

**Investigating the use of ICT tools on the Canvas learning
management system (LMS) by STEM lecturers at a South African
University**



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Research submitted to the Faculty of Humanities, University of the Witwatersrand, in partial fulfillment of the requirements for the degree of Master of Education

Johannesburg, March 2024

Declaration

I declare that this research paper, submitted for the degree of Masters in Education, is my own work and has not been submitted before for any examination or degree at this or any other university or college.

A handwritten signature in black ink, appearing to be 'BM' with a stylized flourish.

Mapoulo Boitumelo Madimabe

17 March 2024

Acknowledgment

I express my gratitude, first and foremost, to God for giving me the wisdom and strength to navigate and complete this academic journey. The path has never been easy, but I am thankful for the resilience that God has granted me. I sincerely thank my parents for always supporting and believing in me. A special acknowledgment goes to my supervisor, Prof. Eunice Nyamupangedengu, for her invaluable intellectual guidance and support throughout the duration of this study. To my friends, Neo Lefora and Simphiwe Mlotshwa, your incredible support has been a cornerstone in my studies, and I am forever appreciative of your presence. I also want to extend my gratitude to M.W. Makgamatha. Lastly, I wish to thank the NRF bursary for funding my studies.

Dedication

To my beloved daughter, M.O.M Madimabe,

Your arrival into my life has brought boundless joy and inspiration. From the moment you entered this world, you have filled my heart with a sense of purpose and determination. This research report is dedicated to you as a testament to the profound impact you have on my life. O a ratwa!

Abstract

The introduction of Learning Management Systems (LMS) in education has been recognized for its substantial impact on teaching and learning, as noted by various scholars (Bradley, 2021; John, 2021). Among these systems, Canvas has witnessed a notable surge in adoption over the years. Scholars like Bradley (2021) attribute its rapid adoption due to the necessity of aligning education with the digital era. While others emphasize the facilitation of teaching and learning through the various CIT tools available on the platform (John, 2021; Burrack & Thompson, 2021). Given the increasing reliance on digital tools in education and the unique challenges faced by STEM (Science, Technology, Engineering, and Mathematics) disciplines, there is a need to explore how STEM lecturers are adapting to and utilizing these tools. The complexity of STEM subjects, which often extends beyond everyday experiences, as described by Young and Muller (2001), further underscores the importance of understanding how educators in this field engage with Canvas's ICT tools to enhance their teaching practices. Therefore, this study saw the need to investigate how STEM (Science, Technology, Engineering, and Mathematics) lecturers in a school of education utilize the ICT tools provided by Canvas. STEM educators were chosen due to the complexity of their discipline, extending beyond everyday experiences, as described by Young and Muller (2001). The study sought to understand how these lecturers employ ICT tools in their subjects. Employing a mixed-method approach, survey questionnaires, and semi-structured interviews, the research engaged 15 STEM lecturers who consented to participate. The results revealed that STEM lecturers employ various tools to fulfill different tasks. These include communicating with students, storing or filing, tracking students' attendance, and assigning and assessing tasks. The usage of these tools is influenced by factors such as teaching preferences, objectives, tool knowledge, discipline nature, and tool capability. Despite the benefits, participants reported encountering challenges related to pedagogy and technical issues. Proposed solutions include in-person classes during load shedding and continued printing of course materials for students for those times when they cannot access the platform. Self-practice is also strongly recommended. STEM lecturers emphasized the importance of engaging in regular practices through platforms like YouTube. This self-directed learning approach enables lecturers to enhance their familiarity with the tools, serving as a valuable resource in instances where assistance from the university or colleagues is not readily available.

Key words: LMS, Canvas LMS, ICT tools, STEM

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Chapter 1: Background of the study

1.1. Introduction and Background

This research explores the use of Information and Communication Technology (ICT) tools provided by the CANVAS learning management system (LMS), as utilized by Science, Technology, Engineering, and Mathematics (STEM) lecturers within a South African university (see section 2.2.2 for details of what ICTs are). As online learning markets bloomed, so did the proliferation of educational technologies (Dlamini & Nkambule, 2020). Learning management systems (LMS), along with other learning software such as Course Management Systems (CMS) and Learning Content Management Systems (LCMS), are some of the technological advancements that have emerged as a result of a demand for ICT (Bradley, 2021). LMS is a software platform that emerged from online education and serves to manage, deliver, and track learning and teaching (Bradley, 2021). It is a software application deemed to have the potential to provide substantial improvement in education, but most importantly, it aligns with the needs of the 4th industrial revolution (Turnbull et al., 2022). Moodle, Teachable, Canvas, and Sakai are examples of LMS used in education. This study, however, is interested primarily in Canvas LMS. Canvas is a learning platform that caters to online, in-person, or hybrid lessons (John, 2014). It is a central hub for coursework materials and a mediator between lecturers and students (Mpungose & Khoza, 2022). The study is interested in how STEM lecturers use Canvas educational technologies in teaching and learning.

STEM lecturers are specialists in Science, Technology, Engineering, and Mathematics education. They are seen as stewards of powerful knowledge, as described by Muller and Young (2001), that is, disciplinary knowledge that extends beyond students' everyday experiences. Therefore, the lecturers' trade of disciplinary knowledge necessitates the critical use of e-learning sites to supplement the teaching and learning process. As such, STEM fields are constantly evolving as new technologies and techniques emerge. Consequently, lecturers who specialize in these areas need to keep abreast with the latest developments so that they can incorporate them into their teaching practices.

