them and what they mean (Editorial). *International Journal of Osteopathic Medicine, 23*, 2–3. https://doi.org/10.1016/j.ijosm.2017.02.001

Watson, J. (2008). Blended learning: The convergence of online and face-to-face education. *North American Council for Online Learning.* https://files.eric.ed.gov/fulltext/ED509636.pdf

Web, M. (2015). *The advantages and risks of open-source software.* https://www.hiscox.co.uk/business-blog/advantages-risks-open-source-software/

Wichadee, S. (2015). Factors related to faculty members' attitude and the adoption of a learning management system. *The Turkish Online Journal of Educational Technology, 14*(4), 53-6. https://files.eric.ed.gov/fulltext/EJ1077631.pdf

Wilson, S. (2014). *Open source in education: Where does the change need to happen?* https://osswatch.jiscinvolve.org/wp/2014/04/24/open-source-in-education-where-does-the-change-need-to-happen/

Winstead, S. (2020). *ID tips and tricks: Six disadvantages of blended learning you have to cope with.* https://mye-Learningworld.com/6-disadvantages-of-blended-learning/

Wisconsin Council of Administrators of Special Services (WCASS). (2019). *Guide for IEP teams: How to support students with print disability.* https://wcass.memberclicks.net/assets/docs/PositionPapers/January%20%2017%202019%20Print%20Disability.pdf

Wojciechowski, A., & Palmer, L. B. (2005). Individual student characteristics: Can any be predictors of success in online classes? *Online Journal of Distance Learning Administration, 8*(2), 1-20. https://www.westga.edu/~distance/ojdla/summer82/wojciechowski82.pdf

Yeou, M. (2016). An investigation of students' acceptance of Moodle in a blended learning setting using technology acceptance model. *Journal of Educational. Technology. Systems, 44*. 300-318. https://doi.org/10.1177/0047239515618464

Yigit, T., Koyun, A., Yüksel, A., & Cankaya, I. (2014). Evaluation of blended learning approach in computer engineering education. *Procedia - Social and Behavioral Science, 141*. 807-812. https://www.researchgate.net/publication/266208637_Evaluation_of_Blended_Learning_Approach_in_Computer_Engineering_Education

Yildirim, S, Temur, N., Kocaman A., Goktas, Y. (2004). What makes a good LMS: an analytical approach to assessment of LMSs. In: *Information technology based proceedings of the fifth international conference on higher education and training. ITHET*. 125–130. https://doi.org/10.1109/ITHET.2004.1358150

Yilmaz, K. (2013). Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences. *European Journal of Education, 48*(2), 311-325. http://www.jstor.org/stable/26357806

Yilmaz, Y. (2012). Knowledge management in E-learning practices. Turkish Online Journal of *Educational Technology. 11*. 150-155.

https://www.researchgate.net/publication/286746069_Knowledge_management_in_E-learning_practices/citation/download

Yin, R. K. (2015). *Qualitative research from start to finish* (2nd ed.). Sage.

Yin, R. K. (2018). *Case study research and applications* (6th ed.). Sage.

Yulia, H. (2016). Readiness for Blended Learning viewed from the Students' Attitude towards Learning Aspects. *International Journal of Active Learning, 2*(1), 15-26. https://www.semanticscholar.org/paper/Readiness-for-Blended-Learning-viewed-from-the-Yulia/07ca32a97132a40e710c578ea075028f8c577052

Zainuddin, N., Idrus, R. M., & Jamal, A. F. M. (2016). Moodle as an ODL teaching tool: A perspective of students and academics. *The Electronic Journal of e-Learning, 14*(4), 282-290. https://files.eric.ed.gov/fulltext/EJ1120628.pdf

Zhang, C., & Zhong, J. (2018). Construction of blended learning based on Moodle. *MATEC Web of Conferences, 232. 02031*. 1-4. https://doi.org/10.1051/matecconf/201823202031

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? Contemporary. *Educational. Psychology, 11,* 307 313. https://doi.org/10.1016/0361-476x(86)90027-5

APPENDICES

Appendix A - Final Survey Questionnaire - Students

Dear Participants,

Thank you for participating in this research project. The aim of this project is to evaluate the effective use of Moodle as a Learning Management System (LMS) at Namibia University of Science of Technology.

This is an anonymous web-based survey questionnaire that contains a combination of open and close-ended questions. Participation in this survey is entirely on a voluntary basis. By continuing with this survey, you agree to participate in this research in accordance with the consent form you read and signed. Please note that the answers provided by the participants will be used for the research purposes only and no personal information of the participants will be disclosed at any stage of the research. The online survey will take approximately fifteen (15) minutes to complete. The findings that are derived from this survey will be used to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology.

Instructions: Based on your experiences with Moodle as a learning management system at NUST, answer the questions frankly and objectively.

Please mark with a cross (X) in the appropriate box next to indicate your response. Mark one box only.

Section A – Demographic information

In this section, I would like to know a little about you. Please mark only one box with a cross (X) in the appropriate box to indicate your response.

1. **Please indicate your gender.**
   Female ☐
   Male ☐

2. **Please indicate your mode of study.**
   ☐ Full-time Student ☐ Part-time Student ☐ Distance Student

3. **Please indicate your study programme from the list below.**

☐ Bachelor of Communication
☐ Bachelor of English
☐ Bachelor of Journalism and Media Technology
☐ Bachelor of Criminal Justice in Correctional Management

☐ Bachelor of Public Management
☐ Bachelor of Criminal Justice in Policing
☐ Certificate in Vocational Education and Training: Trainer
☐ Higher Certificate in Vocational Education and Training: Trainer
☐ Diploma in Vocational Education and Training Management
☐ Other

4. Please indicate the year of your study programme.

☐ **First Year**
☐ **Second Year**
☐ **Third Year**

5. What is your age?

Appendix A - Questionnaire – Students: Section B – Please mark with a cross (X) in the appropriate box to indicate your response. Mark one box only.

Responsiveness in using My NUST eLearning platform (Moodle) (Questions 6 – 21)				
Awareness	Course Lecturer	Friend	I attended a Moodle orientation session	Uncertain
6. How did you find out about the existence of MyNUST e-learning platform?	☐	☐	☐	☐

Access – Type of device 7. Indicate the type of device you use to access the My NUST e-learning platform.	My own Computer / laptop	Cellphone	iPad	Android tablet	I use a computer at the library/ lab / regional centre	Other

Frequent access to eLearning platform 8. How often do you access the MyNUST e-learning platform?	☐ Once a week	☐ Once a month	☐ Daily	☐ I do not use the My NUST eLearning platform	

Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

	Never	Almost Never	Occasionally/Sometime	Almost Every time	Every time
9 (a). How often do you use the MyNUST e-learning platform (Moodle) to engage in the following activities? [View course announcements/News]					
9 (b) How often do you use the MyNUST e-earning platform (Moodle) to engage in the following activities? [View course syllabus]					
9. (c)How often do you use the MyNUST e-learning platform (Moodle) to engage in the following activities? [Download course material]					
9. (d) How often do you use the MyNUST e-learning platform (Moodle) to engage in the following activities? [Download assignments]					
10.(a) How often do you use the MyNUST e-learning platform (Moodle) to engage in the following learning activities. [Taking a Moodle quizzes]					
10. (b) How often do you use the MyNUST e-learning platform (Moodle) to engage in the following learning activities. [Writing an online Tests]					
10.(c) How often do you use the MyNUST e-learning platform (Moodle) to engage in the following learning activities. [Using the Workshop feature for peer assessment]					
10. (d) How often do you use the MyNUST e-learning platform (Moodle) to engage in the following learning activities. [Participate in online forum discussions]					
11.(e) How often do you use the MyNUST e-learning platform (Moodle) to engage in the following learning activities. [Submit assignments on the eLearning platform]					
11.(a) How often do you use the MyNust e-learning platform to: [contact your lecturers for general inquiries.]					
11.(b) How often do you use the MyNust e-learning platform to: [contact your classmates]					
11.(c) How often do you use the MyNust e-learning platform to: [seek academic support from lecturers]					
11.(d) How often do you use the MyNust e-learning platform to: [seek academic support from classmates]					

11.(d) How often do you use the MyNust e-learning platform to: [seek academic support from classmates]					
11.(e) How often do you use the MyNust e-learning platform to: [report technical issues experienced with the My NUST e-learning platform]					

Appendix A - Questionnaire – Students: Section C - Factors that affect blended learning at NUST (Questions 12 – 22) Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

Factors that affect blended learning at NUST	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
12. I have open access to reliable internet at my home.					
13. I am motivated to study online through the MyNUST e-learning Platform/Moodle.					
14. I was ready to engage with online learning at the beginning of the semester.					
15. I found it difficult to adapt to online learning.					
16. Studying online requires a certain level of computer literacy to navigate through the platform.					
17. I am afforded ample time to complete online tasks.					
18. Engaging in online learning provides flexible opportunities to learn in a self-directed manner.					
19. Using the MyNUST e-learning platform allowed me an opportunity to take ownership of my studies.					
20. Studying online provides opportunities to manage my studies better.					
21. Studying online creates a feeling of isolation from my peers.					
22 I feel lost and unsure about my ability to manage online learning.					

Appendix A - Questionnaire – Students: Section D - The use of Moodle to increase students' course engagement (Questions 23 – 28) Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

The use of Moodle to increase students' course engagement	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
23. Adequate opportunities are available in my courses to engage in online forum discussions.					
24. The topics provided for online forum discussions are interesting; as such, they stimulate peer interaction.					
24. Online course facilitators provide feedback of online discussions in a timely manner.					
26. I know how to use the ePortfolio on the My NUST e-learning platform for self and peer reflections.					
27. Online course facilitators provide enough reading materials and online resources to increase course engagement.					
28. Using the MyNUST e-learning platform has led to increased course engagement opportunities.					

Appendix A - Questionnaire – Students: Section E - The use of Moodle for increased communication (Questions -29-34). Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

The use of Moodle for increased communication	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
29. Access to the MyNUST e-learning Platform/Moodle makes communication with lecturers easier.					
30. I use the messaging feature of the My NUST e-learning Platform/Moodle to contact my lecturers.					
31. Communication in an online environment is more open than face-to-face classes.					
32. I rely on the 'upcoming events' feature to get information on offline activities that take place at a specific time					
33. I rely on the 'upcoming events' feature to get information on online planned activities to take place at a specific time.					
34. Using the MyNUST e-learning platform has led to increased communication opportunities.					

Appendix A - Questionnaire – Students: Section F - The use of Moodle to develop problem solving skills (Questions 35– 44). Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only.

The use of Moodle to develop problem solving skills	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
35. Assessment activities on the MyNUST e-learning platform (Moodle) are structured in such a way to find solutions to real life problems.					
36. Online tasks are structured in such a way to promote rational thinking.					
37. Online tasks are structured in such a way to promote independent thinking					
38. Online tasks are structured in a manner to provide multiple paths to solve problems.					
39. The learning activities in my online courses assist with the development of critical thinking skills.					
40. Online discussions topics require the application of critical thinking skills.					
41. I use the quick messaging tool to share some thoughts and perspectives with online course participants.					
42. I am required to complete additional assignments on real-time problems based on particular units.					
43. I am provided with quality Assignment feedback to assist with the development of problem-solving skills.					
44. My engagement in online tasks have increased my ability to solve problems.					

Appendix A - Questionnaire – Students: Section G – (Security) Effective and Safe use of the MyNUST eLearning platform. (Question 45)

Effective use of the MyNUST e-learning platform. Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only. Yes/No		
Effective use of the MyNUST eLearning platform	Yes	No
45. Do you think the MyNUST e-learning Platform (Moodle) is used effectively at NUST.		

Illegal access to eLearning platform. (Question 48)
Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only. Yes/No

	Yes	No
46. Have you ever experienced a situation where an online test/quiz meant for you, was illegally completed by another student?		

Students' Recommendations to use Moodle in more effective manner
Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only. Yes/No

47. How can students be assisted to use the My NUST e-learning Platform/Moodle in a more effective manner?

Thank you.

Appendix B - Final Survey Questionnaire – Lecturers

Dear Participants,

Thank you for participating in this research project. The aim of this project is to evaluate the effective use of Moodle as a Learning Management System (LMS) at Namibia University of Science of Technology.

This is an anonymous web-based survey questionnaire that contains a combination of open and close-ended questions. Participation in this survey is entirely on a voluntary basis. By continuing with this survey, you agree to participate in this research in accordance with the informed consent form you read and signed. Please note that the answers provided by the participants will be used for research purposes only and no personal information will be disclosed at any stage of the research. The online survey will take approximately fifteen (15) minutes to complete. The findings that are derived from this survey will be used to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology.

Thank you for your cooperation.

Instructions: Based on your experiences with Moodle as a learning management system at NUST, answer the questions frankly and objectively.

Please mark with a cross (X) in the appropriate box next to indicate your response. Mark one box only.

Section A. Subject demographics

1. What is your gender?

   ☐ Female ☐ Male

2. What is your age?

   [ ]

3. How many years of teaching experience do you have in a higher education environment?

   [ ]

4. Please indicate the department where you teach from the list below.

☐ Department of Communication
☐ Department of Technical and Vocational Education and Training
☐ Department of Social Sciences
☐ Management Department

Appendix B - Survey Questionnaire – Lecturers: Section B. Statements 5-12: Section B - Responsiveness to use Moodle tools on the MyNUST e-learning platform (Questions 5 -12). Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only.

Responsiveness to use the Moodle platform /My NUST eLearning platform. (Questions 5 -12)					
Frequent Use of Moodle Tools/Features	Never	Almost Never	Occasionally/Sometimes	Almost Every time	Every time
5. (a) to 5(c) Uploading content 5. (a) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Upload course materials using the File tool]					
5. (b) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Upload course materials using the Folder tool]					
5.(c) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Upload videos]					

Frequent Use of Moodle Tools/Features	Never	Almost Never	Occasionally/Sometimes	Almost Every time	Every time
6. (a) to (7. f) Using Moodle tools for teaching 6. (a) How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Chat feature: The Chat activity creates opportunities for participants to engage in real-time synchronous discussion.]					
6. (b) How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Forum (online discussion): This tool allows participants to engage in asynchronous discussions at different times. All participants do not have to be online at the same time.]					
6. (c)How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Quiz: Teachers use this tool to design and set various kinds of tests or quizzes.]					
6. (d) How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Assignments: Teachers use the assignments tool to create tasks or assignments for students.]					
6. (e) How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Feedback Tool: It allows teachers to create and conduct surveys to collect data or feedback.]					
6. (f) How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Moodle workshop tool for peer assessment]					
6. (g) How often do you use the following learning activities on the MyNUST e-learning platform (Moodle) for the courses you teach. [Glossary: Allows participants opportunities to create and retain a list of definitions, like a dictionary]					

Frequent Use of Moodle Tools/Features	Never	Almost Never	Occasionally/Sometimes	Almost Every time	Every time
7. (a) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Lesson Tool/Feature: This tool is used to deliver content in flexible ways.]					
7. (b) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Wiki: This tool allows participants to create web pages that anyone can add to or edit.]					
7. (c) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Choice Tool: This activity allows the teacher to ask a question to students and specifies a choice of multiple responses.]					
7. (d) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Shareable Content Object Reference Model (SCORM): It enables SCORM packages to be included as course content.]					
7. (e) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [Survey feature: Teachers can create a survey to collect data from students to help teachers learn about their class and reflect on their teaching]					
7. (f) How often do you use the following tools on the MyNUST e-learning platform (Moodle). [H5P is an abbreviation for HTML5 package aims to make it easy for everyone to create, share and reuse interactive HTML5 content.]					

Frequent Use of Moodle Tools/Features	Never	Almost Never	Occasionally/Sometimes	Almost Every time	Every time
Sending out announcements 8. How often do you use the Announcements/News tool to send out course reminders to students?					
Grading 9. How often do you grade students' assignments online on the MyNUST e-learning platform?					
Assignment Feedback 10. How often do you upload assignment feedback for your students via					
Assignment resubmission opportunities 11. How often do you allow students the opportunity to resubmit assignments?					

Please mark with a cross (X) in the appropriate box to indicate your response. Mark one box only.

Frequent use of the platform	Once a week	Once a month	Daily	I do not use the My NUST eLearning platform
12. How frequently do you use My NUST e-earning platform?				

Type of Training/Development Opportunities	I attended training workshops	I attended training workshops	I attended training workshops	I attended training workshops
13. Indicate the type of faculty development toward the effective use of Moodle you participated in during the last 12 months.	Yes	Yes	Yes	Yes
	No	No	No	No

Appendix B - Survey Questionnaire – Lecturers: Section C - Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement to the following statements. Mark one box only.