1.2 Problem statement

The integration of advanced technological systems in higher education, particularly LMS like Canvas, has been recognized as a key innovation for enhancing the quality of teaching and learning (Almasri, 2022). However, while these technologies present significant opportunities, they also introduce challenges, particularly in STEM education, where the effective use of Information and Communication Technologies (ICTs) is critical (Das, 2019). One of the primary challenges, as identified by Dlamini and Nkambule (2020), is the gap in lecturers' knowledge and proficiency with these ICT tools. The affordances of ICTs, as noted by Drennan and Moll (2018), are crucial in shaping how they are utilized in teaching and learning. For STEM lecturers and instructional designers, a deep understanding of these capabilities is essential. By effectively leveraging ICT tools within Canvas LMS, STEM lecturers can enhance the quality of education, making it more accessible and tailored to diverse student needs. However, if lecturers lack the knowledge or fail to fully utilize these tools, it can hinder their ability to deliver high-quality, impactful STEM education. This study seeks to investigate the use of ICT tools available on Canvas LMS by STEM lecturers. It aims to identify the challenges faced in STEM education regarding the adoption and effective use of these tools and explore the potential of Canvas LMS in unlocking greater access to STEM education. By addressing these gaps, the study aspires to contribute to more effective teaching practices that can enhance student learning outcomes and broaden access to quality STEM education.

1.3 Rationale

Canvas LMS offers various ICT tools that can support different pedagogical approaches. Investigating how STEM lecturers use these tools (if at all) in their teaching practices can shed light on whether the canvas LMS is used to its maximum capacity in university settings, particularly in areas of Mathematics, Science, Technology, and Engineering education. This is because the knowledge in these disciplines is abstract and complex, thus requiring delicate instruction. This study aims to explore how these STEM lecturers use the ICT tools offered by the Canvas learning management system when teaching STEM subjects. Moreover, identifying how STEM lecturers engage with these tools can help determine the gaps in their ICT competencies of Canvas and provide insight into areas where additional training and support may be needed.

1.4 Aims of the study.

The aim of this study was to investigate the utilization of ICT tools on the Canvas Learning Management System (LMS) by STEM (Science, Technology, Engineering, and Mathematics) lecturers at a South African university. The research sought to provide insights into how STEM lecturers integrate these digital tools into their teaching practices, considering the complex and abstract nature of STEM disciplines. The questions that guide this study are

1.5 Research questions.

1. What are STEM, lecturers perceptions on the ICT tools found on Canvas LMS?
2. Which ICT tools found on Canvas LMS do STEM lecturers use in their teaching?
3. What do STEM lecturers use the ICT tools found on Canvas LMS for?
4. What challenges have STEM lecturers encountered while using the ICT tools found on Canvas LMS?

1.6 Outline of the study

The first chapter of this study introduces the study by presenting the background, the problem statement, the aim, and the research questions. Chapter 2 presents the literature review, which covers the key ideas of this research. These include understanding ICT in education, introducing and using LMS in education, Canvas as an LMS, and Canvas ICT tools. In addition, the conceptual framework used in this study is explained in this chapter. Chapter 3 includes the research design, context of the study, participants, data collection instruments and procedure, data analysis, validity and reliability of data, and ethics considerations will be explained in this chapter. Chapter 4 presents and discusses the results from the questionnaires and semi-structured interviews, with each result presented in their sections. Lastly, chapter 5 summarizes the study, answers the research questions, highlights the study's limitations, recommends, and concludes.

1.7 Conclusion

In this chapter, an introduction and background of the study was provided. In addition, the problem statement, aim, and research questions were highlighted in this chapter. Lastly, an outline of the study was provided.

Chapter 2: Literature Review and Conceptual Framework

2.0 Introduction

This chapter presents a literature review that covers pertinent literature of my study. These include understanding ICT in education, ICT tools, learning management, Canvas LMS, and Canvas tools and their affordances. Finally, this chapter will discuss the conceptual framework used and explain how it guides the study.

2.1 ICTs in the modern world

We live in a rapidly changing world as a result of the Fourth Industrial Revolution (4IR) and technological advancements such as the Internet of Things (IoT) and artificial intelligence (Dube, 2020). Different sectors within society are compelled to change and meet the needs of the technological era; education is no exception. In keeping with the technological advancements of modern life, Information and Communication Technology (ICT) has become necessary for day-to-day activities, particularly in education (Deshpande & Shesh, 2021). This is in line with Shah (2022), who contested the integration of ICT in schools. ICTs are a “diverse set of technological tools and resources used to communicate, create, store, manage and disseminate information” (Das, p.97, 2019). This describes a comprehensive array of technology-based tools and resources for storing, managing, and communicating information. On the other hand, Suleiman et al. (2020) described ICT as a combination of two terms: information technology and communication technology. According to Suleiman et al. (2020), information technology refers to using and managing computers, software, and networks to store, process, and transmit retrieved information. Communication technology refers to the devices, programs, and processes that enable sharing of ideas, information, and messages among a group of people (Suleiman et al., 2020). The two terms suggest that ICTs are technologies used to manage, store, and communicate information.

Examples include mobile phones, laptops, podcasts, robotics, and digital television. Tinio (2003) categorized ICTs are classified under four categories by Tinionamely computers, the internet, broadcasting technologies, and telephony. The computer category comprises all the hardware drives that enable data processing and storage, such as laptops (Tinio, 2003). On the other hand, the internet category consists of interconnected documents and resources that allow information through the internet connection, such as software (Tinio, 2003). Broadcasting technologies include

various means of communication, such as radio, television, emails, video conferencing, and social media (Tinio, 2003). Similar to broadcasting technologies is the telephony category (Tinio, 2003), with telephones being one of the examples. The use of ICTs in various disciplines depends on their disciplinary scope and aim. In the education field, for instance, the most used ICTs are computers, the internet, and educational software such as Google Classroom and LMS. In contrast, other fields, such as telecommunication industries, use radio and television abundantly. ICT in education, however, refers to the use of ICT to enhance and support teaching, learning, and educational management processes (Minamotov & Nasirdinova, 2020). This definition will be adopted whenever reference is made to ICT in education throughout this paper.

2.2 Modern technologies in education

More advanced and sophisticated ICTs have been recently introduced in education to accommodate the needs of the digital era. Although ICTs have long been used in education, more advanced and predominant forms became prevalent during the COVID-19 pandemic when modes of teaching and learning were strictly online to accommodate the pandemic restrictions (Dube, 2020). Examples include virtual simulation, LMS, and CMS (Verawati et al., 2022). As a result, the integration of ICT has now encroached on education to a point where they have become a fundamental part of it (Dlamini & Nkambule, 2020). In education, ICTs have brought about unprecedented changes in how knowledge is represented, communicated, and delivered (Moll et al., 2022). Consequently, their enhancement in teaching and learning has fueled their rapid adoption and integration by many learning institutions (Shah, 2022). Tefera et al. (2022) highlight that integrating ICT is not a panacea for problems experienced in the education sector. Therefore, the lecturers must note that integrating ICT does not automatically guarantee effective teaching and learning.

2.2.1 ICT integration in education

ICT integration in education refers to integrating and effectively using ICT tools and resources in the teaching and learning process within educational settings (Turgut & Aslan, 2019). This integration involves utilizing a wide range of digital technologies, such as computers, tablets, smartphones, interactive whiteboards, software applications, the internet, and digital content, to enhance and support educational activities (Kler, 2014). The goal is to leverage these technologies

to improve the quality of education, engage students, and better prepare them for the demands of the 21st century.

2.2.2 Understanding ICT tools

Tools in the context of ICT refer to digital or electronic technologies, devices, and or software that facilitate information management, processing, storing, and communication (Das, 2019). These tools are not only limited to these functions but also refer to the “equipment and services associated with these technologies, such as videoconferencing, e-mail, and blogs” (Alkamel & Chouthaiwale, 2018, p. 30). This implies that ICT refers to technological tools and the associated services. Technological tools are predominantly intangible and exist in the digital realm (Alkamel & Chouthaiwale, 2018). Therefore, the ICT tools are predominately software-based and are often accessed through hardware devices such as computers, smartphones, and other electronic devices. Alkamel and Chouthaiwale (2018) highlight that they rely on the integration of hardware, software, and network to function effectively.

2.3 Learning Management Systems

According to Dlamini and Nkambule (2020), a technology-driven classroom does not limit the user, teacher, and students, as it caters to boundless learning, unlike conventional teaching. Learning management systems (LMS) and other teaching and learning software are some of the technological advancements that emerged due to a need for ICT integration in education (Bradley, 2021). LMS is considered one of the most commonly used software in educational settings, particularly within institutions of higher learning (Agaci, 2017; Bradley, 2021). The adoption of LMS has a long history in education, where they were first formally introduced in the late 1900s (Sulun, 2018). The growth of multimedia and the expansion of the internet contributed to its acceptance and adoption (Agaci, 2017). As the name suggests, it is a web-based system that manages the learning process. However, in the first stage of their expansion, these systems did not have a common name like today (Sulun, 2018). Instead, they were called platforms, portals, and education management systems.

Education Management Systems consist of different software, with LMS being one of them (Sulun, 2018). Other education management systems are instructional management systems (IMS) and content management systems (CMS). While some features and functionalities may overlap

among these systems, understanding their unique purposes helps users choose the most suitable one for their needs (Sulun, 2018). For instance, IMS mainly focuses on instructional planning for teaching, whereas CMS is geared towards organizing and managing digital content. These systems, however, are not intended to substitute traditional teaching methods but rather to respond to the teaching innovation needs of the technological era (Bradley, 2021).

As Agaci (2017) suggested, LMS offers many functions; they serve as a communication platform between lecturers and students, manage learning materials, and are considered content organizers. Agaci (2017) argued that content organizers manage any aspects of the course, such as student enrollment, creating a series of learning materials, delivering study materials, and assigning students to tasks. According to Bradley (2021), LMS's rapid adoption and integration in education is due to its compatibility with many content formats. For instance, an instructor can use videos to deliver content, articles (texts), and audio. Thus, instructors are not limited to a specific teaching mode. Furthermore, students can access instructional materials and receive instructor information through synchronous and asynchronous modalities (Sulun, 2018; Bradley, 2021). This characteristic of learning transcends temporal and spatial limitations, thereby cultivating a flexible learning environment.

LMS can be considered propriety or open source (Bradley, 2021). The distinction between the two types of LMS is that a propriety system is licensed. Therefore, students use an exclusive code to access the system (Bradley, 2021; John, 2021). An open-source system does not include any subscription or license; instead, it offers free access and usage (Bradley, 2021). Therefore, educational institutions are confronted with the imperative of choosing a suitable LMS that aligns with their academic objectives and goals. Several open-source systems, such as Moodle, Sakai, Canvas, and Drupal, are illustrative examples in this context.

2.3.1 Canvas as an LMS

Canvas, as described by Bradley (2021), is an open-source web-based system built to support both synchronous and asynchronous settings (Bradley, 2021). In addition, Bradley (2021) explains open-source web-based systems as software platforms that operate using an internet connection and embody the principle of community-driven developments, sharing, and empowerment, making it valuable for a wide range of applications and industries. In addition, Canvas, like any other open source, comes with licenses that define the terms under which the software can be used,

shared, and modified (Canvas, 2021). It comprises advanced tools for effective teaching and learning strategies (John, 2021; Burrack & Thompson, 2021). This concurs with Mpungose and Khoza (2022), who indicate that the adoption of canvas e-learning has shown notable changes in teaching and learning. For instance, a higher level of student engagement and participation has been realized since the advent of Canvas e-learning at various institutions (Mpungose & Khoza, 2022). Unlike in traditional learning settings where students only had physical access to instructional materials, Canvas users can access the software anytime (Canvas, 2021). Thus, it is not bound to time and space. Students who use Canvas, therefore, have enough time to prepare and work with the materials at hand (Burrack & Thompson, 2021). In addition, it does not require the user to download or install the actual app (canvas app). However, one can access it through a Google website that is easy to access and use.