Section C - Factors that affect blended learning at NUST (Questions 14 – 26)					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
14. I have open access to reliable internet at my home.					
15. I am motivated to teach online through the MyNUST e-learning platform/Moodle.					
16. I was ready to engage with online teaching at the beginning of the					
17. I experience challenges to adapt to online teaching.					
18. I afford students ample opportunities to communicate with their classmates through the MyNUST e-learning platform/Moodle					

	Strongly agree	Agree	Uncertain	Disagree	Strongly
19. Facilitating online teaching requires a certain level of computer literacy to navigate through the platform.					
20. I afford flexible opportunities for students to learn in a self-directed manner.					
21. Students are allowed to submit assignments after the due date with the necessary permission.					

Appendix B - Survey Questionnaire – Lecturers: Section C - Factors that affect blended	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
22. Facilitating online teaching allows me a chance to take ownership of my course.					
23. Facilitating online teaching provides opportunities to manage my course better.					
24. I feel lost and unsure about my ability to manage and facilitate online teaching.					
25. I need more training to improve my confidence in using Moodle tools.					
26. My heavy workload makes it difficult to use the MyNUST platform effectively.					

Appendix B - Survey Questionnaire – Lecturers: Section D -The use of Moodle for increased communication (Questions 27- 29). Please mark with a cross (X) in the appropriate box to rate the level of your agreement to the following statements. Mark one box only.

The use of Moodle for increased communication (Questions 27 –29)	Strongly agree	Agree	Uncertain	disagree	Strongly disagree
27. The use of the eLearning platform/Moodle at NUST has led to increased communication between my students and myself.					
28. The messaging tool in Moodle is an effective manner to communicate with students.					
29. (a) Rate your level of agreement or disagree with each of the following statements. [I make use of WhatsApp to maintain effective communicate with my class group]					

29. (b) Rate your level of agreement or disagree with each of the following statements. [I make use of Telecom's Short message services (SMS) to maintain effective communication with my class group]					
29. (c) Rate your level of agreement or disagree with each of the following statements. [I make use of the My NUST Moodle messaging tool to maintain effective communication with my class group]					
29. (d) Rate your level of agreement or disagree with each of the following statements. [I email students to maintain effective communication with my class group]					
29. (e) Rate your level of agreement or disagree with each of the following statements. [I make use of the MS Teams chat tool to maintain effective communication with my class group]					
29. (f) Rate your level of agreement or disagree with each of the following statements. [I make use of the MS Teams call tool to maintain effective communication with my class group]					
29.(g) Rate your level of agreement or disagree with each of the following statements. [I make use of personal phone calls to maintain effective communication with my class group]					
29. (h) Rate your level of agreement or disagree with each of the following statements. [I make use of Facebook to maintain effective communication with my class group]					

30. Communication in an online environment is more open than face-to-face classes.					
The extent to which the use of Moodle has led to increased communication	Excellent extent	Great extent	Satisfactory extent	Poor extent	Very small extent
31. To what extent has the use of Moodle led to increased communication at NUST?					

Appendix B - Survey Questionnaire – Lecturers: Section E - Development of problem-solving skills (Questions 32 – 42). Please mark with a cross (X) in the appropriate box to rate the level of your agreement to the following statements. Mark one box only.

The use of Moodle for increased communication (Questions 32 –42)					
	Strongly agree	Agree	Uncertain	disagree	Strongly disagree
32. Online tasks submitted for grading show evidence that the use of Moodle at NUST has promoted students' rational thinking.					
33. Online tasks submitted for grading show evidence that the use of Moodle at NUST has promoted independent thinking.					
34. The use of Moodle as an LMS at NUST capacitated students to seek multiple paths to analyse problems.					
35. The engagement of students in discussion forums in Moodle has developed their ability to think critically.					
36. I encourage students to use the quick messaging tool to share some thoughts and perspectives with online course participants.					
37. Assignments are set in such a way to challenge students to solve authentic workplace-related issues.					

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
38. Students are required to submit additional activities to promote real-time problem solving based on particular units.					
39. My course provides videos related to real life scenarios to develop problem-solving skills amongst students.					
40. My course provides web links to articles which are related to real life scenarios to engage students in solving problems.					

41. My course provides PowerPoint presentations which are related to real life scenarios to engage students in solving problems.					
The extent to which the use of Moodle has led to increased problem-solving abilities	Excellent extent	Great extent	Satisfactory extent	Poor extent	Very small extent
42. To what extent has the use of Moodle as an LMS led to increased problem-solving abilities among students in my classes.					

Appendix B - Survey Questionnaire – Lecturers: Recommendations from Lecturers

43. How can the institution/your department assist lecturers to use the MyNUST e-learning platform/Moodle in a more effective manner?

Thank you.

Appendix C - Final Interview Questions – Lecturing Staff, Academic coordinators, Instructional Designers and the Moodle site administrator

Dear Participants,

Thank you for participating in this research project. The aim of this project is to evaluate the effective use of Moodle as a Learning Management System (LMS) at Namibia University of Science of Technology. Participation in this interview is entirely on a voluntary basis. Please note that the responses provided by participants in this research will not be disclosed to any one at any stage of the research. The interview will take 45 minutes to complete. The findings that are derived from this interview will be used to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology (NUST).

Section A. Subject demographics

1. What is your gender?

   ☐ Female ☐ Male

2. What is your age?

   [ ]

3. How many years of work experience do you have in a higher education environment?

   [ ]

4. Please indicate the department where you teach/work from the list below.

   ☐ Department of Communication
   ☐ Department of Technical and Vocational Education and Training
   ☐ Department of Social Sciences
   ☐ Centre of Open Distance and Lifelong Learning
   ☐ Teaching and Learning Unit
   ☐ Other – Specify

Appendix C - Interview Questions – Lecturing Staff, Academic coordinators, Instructional Designers and the Moodle site administrator:

1. Comment on the availability of human capital to offer timely technical support at NUST.

2. How does the institution ensure that quality online teaching is offered in all online courses offered at the university?

3. How does the institution ensure that stimulating instructional materials are created and uploaded on the Moodle platform?

4. Comment on the strategies NUST has adopted regarding the design of online courses.

5. Comment on the managerial commitment at NUST to recognise efforts of academics to develop instructional material.

6. Comment on the communication tools used to communicate with NUST students and staff.

7. How does NUST ensure that quality training is offered to online facilitators to promote the effective use of Moodle as an LMS?

8. Comment on NUST's strategy to ensure that all students have access to online resources.

9. Comment on the interventions at Management level to ensure that all students across NUST have access to online learning.

10. Comment on NUST strategy to address the following to promote the effective and safe use of Moodle as an LMS at NUST?

    (a) loss of data

b) data leakages

c) security vulnerabilities

d) SQL Injection security risk - the SQL Injection security risk is a high-risk vulnerability that allows attackers to perform SQL queries in the Moodle databases due to inadequate sanitisation of data supplied by users.

e) Cross-Site Scripting (XSS) attacks - XSS attacks are responsible for common application-layer web attacks and target scripts embedded in a page on the client's server.

f) How does the Moodle technical team at NUST minimise the security risks associated with the use of Moodle as a Learning Management System.

11. What safety strategies are in place for using an open source, such as Moodle, as a Learning Management System? (Moodle updates, Moodle upgrades, Keeping Moodle themes and plugins current, redundant plugins, password policy, encourage Moodle users to change their passwords, choice of username to make it difficult for hackers to access the platform, limit of the use of incorrect login attempts, robust backup system, HTTPS login, Cron execution)

Appendix C - Interview Questions – Lecturing Staff, Academic coordinators, Instructional Designers and the Moodle site administrator:

C. Recommendations for the effective and safe use of the My NUST eLearning platform/ Moodle at NUST.

12. Do you have any suggestions or recommendations to improve the **safe** use of Moodle as a Learning Management System at NUST for the effective delivery of blended/online learning?

13. Do you have any suggestions or recommendations to improve the **effective** use of Moodle as a Learning Management System at NUST for the effective delivery of blended/online learning?

Thank you.

Appendix D - Sample of Non-Completed Informed Consent Form

Part 2: Certificate of Consent
This section is mandatory and should to be signed by the participant(s)

Part 2: Certificate of Consent
This section is mandatory and should to be signed by the participant(s)

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential. I consent voluntarily to be a participant in this study.