Some features distinguish Canvas from other LMSs, which have many options that enable it to interoperate with open-source application programs developed by trusted resources in education. For instance, it allows lecturers to integrate Google Docs, which is used for collaboration work (Coll, 2015). By using such educational resources that facilitate collaboration and allow changes to be saved instantly, the time for teaching can be further extended. Moreover, integrating external programs such as plagiarism checkers and Turnitin helps lecturers in instances of potential plagiarism by comparing students' work or submissions against a vast database of academic and online resources. This automated integration eliminates the need for manual upload on the actual plagiarism website and streamlines the process of checking and evaluating the student's work. Thus, this manages or saves time and promotes academic honesty and integrity (Coll, 2015).

2.3.2 Canvas Tools

The canvas e-learning platform contains various learning, teaching, and administrative tools. Consequently, the pedagogical realization of the platform's capabilities necessitates the lecturer's understanding of the tools embedded within the canvas LMS platform. Canvas e-learning users include students and lecturers. The tools available on the Canvas e-learning tools are the same for the two users, although their functionality and purpose differ for the different user groups (Canvas, 2021). The lecturers have administrative functions of the software, which comprise more advanced features, whereas students have end-user functions and comprise 'general' features. Administrative functions include disseminating course materials, creating assignments or quizzes, enrolling

students in courses, and adjusting to accommodate students' educational needs. On the contrary, end-user functions only grant access to the end product designed 'behind the scenes.' Examples include downloading course materials, submitting assignments or tests, and checking grades (Canvas, 2021).

Lecturers may create and share instructional material and content, such as video instruction and audio features. Some tools used to publish these materials and content comprise modules, pages, assignments, and quizzes (Canvas, 2021). For instance, lecturers can organize course content using topics or sessions as an organizing feature in the module tool. This allows easy access to the course content as they are presented logically, efficiently, and comprehensibly. Students can easily navigate the tools as content is presented structurally; they know which materials are covered in specific days or weeks (Agaci, 2017). Lecturers can also organize and store some content using a File tool (Canvas, 2021). The file tool stores additional information or content that students do not use daily. Content can include links, videos, articles, software books, and records. This tool is reliable since it keeps the entire history so that students and lecturers do not have to worry about losing the information or resources previously uploaded. On the other hand, the assignment and quiz tool allows the lecturers to assess students' understanding level by designing a task that probes students' understanding (Canvas, 2021). Various question types are available, and teachers can choose according to their learners' needs. Lecturers can create a submission tab- where students can upload their work. In addition, there are various assignment submission methods (Canvas, 2021). For instance, there is 'file upload,' where students can upload their assignment directly from their computer; 'text entry,' where they can type their response directly into the text box within Canvas; and lastly, 'external tools,' where instructors can integrate external tools like Google Drive or Dropbox for submission. Moreover, Canvas LMS provides lecturers various options and settings for managing assignments, including availability and due dates (Canvas, 2021). Thus, lecturers determine how long the assignment window should be open. They can choose to lock the assignment tab automatically after the due date. As a result, students can no longer submit or access the assignment after the due date.

Canvas has tools that allow lecturers to provide students with constructive feedback. For example, the speedgrader tool is a canvas tool used to give feedback to students (Canvas, 2021). This can be achieved on the Speedgrader once students have submitted the assignment or task (Canvas,

2021). As a result, students can access or see any changes made, provided the lecturer allows for such. The changes include feedback, marks, new submission dates, and activity extensions. In essence, the lecturer has the option to either make the changes public or private (Canvas, 2021). Students cannot access any adjustments and changes made privately, thus minimizing transparency. Moreover, any changes in the student's marks are reported in the Gradebook. The Gradebook tool has two objectives: display marks and allow students to track their average using an interactive graph. An interactive graph displays students' marks on a graph so that they can see their class average (Canvas, 2021).

The lecturer can use Groups, Conferences, Chats, and Collaboration tools to foster collaborative learning (Agaci, 2017). These platforms promote collaborative learning among students. For instance, STEM lecturers can use the Chat tool embedded in Canvas to communicate and discuss important information with the students. This tool allows for a wider audience as it does not limit the number of participants involved. When lecturers want small group discussions, they can use tools such as Group, which accommodate a limited number of participants. These tools are available for STEM lecturers; however, they must be acquainted with the tool's affordances to maximize their potential. Similarly, Burrack and Thompson (2021) state that Canvas e-learning is a powerful tool; however, it is scalable to the user's knowledge and understanding of its operation. Awareness of the Canvas LMS tools and their affordances can contribute to the informed decisions that the STEM lecturers make in their teaching practices. For instance, they can tailor instruction in ways that are context and content relevant to the students.

Different factors influence STEM lecture usage of Canvas LMS. One example is the teachers' teaching philosophy or preferred teaching methods. STEM lecturers have different teaching philosophies and strategies (De Silva & Wickramasinghe, 2022). As a result, some of them may lean towards traditional lecture-based teaching, while others may prepare active learning, problem-solving, inquiry-based learning, or collaborative activities. Therefore, there is an alignment between the extent to which the lecturer uses the ICT tool and their preferred method of teaching (Sulun, 2018). De Silva and Wickramasinghe (2022) accentuate that STEM subjects encompass a wide range of disciplines, each requiring a unique teaching requirement and utilizing specific Canvas tools. For instance, teaching calculus in mathematics may involve different strategies than teaching computer programming in technology.

Therefore, the choice of Canvas tools and their integration into the curriculum can depend on the specific needs of the subject matter. Another contributing factor that influences STEM lecturers' use of Canvas LMS tools is the availability of resources such as internet connectivity, training programs, and support from the institution. Bindu (2018) reveals that institutions offering workshops, training sessions, or technical assistance on Canvas LMS have lecturers more likely to utilize the platform successfully. Therefore, this informs the purpose of the study, which is to investigate the use of ICT tools in Canvas LMS within a South African Higher Education institution. The various tools and features of Canvas have been summarized in the table below.

Table 1, adapted from Agaci (2017) and the Canvas website, summarizes the functional affordances of Canvas LMS according to two categories: students and lecturers.

Lecturers	Students
Registration	Registration
Design, publish, and send the invitation to the course	Accept and enroll in the course
Rename and create the course.	View and select
Post Forums and chats	Participate in forums/ Chats.
Create Tests/Quizzes/ assignment.	Take Tests/ Quizzes and assignment.
Download the assignment from the assignment tab	Upload the assignment in the assignment tab
Assign grades	Check grades

2.2.3 Capabilities and Affordances of Canvas Tools

Affordances, as explained by Moll et al. (2022), describe the possibilities and opportunities for teaching and learning that a specific tool offers. It focuses on how these tools can support and improve educational outcomes. Studies such as those by Drennan and Moll (2018) and Dlamini and Nkambule (2020) explain affordances using technological capabilities and technological

affordances. Technological capability refers to the ability of technological software or hardware to perform specific tasks (Moll et al., 2022). For instance, Canvas LMS has a multimedia capability that enables the integration of external tools and resources. Moreover, this allows for multiple representations of knowledge. Lecturers can use this tool's affordance to provide more learning resources or expose students to a broader range of learning platforms. Technological affordance "elucidates the power and potentials inherent in the technology itself, which are actualized only when the teachers use them strategically in realizing their pedagogical ends" (Moll et al., p. 60, 2022). Canvas e-learning, for instance, has tools that provide affordances for sharing content with students, such as module and file tools. Moreover, a video conferencing platform (technological capability) such as BigBlueButton might be used to conduct or facilitate (capability) a synchronous lecture (affordance).

2.4 Challenges in STEM Education

According to Carnevale et al. (2011), STEM education is inherently challenging due to the abstract and complex nature of the content involved in these disciplines. Mathematics, for instance, involves intricate problem-solving and abstract reasoning, while science and engineering require an understanding of complex systems, experimental processes, and technical skills. The traditional teaching methods often fall short in effectively conveying these concepts (Honey et al., 2014), leading to difficulties in student comprehension and engagement (Freeman & Jackson, 2009). Additionally, the rapidly evolving nature of STEM fields demands that educators continuously update their knowledge and teaching methods to keep pace with new developments and technological advancements. Another significant challenge in STEM education is the disparity in resource availability (Honey et al., 2014). Many educational institutions, particularly in developing regions, lack access to state-of-the-art laboratories, tools, and instructional materials necessary for effective STEM education (Freeman & Jackson, 2009). This gap in resources can result in an uneven learning experience for students, where some receive a more comprehensive education than others.

2.5 The potential of ICTs in unlocking access to STEM Education

Information and Communication Technologies (ICTs) have the potential to revolutionize STEM education by addressing many of these challenges. ICT tools, particularly those integrated into Learning Management Systems (LMS) like Canvas, offer innovative ways to enhance teaching

and learning in STEM disciplines. These technologies can transform abstract concepts into interactive and visual experiences, making complex ideas more accessible to students (Almasri, 2022). For example, simulation software, virtual labs, and interactive models can provide students with hands-on experiences that would be otherwise impossible in a traditional classroom setting (Das, 2019).

Moreover, ICTs enable personalized learning, allowing educators to tailor their instruction to meet the individual needs of students. This adaptability is particularly beneficial in STEM education, where students often have varying levels of understanding and different learning paces (Drennan & Moll, 2018). Through tools like Canvas, educators can create differentiated assignments, provide instant feedback, and track student progress in real-time, thereby supporting more effective and targeted teaching strategies (Dlamini & Nkambule, 2020).

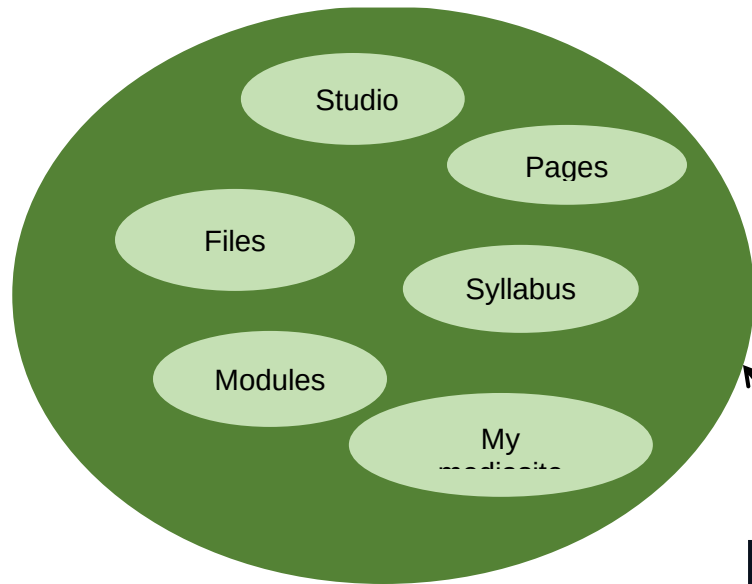
ICTs also facilitate collaboration and communication, essential components of modern STEM education. Through online discussion forums, group projects, and peer review systems, students can engage in collaborative learning, share ideas, and solve problems together, even when they are not physically present in the same location (Burrack & Thompson, 2021). This capability is crucial in preparing students for the collaborative nature of the modern STEM workforce.

Furthermore, the use of ICT tools in STEM education can help bridge the resource gap by providing access to high-quality educational content and experiences regardless of geographical location. For instance, students in under-resourced schools can benefit from online courses, virtual labs, and other digital resources that level the playing field and provide them with opportunities to engage with advanced STEM content (Almasri, 2022).