Print name of Participant:	
Signature of Participant:	
Date:	

If illiterate:
I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of witness:	
Signature of witness:	
Date:	

UU_IC - Version 2.1

Informed Consent Form

Part 1: Debriefing of Participants

Student's Name: Jacqueline Teresa Charmaine Bock

Student's E-mail Address: msjacquelinetc@yahoo.com

Student ID #: R1712D4223848

Supervisor's Name: Dr Muraina Olanrewaju

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology

Date: 08-Dec-2020

Provide a short description (purpose, aim and significance) of the research project, and explain why and how you have chosen this person to participate in this research (maximum 150 words).

The purpose of this study is to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology to: (1) establish the level of responsiveness of NUST lecturers and students to capitalise optimally on Moodle' s existing features to promote smooth communication between the institution and students in a cost-effective manner; (2) explore the signifying factors that affect blended eLearning in higher education; (3) establish whether the use of Moodle has led to increased student engagement, communication and problem solving skills; (4) develop a strategy for NUST to capitalise on the effective and safe use of Moodle. Students have been selected to participate in this survey on the basis that they are registered in the Faculty of Human Sciences at the Namibia University of Science and Technology (NUST). Study participants were chosen on the basis of their close involvement in using Moodle as a Learning Management System, and the Moodle site administrator was selected on the basis of his involvement in maintaining the Moodle server since the inception of eLearning at NUST.

The above named Student is committed in ensuring participant's voluntarily participation in the research project and guaranteeing there are no potential risks and/or harms to the participants.

Participants have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

I, Jacqueline Teresa Charmaine Bock **, ensure that all information stated above is true and that all conditions have been met.**

Student's Signature: Jacqueline T C Bock

Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should to be signed by the participant(s)

Student's Name: Jacqueline Teresa Charmaine Bock

Student's E-mail Address: msjacquelinetc@yahoo.com

Student ID #: R1712D4223848

Supervisor's Name: Dr Muraina Olanrewaju

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise. I consent voluntarily to be a participant in this study.

Participant's Print name:

Participant's Signature: _____

Date:

If the Participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the aforementioned individual has given consent freely.

Witness's Print name:

Witness's Signature: _____

Date:

1

Appendix E - Research Ethics Application

UNICAF UNIVERSITY

REAF_DS - Version 3.1

UNICAF UNIVERSITY RESEARCH ETHICS APPLICATION FORM DOCTORAL STUDIES	UREC USE ONLY: Application No: Date Received:

Student's Name: Jacqueline Teresa Charmaine Bock

Student's E-mail Address: msjacquelinetc@yahoo.com

Student's ID #: R1712D4223848

Supervisor's Name: Dr Muraina Olanrewaju

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology

1. **Please state the timelines involved in the proposed research project:**

Estimated Start Date: 15-Jan-2021 Estimated End Date: 31-Dec-2021

2. **External Research Funding (if applicable):**

2.a. Do you have any external funding for your research?

☐ YES ☑ NO

If YES, please answer questions **2b** and **2c**.

2.b. List any external (third party) sources of funding you plan to utilise for your project. You need to include full details on the source of funds (e.g. state, private or individual sponsor), any prior / existing or future relationships between the funding body / sponsor and any of the principal investigator(s) or co-investigator(s) or student researcher(s), status and timeline of the application and any conditions attached.

No external funding for this research was provided. However, the student was awarded a Unicaf University scholarship of 63 % toward the payment of tuition fees.

2.c. If there are any perceived ethical issues or potential conflicts of interest arising from applying or and receiving external funding for the proposed research then these need to be fully disclosed below and also further elaborated on, in the relevant sections on ethical considerations later on in this form.

Not Applicable

3. The research project

3.a. Project Summary:

In this section fully describe the purpose and underlying rationale for the proposed research project. Ensure that you pose the research questions to be examined, state the hypotheses, and discuss the expected results of your research and their potential.

It is important in your description to use plain language so it can be understood by all members of the UREC, especially those who are not necessarily experts in the particular discipline. To that effect ensure that you fully explain / define any technical terms or discipline-specific terminology (use the space provided in the box).

The purpose of this study is to evaluate the effective use of the Modular Object-Oriented Dynamic Learning Environment (Moodle) as a Learning Management System (LMS) at Namibia University of Science and Technology (NUST). With this study, the researcher hopes to establish the level of responsiveness of NUST employees, lecturers and students to capitalise optimally on Moodle's existing features to promote smooth communication between the institution and students in a cost-effective manner. The researcher aims to explore the signifying factors that affect blended learning at NUST. This study will establish whether the use of Moodle has led to increased student engagement, communication and problem solving skills. The researcher seeks to develop a strategy for NUST to capitalise on the effective and safe use of Moodle as a Learning Management System at NUST.

Despite numerous built-in features in Moodle as an LMS, both eLearning centres at the Namibia University of Science and Technology utilize only a limited number of features and tools available in Moodle. Despite the messaging function built in into Moodle, the institution makes use of bulk short message services, which is extremely costly. In addition, concerns have been raised about the limited utilisation of Moodle tools by online course developers, e-Tutors and students. Two separate units, the Teaching Learning Unit (TLU) and the Centre for Open and Lifelong Learning (COLL), share the responsibility towards course design, development and delivery. The effective use of Moodle as a Learning Management System (LMS) at NUST is of crucial importance to the researcher as a course developer and instructional designer in her role to support, train and monitor Moodle users at NUST. The proposed study is grounded on the following questions: RQ1. What is the level of responsiveness of NUST students and lecturers to capitalise optimally on existing features of Moodle? RQ2. What are the signifying factors that affect blended learning in higher education? RQ3 What impact does the use of Moodle have towards increased students' engagement? RQ4 What impact does the use of Moodle have towards increased students' communication? RQ5 What impact does the use of Moodle have towards increased students' problem solving skills? RQ6 Which strategies can be adopted by NUST to increase the effective and safe use of Moodle as an LMS?

3.b. Significance of the Proposed Research Study and Potential Benefits:

Outline the potential significance and/or benefits of the research (use the space provided in the box)

This study intends to create new knowledge in the areas of the effective and safe use of Moodle as an open source software for higher educational institutions nationally and internationally. In addition, this research will attest if Moodle as an LMS has led to increased student engagement, communication and problem solving skills. This study also aims to address pressing management issues by developing a strategy to utilise existing technologies optimally and, at the same time, slash operational costs at NUST institutional wide. The researcher hopes to find solutions to slash operational costs, such as, telecommunication expenditure institution wide, with the optimal integration of Moodle features for online learning at NUST. Exploring the signifying factors that affect blended learning in higher education will enable the researcher to create awareness amongst NUST management to become responsive to the challenges the institution is facing as a blended learning university. Finally, the researcher hopes to develop strategies that can be adopted by both eLearning Centres at NUST to increase the effective and safe use of Moodle as an LMS. The entire NUST community will benefit from the effective and safe use of Moodle to address current challenges with fully fledge online course integration, and consequently, improve student performance, student support, institutional standards, guidelines and practices.

4. **Project execution:**

4.a. The following study is an:

- [x] experimental study (primary research)
- [ ] desktop study (secondary research)
- [ ] desktop study using existing databases involving information of human/animal subjects
- [ ] Other

If you have chosen 'Other' please Explain:

Not Applicable

4.b. Methods. The following study will involve the use of:

Method	Materials / Tools
Qualitative:	☑ Face to Face Interviews
	☐ Phone Interviews
	☐ Face to Face Focus Groups
	☐ Online Focus Groups
	☐ Other *
Quantitative:	☐ Face to Face Questionnaires
	☑ Online Questionnaires
	☐ Experiments
	☐ Tests
	☐ Other *

*If you have chosen 'Other' please Explain:

Jacqueline Teresa Charmaine Bock

5. Participants:

5 a. Does the Project involve the recruitment and participation of additional persons other than the researcher(s) themselves?

☑ YES **If YES, please complete all following sections.**

☐ NO **If NO, please directly proceed to Question 7.**

5 b. Relevant Details of the Participants of the Proposed Research

State the number of participants you plan to recruit, and explain in the box below how the total number was calculated.

Number of participants: 437

Group 1: Students: Target population = 1400 - Ideal Sample size = 307 participants. However, 400 students will be selected to cater for non responses. Group 2: Lecturing Staff: Target Population = 80 - Ideal sample size is 20 but 30 lecturers will be selected. Group 3: Seven participants comprising of two Academic Support Coordinators, four Instructional Designers and one Moodle site administrator.