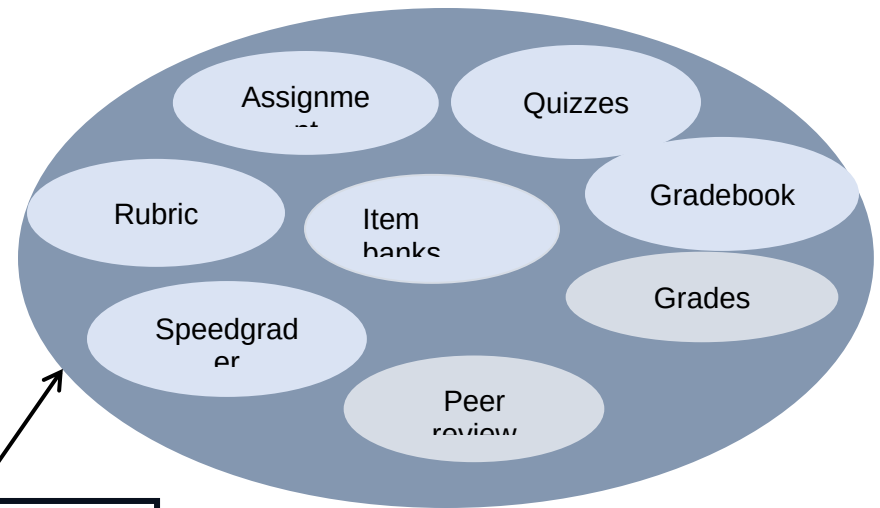
2.6 Conceptual framework

Canvas, a Learning Management System (LMS), offers various capabilities and affordances that enable lecturers to create, manage, and deliver online learning experiences (Canvas, 2021). The conceptual framework employed herein provides a structured perspective on how Canvas LMS's capabilities and affordances can inform online education's design, implementation, and assessment. Therefore, the components found within the CANVAS LMS constitute a frame through which the use of ICT tools can be investigated. The following conceptual framework shows the categories of the ICT tools found within the canvas LMS and how they guided the study.

Content delivery &

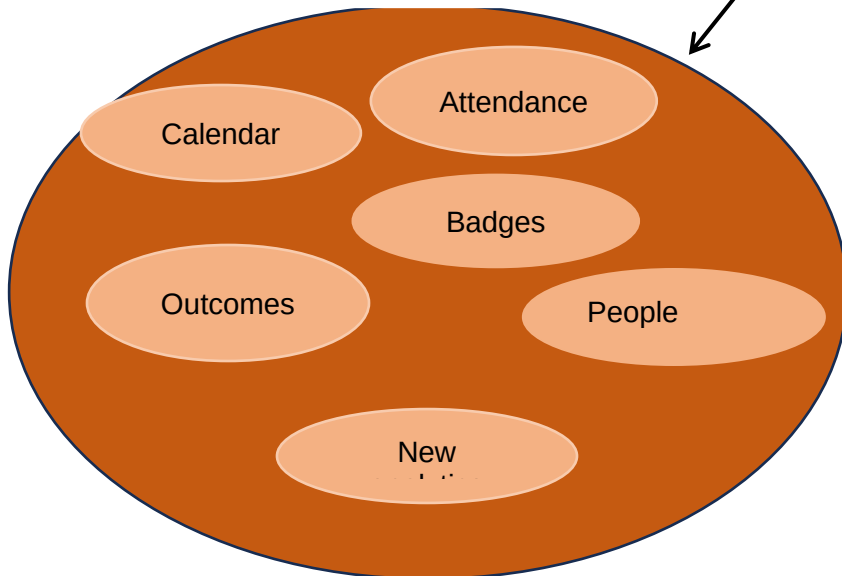


Assessment & Feedback

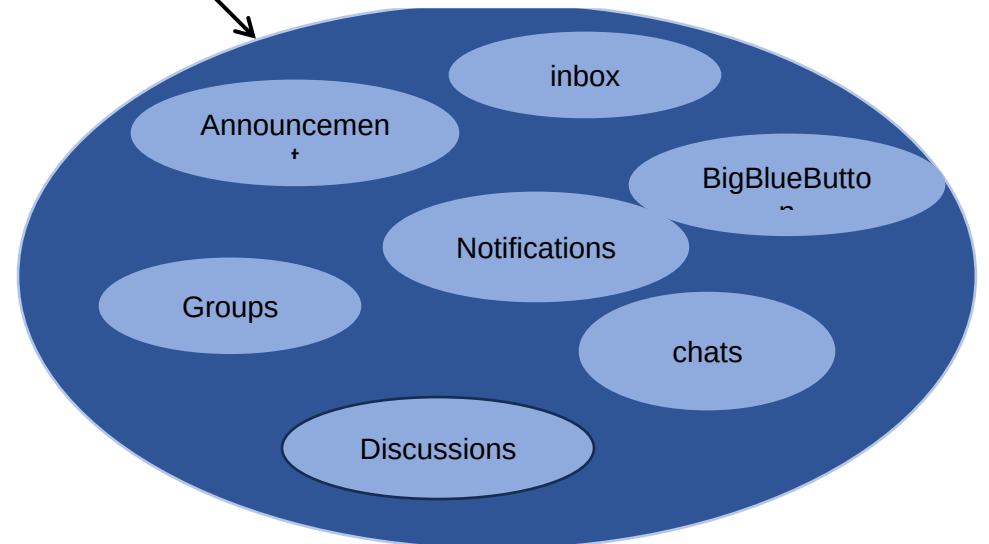


Categories of canvas LMS tools

Data & analytics



Communication & collaboration



Content delivery management component: This component aims to facilitate the effective creation, organization, and delivery of course content within the Canvas Learning Management System (Canvas, 2021). This component is beneficial to STEM lecturers because it helps them arrange lessons, topics, and resources logically, making it easier for students to navigate and access the materials. In addition, it enables lecturers to include videos, interactive simulations, diagrams, and other multimedia elements of the course. This aids in explaining the more intricate STEM concepts more effectively. In essence, this component helps lecturers to create well-structured, engaging, and accessible course materials. The following are some examples of the tools used for content delivery and management. However, it is essential to note that although these tools perform similar functions, i.e., content delivery and content management, respectively, they possess features that distinguish them.