Describe important characteristics such as: demographics (e.g. age, gender, location, affiliation, level of fitness, intellectual ability etc). It is also important that you specify any inclusion and exclusion criteria that will be applied (e.g. eligibility criteria for participants).

Age range: From 19 To 65

Gender: ✔ Female ✔ Male

Eligibility Criteria:

- Inclusion criteria: 2nd and 3rd year students registered in the Faculty of Humanities at NUST. Lecturing staff - Lecturing staff teaching in the Human Sciences Faculty during the 2020 academic year.
- Exclusion criteria: The study excludes 1st year students and students in faculties, other than the Faculty of Human Sciences. The study will also exclude lecturing staff outside the Human Sciences Faculty, as well as staff members who are on study leave.

Disabilities: The sample selection does not include students with disabilities.

Other relevant information (use the space provided in the box):

Not applicable

5 c. Participation & Research setting:

Clearly describe which group of participants is completing/participating in the material(s)/ tool(s) described in 5b above (use the space provided in the box).

Group 1 - Four hundred (400) students will be required to complete online questionnaires.
Group 2 - Thirty (30) full-time lecturing staff will be required to complete online questionnaires
Group 3 - Two (2) academic coordinators (Distance); Two (2) academic coordinators (Full time/ Part time), two (2) instructional designers and one (1) Moodle site administrator will be participants to be included in face-to-face in-depth interviews.

5 d. Recruitment Process for Human Research Participants:

Clearly describe how the potential participants will be identified, approached and recruited (use the space provided in the box).

An e-mail was sent to Office of the Registrar to apply for permission for this study to be conducted at NUST. The researcher obtained a spreadsheet from the Institutional Planning department containing all the e-mail telephone contact details of students and staff members from: (1) The Faculty of Human Sciences (2) The Centre of Open and Lifelong Learning (COLL) and (3) The Teaching and Learning Unit (TLU). A separate mail will be forwarded to the Dean of the Faculty of Human Sciences to inform him about the study to be conducted in the faculty. Probability Sampling: Participants to be taking part in this study (students and lecturing staff) will be selected randomly from the spreadsheet obtained from the Institutional Planning Department. Non-probability Sampling: Purposeful sampling was used to select academic coordinators, instructional designers and the Moodle site administrator from COLL and TLU as participants in this study.

5 e. Research Participants Informed Consent.

Select below which categories of participants will participate in the study. Complete the relevant Informed Consent form and submit it along with the REAF form.

Yes	No	Categories of participants	Form to be completed
☑	☐	Typically Developing population(s) above the maturity age *	Informed Consent Form
☐	☑	Typically Developing population(s) under the maturity age *	Guardian Informed Consent Form

* Maturity age is defined by national regulations in laws of the country in which the research is being conducted.

5 f. Relationship between the principal investigator and participants.

Is there any relationship between the principal investigator (student), co-investigators(s), (supervisor) and participant(s)? For example, if you are conducting research in a school environment on students in your classroom (e.g. instructor-student).

☑ YES ☐ NO

If YES, specify (use the space provided in the box).

The researcher is employed as an instructional designer at NUST, and works at the the distance education unit. The relationship is described as instructional designer-student relationship. The relationship with lecturing staff members, academic coordinators, instructional designers and the Moodle site administrator is collegial in nature. The researcher wil lensure that this study is trustworthy, ethical and abides by professional standards, and will ensure that results and conclusions of this study are free from bias.

6. **Potential Risks of the Proposed Research Study.**

6 a. i. Are there any potential risks, psychological harm and/or ethical issues associated with the proposed research study, other than risks pertaining to everyday life events (such as the risk of an accident when travelling to a remote location for data collection)?

☐ YES ☑ NO

If YES, specify below and answer the question 6 a.ii.

6 a.ii Provide information on what measures will be taken in order to exclude or minimise risks described in 6.a.i.

No potential environmental or societal risks will arise from the proposed research.

6 b. Choose the appropriate option

		Yes	No
i.	Will you obtain written informed consent form from all participants?	✔	
ii.	Does the research involve as participants, people whose ability to give free and informed consent is in question?		✔
iii.	Does this research involve participants who are children under maturity age? **If you answered YES to question iii, complete all following questions.** **If you answered NO to question iii, do not answer Questions iv, v, vi and proceed to Questions vii, viii, ix and x.**		✔
iv.	Will the research tools be implemented in a professional educational setting in the presence of other adults (i.e. classroom in the presence of a teacher)?		
v.	Will informed consent be obtained from the legal guardians (i.e. parents) of children?		
vi.	Will verbal assent be obtained from children?		
vii.	Will all data be treated as confidential? If NO, explain why confidentiality of the collected data is not appropriate for this proposed research project, providing details of how all participants will be informed of the fact that any data which they will provide will not be confidential.	✔	
viii.	Will all participants /data collected be anonymous? If NO, explain why and describe the procedures to be used to ensure the anonymity of participants and/or confidentiality of the collected data both during the conduct of the research and in the subsequent release of its findings.	✔	

		Yes	No
ix.	Have you ensured that personal data and research data collected from participants will be securely stored for five years?	☑	☐
x.	Does this research involve the deception of participants? If YES, describe the nature and extent of the deception involved. Explain how and when the deception will be revealed, and who will administer this debrief to the participants:	☐	☑

6 c. i. Are there any other ethical issues associated with the proposed research study that are not already adequately covered in the preceding sections?

☐ Yes ☑ No

If YES, specify (maximum 150 words).

6.c.ii Provide information on what measures will be taken in order to exclude or minimise ethical issues described in 6.c.i.

msjacquelinetc@yahoo.com

6 d. Indicate the Risk Rating.

☐ High ☑ Low

7. **Further Approvals**

Are there any other approvals required (in addition to ethics clearance from UREC) in order to carry out the proposed research study?

☑ YES ☐ NO

If YES, specify (maximum 100 words).

Yes, permission was granted by the acting registrar at NUST to conduct the proposed study at Namibia University of Science and Technology. The letter of consent to conduct this research with the Namibia University of Science and Technology is attached to this application.

8. **Application Checklist**

Mark √ if the study involves any of the following:

☐ Children and young people under 18 years of age, vulnerable population such as children with special educational needs (SEN), racial or ethnic minorities, socioeconomically disadvantaged, pregnant women, elderly, malnourished people, and ill people.

☐ Research that foresees risks and disadvantages that would affect any participant of the study such as anxiety, stress, pain or physical discomfort, harm risk (which is more than is expected from everyday life) or any other act that participants might believe is detrimental to their wellbeing and / or has the potential to / will infringe on their human rights / fundamental rights.

☐ Risk to the well-being and personal safety of the researcher.

☐ Administration of any substance (food / drink / chemicals / pharmaceuticals / supplements / chemical agent or vaccines or other substances (including vitamins or food substances) to human participants.

☐ Results that may have an adverse impact on the natural or built environment.

9. **Further documents**

Check that the following documents are attached to your application:

		ATTACHED	NOT APPLICABLE
1	Recruitment advertisement (if any)	☐	☑
2	Informed Consent Form / Guardian Informed Consent Form	☑	☐
3	Research Tool(s)	☑	☐
4	Gatekeeper Letter	☑	☐
5	Any other approvals required in order to carry out the proposed research study, e.g., institutional permission (e.g. school principal or company director) or approval from a local ethics or professional regulatory body.	☑	☐

10. Final Declaration by Applicants:

(a) I declare that this application is submitted on the basis that the information it contains is confidential and will only be used by Unicaf University for the explicit purpose of ethical review and monitoring of the conduct of the research proposed project as described in the preceding pages.

(b) I understand that this information will not be used for any other purpose without my prior consent, excluding use intended to satisfy reporting requirements to relevant regulatory bodies.

(c) The information in this form, together with any accompanying information, is complete and correct to the best of my knowledge and belief and I take full responsibility for it.

(d) I undertake to abide by the highest possible international ethical standards governing the Code of Practice for Research Involving Human Participants, as published by the UN WHO Research Ethics Review Committee (ERC) on http://www.who.int/ethics/research/en/ and to which Unicaf University aspires to.

(e) In addition to respect any and all relevant professional bodies' codes of conduct and/or ethical guidelines, where applicable, while in pursuit of this research project.

☑ **I agree with all points listed under Question 10**

Student's Name: Jacqueline Teresa Charmaine Bock

Supervisor's Name: Dr Muraina Olanrewaju

Date of Application: 08-Dec-2020

Important Note:
Save your completed form (we suggest you also print a copy for your records) and then submit it to your UU Dissertation/project supervisor (tutor). **In the case of student projects, the responsibility lies with the Faculty Dissertation/Project Supervisor.** If this is a student application, then it should be submitted via the relevant link in the VLE. Please submit only electronically filled in copies; do not hand fill and submit scanned paper copies of this application.

Appendix F - Informed Consent

UU_IC - Version 2.1

Informed Consent Form

Part 1: Debriefing of Participants

Student's Name: Jacqueline Teresa Charmaine Bock

Student's E-mail Address: msjacquelinetc@yahoo.com

Student ID #: R1712D4223848

Supervisor's Name: Dr Muraina Olanrewaju

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology

Date: 08-Dec-2020

Provide a short description (purpose, aim and significance) of the research project, and explain why and how you have chosen this person to participate in this research (maximum 150 words).

The purpose of this study is to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology to: (1) establish the level of responsiveness of NUST lecturers and students to capitalise optimally on Moodle' s existing features to promote smooth communication between the institution and students in a cost-effective manner; (2) explore the signifying factors that affect blended eLearning in higher education; (3) establish whether the use of Moodle has led to increased student engagement, communication and problem solving skills; (4) develop a strategy for NUST to capitalise on the effective and safe use of Moodle. Students have been selected to participate in this survey on the basis that they are registered in the Faculty of Human Sciences at the Namibia University of Science and Technology (NUST). Study participants were chosen on the basis of their close involvement in using Moodle as a Learning Management System, and the Moodle site administrator was selected on the basis of his involvement in maintaining the Moodle server since the inception of eLearning at NUST.

The above named Student is committed in ensuring participant's voluntarily participation in the research project and guaranteeing there are no potential risks and/or harms to the participants.

Participants have the right to withdraw at any stage (prior or post the completion) of the research without any consequences and without providing any explanation. In these cases, data collected will be deleted.

All data and information collected will be coded and will not be accessible to anyone outside this research. Data described and included in dissemination activities will only refer to coded information ensuring beyond the bounds of possibility participant identification.

I, Jacqueline Teresa Charmaine Bock **, ensure that all information stated above is true and that all conditions have been met.**

Student's Signature: Jacqueline T C Bock

1

Informed Consent Form

Part 2: Certificate of Consent

This section is mandatory and should to be signed by the participant(s)

Student's Name: Jacqueline Teresa Charmaine Bock

Student's E-mail Address: msjacquelinetc@yahoo.com

Student ID #: R171204223848

Supervisor's Name: Dr Muraina Olanrewaju

University Campus: Unicaf University Zambia (UUZ)

Program of Study: UUZ: PhD Doctorate of Philosophy

Research Project Title: An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology

I have read the foregoing information about this study, or it has been read to me. I have had the opportunity to ask questions and discuss about it. I have received satisfactory answers to all my questions and I have received enough information about this study. I understand that I am free to withdraw from this study at any time without giving a reason for withdrawing and without negative consequences. I consent to the use of multimedia (e.g. audio recordings, video recordings) for the purposes of my participation to this study. I understand that my data will remain anonymous and confidential, unless stated otherwise. I consent voluntarily to be a participant in this study.

Participant's Print name: _____

Participant's Signature: _____

Date: _____

If the Participant is illiterate:

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had an opportunity to ask questions. I confirm that the aforementioned individual has given consent freely.

Witness's Print name: _____

Witness's Signature: _____

Date: _____

Appendix G - Gate Keeper Letter

UU_GL - Version 2.0

Gatekeeper letter

Address: Private Bag 1338, Windhoek

Date: 08-Dec-2020

Subject: Permission to conduct research

Dear Ms Heelu,

I am a doctoral student at Unicaf University Zambia.

As part of my degree I am carrying out a study on the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology.

I am writing to enquire whether you would be willing to allow me permission to recruit students and academics in the Faculty of Human Sciences and employees at The Centre of Open and Lifelong Learning (COLL) and the Teaching and Learning Unit (TLU) to participate in this research.

Subject to approval by Unicaf Research Ethics Committee (UREC) this study will be using anonymous web based open and closed ended survey questionnaires and in-depth interviews.

The purpose of this study is to evaluate the effective use of the Modular Object-Oriented Dynamic Learning Environment (Moodle) as a Learning Management System (LMS) at Namibia University of Science and Technology (NUST). The study is titled: *An evaluation of the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology*.

I need your support to send out an e-mail to the Faculty of Human Sciences, COLL and TLU to allow me to recruit participants to participate in this research. The study involves participation of thirty academics and four hundred students in the Faculty of Human Sciences. Furthermore, I would like to conduct in-depth interviews with four instructional designers at COLL, two Moodle managers and the Moodle Site administrator, located at TLU. Academics and students in the Faculty of Human Sciences will have to complete web based survey questionnaires. Students will take approximately twenty minutes to complete the survey questions and lecturing staff members will need thirty minutes.

Thank you in advance for your time and for your consideration of this project. Kindly please let me know if you require any further information or need any further clarifications.

Yours Sincerely,

Jacqueline Teresa Charmaine Bock

Student's Name: Jacqueline Teresa Charmaine Bock
Student's E-mail: msjacquelinetc@yahoo.com
Student's Address and Telephone: P.O. Box 3519, Rehoboth, Telephone 081 295 8055
Supervisor's Title and Name: Dr M. Olanrewaju
Supervisor's Position: Research Supervisor
Supervisor's E-mail: m.olanrewaju@unicaf.org

Appendix K - Conduct Research issued by Namibia University of Science and Technology

NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

13 Jackson Kaujeua Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 2118
F: +264 61 207 9118
E: registrar@nust.na
W: www.nust.na

Office of the Registrar

08 December 2020

Ms. Jacqueline Teresa Charmaine Bock
Email: msjacquelinetc@yahoo.com
Windhoek
NAMIBIA

Dear Ms. Bock,

RE: CONSENT TO CONDUCT YOUR RESEARCH WITH THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY STAFF AND STUDENT

The email dated 08 December 2020, has reference.

Approval is hereby granted for you to conduct the research on *"An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology"*

Any information gathered during the research is to be used for the purpose of the study only and must be treated as confidential. The results of the study should be shared with the University. Individual information of staff and students will not be made available, nor will biographical information of students be made available in such a way that individual students can be identified.

I wish you all the best with your research.

Yours sincerely,

Ms. Selma Heelu
ACTING REGISTRAR

CC:
Deputy Vice-Chancellor: Research and Innovation
Assistant Registrar

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY
Private Bag 13388
Windhoek
NAMIBIA
2020 -12- 08
REGISTRAR
OFFICE OF THE REGISTRAR

Appendix I - Provisional Approval – Unicaf University Research Ethics Committee Decision

UREC's Decision

Name of Participant:	Jacqueline Beck
Title of the Research project:	An evaluation of the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology
Date:	07/11/2019

		Comments
☐	**Approved** without revision or comments.	
√	**Approved** with comments for **minor revision.**	The student is advised to: 1. Ensure she has no access to IP addresses. 2. Ensure that she does not ask the participants to state their name or any other identification on the questionnaire. 3. Make sure that being an online student with another institution will not distort research outcome. 4. Ensure research study participants are only students and/or work with NUST and not any other institution
☐	**Not approved** with guidance comments for moderate revision and resubmission.	
☐	**Not approved** with guidance comments for major revision and resubmission.	

Appendix J - Final Approval: Unicaf University Research Ethics Committee Decision

UNICAF UNIVERSITY

UREC Decision, Version 2.0

Unicaf University Research Ethics Committee Decision

Student's Name: Jacqueline Bock

Student's ID #: R1712D4223848

Supervisor's Name: Dr Muraina Kamilu Olanrewaju

Program of Study: UUZ: PhD Doctorate of Philosophy

Offer ID /Group ID: O22080G22172

Dissertation Stage: 3

Research Project Title: An Evaluation of the Effective use of Moodle as a Learning Management System at Namibia University of Science and Technology

Comments:

REAF:
Correct the Program: UUZ: PhD Doctorate of Philosophy
5f - Relationship between the principal investigator and participants - YES - make sure there is no conflict of interest.
6bii should be no
Informed Consent Form:
Program of study is missing.