- Modules- Allow instructors to organize course content in a structured way. Lecturers can create modules for group-related materials, assignments, quizzes, discussions, and other content. Modules provide a sequential and logical flow to the course.
- Pages—Enable lecturers to create content-rich pages with text, images, links, and multimedia. Pages often deliver lecture notes, instructional content, and additional resources. Pages can be linked within Modules for structured content delivery.
- Files- Is used for uploading, storing, and managing course-related files. Instructors can organize files into folders and link them within Modules, Pages, or other Canvas tools. It is a central repository for documents, presentations, images, and other file types.
- Syllabus- This central tool provides a roadmap for instructors and students throughout the course. It is a reference point for important information, policies, and expectations, fostering clarity and transparency in the learning experience. Additionally, the Syllabus can be updated throughout the course to reflect any changes or adjustments.
- Studio- allows users to create and upload videos directly to Canvas Studio. This feature helps record lectures, presentations, demonstrations, or other video content.
- My mediasite- Allows instructors and users to create multimedia content such as video lectures, presentations, and tutorials. Users can capture video, audio, and screen recordings to create engaging educational materials.

Therefore, this component guided the researcher in investigating Canvas LMS tools, which facilitate content delivery and management.

Assessment and feedback component: This component focuses on tools and features designed to help educators create, manage, and evaluate student assessments and provide timely feedback (Canvas, 2021). STEM lecturers can use the ICT tools within this component to design and administer various assessments, including quizzes, assignments, and exams. Moreover, some of the ICT tools within this component are designed to enable automated grading. This helps reduce the administrative burden on STEM lecturers and allows students to receive timely feedback on their performance. This component enabled the investigation of the assessment and feedback tool in Canvas LMS. Examples include the following:

- Assignments- The Assignments tool is central to creating and managing various assessments, including papers, projects, and online submissions. Lecturers can set due dates, assign point values, and provide detailed instructions.
- Quizzes- The Quizzes tool allows instructors to create and administer quizzes, exams, and surveys. It supports various question types, including multiple-choice, true/false, and short answer. Quizzes are automatically graded, and feedback can be provided.
- Grades- a central component of the educational process, providing a systematic and efficient way to assess student learning, provide feedback, and communicate academic progress.
- Gradebook- The Gradebook tool is where instructors manage and input grades for assignments, quizzes, and other graded activities. Instructors can provide feedback to individual students and track overall class performance.
- SpeedGrader- SpeedGrader is a Canvas tool that allows instructors to grade assignments, quizzes, and discussions efficiently. It provides a streamlined interface for viewing student submissions and providing feedback.
- Rubrics- Rubrics help standardize the grading process by providing specific criteria for assessing assignments and other activities. Instructors can create and attach rubrics to assignments for transparent and consistent grading.
- Item Banks- Item banks are repositories for storing and organizing questions or assessment items. Instructors can create and store a pool of questions in these item banks.
- Peer review- Peer review allows students to provide feedback on the work of their peers.

Communication and Collaboration component: The communication and collaboration component on Canvas LMS facilitates effective communication and collaboration among students and between students and instructors (Canvas, 2021). Its primary aim is to create a supportive and interactive learning environment, foster engagement, and encourage active participation (Canvas, 2021). This component can be precious for STEM lecturers since it provides tools for organizing and managing, which can benefit collaborative work in the STEM discipline. In addition, the components support real-time discussions, chats, and virtual meetings. This can be used to facilitate lectures, thus helping students to learn and acquire knowledge. During lectures, chats, and discussions, students can engage with their lecturers, thus enabling them to seek help, ask questions, and clarify complex STEM concepts. Examples of these tools include:

- Announcement—This feature allows instructors to broadcast information to all members of a course or all members of sections within a course. Students may be able to reply to announcements, but replies are not considered conversations and do not appear in the Inbox.
- Inbox- The Inbox tool enables private communication between users within the course. Lecturers and students can send messages, facilitating one-on-one communication or group discussions.
- Discussions- Discussion boards provide a platform for interactive communication. Instructors can create discussion topics, and students can participate in threaded discussions, sharing thoughts, questions, and responses.
- Collaborations- The Collaborations tool supports real-time document collaboration using external tools such as Google Docs or Etherpad. It encourages group work and collaboration among students.
- Groups- Instructors can create groups within a course to facilitate collaboration among smaller subsets of students. Groups have collaborative tools, including discussion boards, file sharing, and collaboration pages.
- Notifications- Canvas provides notification settings that allow users to customize how they receive communication alerts. Users can receive notifications via email, SMS, or within the Canvas platform.

- BigBlueButton- BigBlueButton is an open-source web conferencing system for online learning. It provides features such as real-time audio and video conferencing, screen sharing, chat, and interactive tools like a whiteboard.

This component guided the researcher in investigating communication and collaboration tools within Canvas LMS in this research study. Specifically, how the tools foster interaction among students and STEM lecturers.

Data and Analytics: The data and analytics component in Canvas LMS focuses on tools and features designed to collect, analyze, and present data related to student performance, engagement, and course effectiveness (Canvas, 2021). This component aims to provide educators with insights into students' progress and support data-driven decision-making (Canvas, 2021). For instance, it can help lecturers make informed decisions about their teaching strategies based on data and analytics, ultimately improving the quality of education. STEM lecturers can use Canvas's data and analytics tools to monitor student progress closely. They can track how students engage with course materials, how they perform in assessments, and when they access the course. This real-time information helps lecturers identify struggling students and intervene with targeted support or additional resources.