Gatekeeper letter:
Complete: Student's Name, Student's E-mail

Appendix A - Questionnaire to Students:
Ask for the actual age and/ or a number of years in the organization, and the number of years the company being in operation, not the range as this will allow for more detailed statistical analysis at a later point.

Appendix B - Survey Questionnaire – Lecturers
Ask for the actual age and/ or a number of years in the organization, and the number of years the company being in operation, not the range as this will allow for more detailed statistical analysis at a later point.

Appendix C - Interview Questions – Academic coordinators, instructional designers and the Moodle site administrator
Add the demographic section.

Decision*: B. Approved with comments for minor revision

Date: 18-Feb-2021

*Provisional approval provided at the Dissertation Stage 1, whereas the final approval is provided at the Dissertation stage 3. The student is allowed to proceed to data collection following the final approval.

Data Collection Tools

Title: The Effective Use of Moodle as a Learning Management System at Namibia University of Science and Technology

Student: Jacqueline Teresa Charmaine Bock
Supervisor: Dr Muraina Kamilu Olanrewaju

1

Appendix A - Questionnaire to Students

Dear Participants,

Thank you for participating in this research project. The aim of this project is to evaluate the effective use of Moodle as a Learning Management System (LMS) at Namibia University of Science of Technology.

This is an anonymous web-based survey questionnaire that contains a combination of open and close-ended questions. Participation in this survey is entirely on a voluntary basis. By continuing with this survey, you agree to participate in this research in accordance with the consent form you read and signed. Please note that the answers provided by the participants will be used for the research purposes only and no personal information of the participants will be disclosed at any stage of the research. The online survey will take approximately ten (10) minutes to complete. The findings that are derived from this survey will be used to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology.

Instructions: Based on your experiences with Moodle as a learning management system at NUST, answer the questions frankly and objectively.

Please mark with a cross (X) in the appropriate box next to indicate your response. Mark one box only.

Section A – Demographic information

In this section, I would like to know a little about you. Please mark only one box with a cross (X) in the appropriate box to indicate your response.

1. **Please indicate your gender.**
   Female ☐
   Male ☐

2. **Please indicate your mode of study.**
   ☐ Full-time Student ☐ Part-time Student ☐ Distance Student

3. **Please indicate your study programme from the list below.**

☐ Bachelor of Communication
☐ Bachelor of English
☐ Bachelor of Journalism and Media Technology
☐ Bachelor of Criminal Justice in Correctional Management
☐ Bachelor of Criminal Justice in Policing

☐ Bachelor of Public Management
☐ Certificate in Vocational Education and Training: Trainer
☐ Higher Certificate in Vocational Education and Training: Trainer
☐ Diploma in Vocational Education and Training Management

4. Please indicate the department linked to your programme.

☐Department of Communication
☐Department of Technical and Vocational Education and Training
☐Department of Social Sciences

5. What is your age?

Section B – Please mark with a cross (X) in the appropriate box to indicate your response. Mark one box only.

Responsiveness in using My NUST eLearning platform (Moodle) (Questions 6 – 21)				
6. I know the existence of My NUST eLearning platform.			Yes ☐	No ☐
7. How did you find out about the existence of My NUST eLearning platform?	Course Lecturer ☐	Friend ☐	I attended a Moodle orientation session ☐	Uncertain ☐

	Once a week	Once a month	Daily	I do not use the My NUST eLearning platform
8. How frequently do you use My NUST eLearning platform?	☐	☐	☐	☐

Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
9. I am confident in using the Moodle platform to participate in chats.					
10. I am confident in using the Moodle platform to access my course outline.					
11. I am confident in using the Moodle platform to download study materials.					
12. I am confident in using the Moodle platform to contact my lecturer when needed.					
13. I am confident in using the Moodle platform to participate in discussion forums.					
14. I am confident in using the Moodle platform to complete quizzes.					
15. I am confident in using the Moodle platform to complete tests.					
16. I am confident in using the Moodle platform to upload assignments.					
17. I am confident in using the Moodle platform to participate in Moodle Wikis.					
18. I am confident in using the Moodle platform to engage in Moodle Workshops to do peer assessments.					
19. I am confident in using the Moodle platform to create Moodle Blogs.					
20. I am confident in using the Moodle platform to view course announcements.					
21. I am confident in using the Moodle platform to upload tasks on my online course for grading.					

Section C - Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

Factors that affect blended learning at NUST (Questions 22 – 32)	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
22. I have open access to reliable internet at my home.					
23. I am motivated to study online through the My NUST eLearning Platform/Moodle.					
24. I was ready to engage with online learning at the beginning of the semester.					
25. I am challenged to adapt to online learning.					
26. Studying online requires a certain level of computer literacy to navigate through the platform.					
27. I am afforded flexible opportunities to learn in a self-directed manner.					
28. I am afforded ample time to complete online tasks.					
29. Studying online allowed me to take ownership of my studies.					
30. Studying online provided opportunities to manage my studies better.					
31. Studying online creates a feeling of isolation from my peers.					
32. Studying online creates a feeling of lost with my studies.					

Section D - Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

The use of Moodle to increase students' course engagement (Questions 33 – 41)					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
33. The topics provided for online forum discussions are interesting; as such, they stimulate peer interaction.					
34. Online course facilitators grade online discussions in a timely manner.					
35. My engagement in live chats has led to increased course engagement.					
36. The use of Moodle blogs is promoted on the My NUST eLearning Platform.					
37. My engagement in Moodle blogs has led to increased course engagement.					
38. Online course facilitators make use of live lessons, for example Zoom, Ms Teams, Big Blue Button, etc.					
39. Online course facilitators encourage the use of ePortfolio for self and peer reflections.					
40. Online course facilitators provide enough reading materials and online resources to increase course engagement.					
41. The use of the Wiki tool is promoted on the My NUST eLearning platform/Moodle					

Section E - Please mark with a cross (X) in the appropriate box to rate the level of your agreement with the following statements. Mark one box only.

The use of Moode for increased communication (Questions 42 - 52

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
42. Access to the My NUST eLearning Platform/Moodle makes contact with lecturers easier.					
43. I receive messages from my course facilitators via the messaging tool on Moodle.					
44. I use the messaging feature of the My NUST eLearning Platform/Moodle to contact my lecturers.					
45. I use the messaging feature on Moodle to contact my class mates					
46. I am satisfied with the level of communication with lecturers through the My NUST eLearning Platform/Moodle					
47. Communication in an online environment is more open then face-to-face classes.					
48. I rely on the 'upcoming events' feature to get information on offline activities that take place at a specific time					
49. I rely on the 'upcoming events' feature to get information on online planned activities to take place at a specific time.					
50. I use the Moodle calendar to add course events in my courses.					
51. Regular course announcement are made through the announcement tool.					
52. The use of the glossary tool is promoted on the My NUST eLearning platform.					

Section F - Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only.

The use of Moodle to develop problem solving skills (Questions 53 – 63)					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
53. Assessment activities are structured to find solutions to real life problems.					
54. The learning activities in my online courses assist with the development of critical thinking skills.					
55. Online tasks are structured to promote rational thinking.					
56. Online tasks are structured in such a way to promote independent thinking					
57. Online tasks are structured in a manner to analyse multiple paths to solve problems.					
58. Online discussions topics require the application of critical thinking skills.					
59. I use the quick messaging tool to share some thoughts and perspectives with online course participants.					
60. I am required to complete additional assignments on real-time problems based on particular units.					
61. I am provided with quality feedback to assist with the development of problem solving skills.					
62. My engagement in online tasks have increased my ability to solve problems.					
63. Class interaction with teaching staff is vital in an online learning environment.					

Section G -

Student recommendations: Please answer the following questions. (Question 64)

64. How can students be assisted to use the My NUST eLearning Platform/ Moodle in a more effective manner?

Thank you.

Appendix B - Survey Questionnaire – Lecturers

Dear Participants,

Thank you for participating in this research project. The aim of this project is to evaluate the effective use of Moodle as a Learning Management System (LMS) at Namibia University of Science of Technology.

This is an anonymous web-based survey questionnaires that contains a combination of open and close-ended questions. Participation in this survey is entirely on a voluntary basis. By continuing with this survey, you agree to participate in this research in accordance with the informed consent form you read and signed. Please note that the answers provided by the participants will be used for research purposes only and no personal information will be disclosed at any stage of the research. The online survey will take approximately ten (10) minutes to complete. The findings that are derived from this survey will be used to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology.

Thank you for your cooperation.

Instructions: Based on your experiences with Moodle as a learning management system at NUST, answer the questions frankly and objectively.

Please mark with a cross (X) in the appropriate box next to indicate your response. Mark one box only.

Section A. Subject demographics

1. What is your gender?

   ☐ Female ☐ Male

2. What is your age?

   [ ]

3. How many years of teaching experience do you have in a higher education environment?

   [ ]

4. Please indicate the department where you teach from the list below.

☐ Department of Communication
☐ Department of Technical and Vocational Education and Training
☐ Department of Social Sciences

Section B. Statements 5-20: Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement with the following statements. Mark one box only.

Responsiveness to use the Moodle platform /My NUST eLearning platform. (Questions 5 -20)					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
5. I am confident to teach online modules on Moodle/ My NUST eLearning platform.					
6. I am confident to engage effectively in Moodle discussion forums.					
7. I am confident to apply Bloom's Taxonomy when designing course-learning outcomes.					
8. I am confident to use the Quiz tool in Moodle to create online quizzes.					
9. I am confident to set up an online test on Moodle.					
10. I am confident to create/develop instructional materials and upload them on Moodle.					
11. I am confident to set/create assignments in Moodle.					
12. I am confident to use the Wiki tool in my course.					
13. I am confident to use of the Moodle Workshop tool to allow my students to engage in peer assessment.					
14. I am confident to send out course announcements / reminders to students.					
15. I am confident to grade assignments online on Moodle.					

16. I am confident to use Moodle to provide assignment feedback to my students.					
17. I allow students' the opportunity to resubmit assignments.					
18. I know the purpose of draft submissions in Moodle.					
19. I use Moodle to upload additional materials for my online students.					

Please mark with a cross (X) in the appropriate box to indicate your response. Mark one box only.

	Once a week	Once a month	Daily	I do not use the My NUST eLearning platform
20. How frequently do you use My NUST eLearning platform?	☐	☐	☐	☐

Section C - Please mark with a cross (X) in the appropriate box to rate the level of your agreement or disagreement to the following statements. Mark one box only.

Factors that affect blended learning at NUST (Questions 21 – 33)					
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
21. I have open access to reliable internet at my home.					
22. I am motivated to teach online through the My NUST eLearning Platform/Moodle.					
23. I was ready to engage with student online at the beginning of the semester.					
24. I am challenged to adapt to online learning.					
25. I afford students ample opportunities to communicate with their class mates through the My NUST eLearning Platform/Moodle					
26. Facilitating online requires a certain level computer literacy to navigate through the platform.					

27. I afford flexible opportunities for students to learn in a self-directed manner.					
28. I afford ample time for students to complete online tasks.					
29. Facilitating online allows me a chance to take ownership of my course.					
30. Facilitating online provided opportunities to manage my course better.					
31. Facilitating online creates a feeling of isolation from my colleagues.					
32. Facilitating online creates a feeling of lost with my course.					
33. I need more training to improve my skillset in using Moodle tools.					

Section D - Please mark with a cross (X) in the appropriate box to rate the level of your agreement to the following statements. Mark one box only.

Opportunities for the development of problem solving skills using Moodle (Questions 34 – 44)					
	Strongly agree	Agree	Uncertain	disagree	Strongly disagree
34. Online tasks are structured to promote rational thinking.					
35. Online tasks are structured in such a way to promote independent thinking.					
36. Online tasks are structured in a manner to analyse multiple paths to solve problems.					
37. Online discussions topics require the application of critical thinking skills.					
38. I encourage students to use the quick messaging tool to share some thoughts and perspectives with online course participants.					
39. Assignments are set in such a way to challenge students to solve authentic workplace-related issues.					
40. Students are required to submit additional activities on real-time problem solving based on particular units.					

41. I provide quality feedback of task submitted to develop the problem solving abilities of students.					
42. I include videos which are related to real life scenarios to engage students in solving problems.					
43. I include web links which are related to real life scenarios to engage students in solving problems					
44. I include PowerPoint presentations which are related to real life scenarios to engage students in solving problems.					

Section E - Please mark with a cross (X) in the appropriate box to rate the level of your agreement to the following statements. Mark one box only.

Effective use of Moodle and Recommendations: Please answer the following questions. (Questions 45 – 47)

	Excellent extent	Great extent	Satisfactorily extent	Poor extent	Very small extent
45. To what extent has the use of Moodle as Learning Management System contribute to the abilities of students to solve problems.					
46. To what extent has the Moodle training opportunities at NUST assist you to use Moodle in an effective manner?					

47. How can the institution assist lecturers to use the My NUST eLearning Platform/ Moodle in a more effective manner?

Thank you.

Appendix C - Interview Questions – Academic coordinators, instructional designers and the Moodle site administrator

Dear Participants,

Thank you for participating in this research project. The aim of this project is to evaluate the effective use of Moodle as a Learning Management System (LMS) at Namibia University of Science of Technology. Participation in this interview is entirely on a voluntary basis. Please note that the responses provided by participants in this research will not be disclosed to any one at any stage of the research. The interview will take 45 minutes to complete. The findings that are derived from this interview will be used to evaluate the effective use of Moodle as a Learning Management System at Namibia University of Science and Technology (NUST).

Section A. Subject demographics

1. What is your gender?

   ☐ Female ☐ Male

2. What is your age?

   [ ]

3. How many years of work experience do you have in a higher education environment?

   [ ]

4. Please indicate the department where you teach/work from the list below.

   ☐ Department of Communication
   ☐ Department of Technical and Vocational Education and Training
   ☐ Department of Social Sciences
   ☐ Centre of Open Distance and Lifelong Learning
   ☐ Teaching and Learning Unit

Section B. Effective use of the My NUST eLearning platform/ Moodle at NUST.

1. Comment on the availability of human capital to offer timely technical support at NUST.

2. How does the institution ensure that quality online teaching is offered in all online courses offered at the university?

3. How does the institution ensure that stimulating instructional materials are created and uploaded on the Moodle platform?

4. Comment on the strategies NUST has adopted regarding the design of online courses.

5. Comment on the managerial commitment at NUST to recognise efforts of academics to develop instructional material.

6. Comment on the communication tools used to communicate with NUST students and staff.

7. How does NUST ensure that quality training is offered to online facilitators to promote the effective use of Moodle as an LMS?

8. Comment on NUST's strategy to ensure that all students have access to online resources.

9. Comment on the interventions at Management level to ensure that all students across NUST have access to online learning.

10. Comment on NUST strategy to address the following to promote the effective and safe use of Moodle as an LMS at NUST?

a) loss of data

b) data leakages

c) security vulnerabilities

7. How does NUST ensure that quality training is offered to online facilitators to promote the effective use of Moodle as an LMS?

8. Comment on NUST's strategy to ensure that all students have access to online resources.

9. Comment on the interventions at Management level to ensure that all students across NUST have access to online learning.

10. Comment on NUST strategy to address the following to promote the effective and safe use of Moodle as an LMS at NUST?

a) loss of data

b) data leakages

c) security vulnerabilities

d) SQL Injection security risk - the SQL Injection security risk is a high-risk vulnerability that allows attackers to perform SQL queries in the Moodle databases due to inadequate sanitization of data supplied by users.

e) Cross-Site Scripting (XSS) attacks- XSS attacks are responsible for common application-layer web attacks and target scripts embedded in a page on the client's server.

f) How does the Moodle technical team at NUST minimise the security risks associated with the use of Moodle as an LMS.

11. What safety strategies are in place for using an open source, such as Moodle, as a Learning Management System? (Moodle updates, Moodle upgrades, Keeping Moodle themes and plugins current, redundant plugins, password policy, encourage Moodle users to change their passwords, choice of username to make it difficult for hackers to access the platform, limit of the use of incorrect login attempts, robust backup system, HTTPS login, Cron execution)

C. Recommendations for the effective and safe use of the My NUST eLearning platform/ Moodle at NUST.

12. Do you have any suggestions or recommendations to improve the **safe** use of Moodle as a Learning Management System at NUST for the effective delivery of blended/online learning?

13. Do you have any suggestions or recommendations to improve the **effective** use of Moodle as a Learning Management System at NUST for the effective delivery of blended/online learning?

Thank you.