- Attendance- allows instructors to record and track student attendance for various class sessions or activities.
- New analytics offer a comprehensive view of a course's overall performance metrics. Instructors can see data related to student participation, assignment submission patterns, and grades. This information can help instructors identify trends and assess the course's overall health.
- Outcomes- Allow the administration and faculty to track mastery in a course.
- b- Serves as a central tool for organizing and managing course-related events, assignments, and due dates.
- People - Displays a list of individuals enrolled in the course. This includes both instructors and students. It provides a snapshot of the class composition.
- Badges- serve as a form of progress tracking, allowing students to see their achievements over time. By earning and collecting badges, students can visually track their journey through the course and recognize their development and growth.

In this study, this component guided the researcher in investigating the canvas features related to data tracking, analytics, and insights.

2.6 Conclusion

This chapter provided extensive literature on the key ideas of this research using different scholars. Its explanations and arguments shed light on the study's main ideas and how they can be used to help the study answer the posed questions. The conceptual framework used in the study was also explained in detail.

Chapter 3: Research Methodology

3.0 Introduction

The research methodology encompasses the strategies for data collection and analysis (Opie, 2014). However, Creswell (2013) advises researchers to carefully choose methods that align with the research questions posed in the study. This study aimed to explore the utilization of ICT tools on Canvas by STEM lecturers at a South African university. In this chapter, the research design employed is outlined first. Subsequently, the methods for data collection and analysis are described and justified. Finally, the chapter elucidates how the researcher ensured data quality and ethical considerations.

3.1 Research Design

According to Creswell and Creswell (2018), quantitative research is a systematic investigation that primarily focuses on quantifying data. This imply, it involves the collection of numerical data, which is then subjected to statistical analysis to identify patterns, relationships, or trends (Creswell & Creswell, 2018). Qualitative research, on the other hand, is focused on understanding human experiences and social phenomena through a more descriptive and interpretive lens. As noted by Merriam and Tisdell (2016), qualitative research is characterized by its emphasis on context, meaning, and process. Researchers using qualitative methods typically engage with participants in a more flexible and open-ended manner, allowing for a deeper exploration of the subject matter.

On that note, this study employed a mixed-method approach as a research design. Ivankova and Wingo (2018) explain a mixed-method approach as the integration of qualitative and quantitative approaches into one study. Therefore, the two distinct approaches are combined to leverage each other's strengths and weaknesses. Thus, helping the researcher gain a more nuanced and comprehensive understanding of the study. In addition, it allows the researcher to address complex research questions and problems (Ivankova & Wingo, 2018). As highlighted by Creswell (1999), the mixed method approach also enables the examination of a more diverse perspective on the same subject and the provision of contextual understanding informed by experiences one encounters. Greeno et al. (1989) highlighted that the integration of a mixed method approach can occur in the following ways: triangulation, complementary, development, and expansion. In triangulation, qualitative and quantitative data are collected simultaneously or separately to compare or contrast the data to get a comprehensive understanding of the task

studied (Greeno et al., 1989). Complementary, on the other hand, occurs when qualitative and quantitative data are used to address the various dimensions of the research topic, with one approach providing insight into a specific occurrence and the other providing statistical analysis (Greeno et al., 1989). Greeno et al. (1989) explain expansion as the process whereby the data is collected and analyzed separately. Lastly, the development approach uses one type of data to guide the development or refinement of a different data collection (Greene et al., 1989). In this study, the complementary approach was used. The complementary mixed methods approach involved a questionnaire and semi-structured interviews.

3.2 Research context

According to Roth and Kostova (2003), the term research context describes the setting, conditions, and environment in which the investigation is conducted. Research contexts include all the relevant factors that influence and shape the study, such as the actual environment, participants, and time frame (Gitlin & Russell, 2014). This study's chosen site or context was a School of Education within a South African higher education institution. This school context was selected primarily due to its alignment with the components essential for this study. Notably, the School of Education utilizes Canvas LMS as its teaching and learning platform, encompassing all STEM disciplines.

3.3 Participants

According to Wendler and Grady (2008), participants are individuals or entities involved in a research study. These individuals contribute data or information that researchers use to address research questions, test hypotheses, or achieve study objectives (Wendler & Grady, 2008). The selected participants for this research study were 15 STEM lecturers: 4 mathematics education lecturers, four technology and engineering education lecturers, three physical science education lecturers, and 4 life science education lecturers. The selection of these participants was informed by the research focus and aims to capture diverse perspectives across distinct STEM disciplines.

Table 2: A summary of the participant's details

Participant no.	Pseudonym	Gender	Division	Teaching experience (no. of years)
1	Joseph	Male	Life Science	More than 15
2	Gift	Male	Life Science	5-10
3	Neo	Male	Technology	0-5
4	Katlego	Male	Mathematics	5-10
5	Clement	Male	Mathematics	More than 15
6	Kamogelo	Male	Technology	10-15
7	Munash	Male	Mathematics	More than 15
8	Helen	Female	Mathematics	0-5
9	Princess	Female	Life Science	More than 15
10	Caiphus	Female	Physical Science	5-10
11	Sphephelo	Male	Physical Science	5-10
12	Koketso	Female	Life Science	More than 15
13	Palesa	Female	Technology	0-5
14	Mary	Female	Physical Science	More than 15
15	Simphiwe	Female	Technology	More than 15

3.4 Data collection instruments

In this study, data was collected using survey questionnaires and semi-structured interviews. The section below provides a comprehensive explanation of these instruments.

3.5 Data collection

3.5.1 Questionnaires

According to Roopa and Rani (2012), a questionnaire is “simply a list of mimeographed or printed questions that is completed by or for a respondent to give his or her opinion” (p.273). In essence, it is an instrument used to collect data that consists of a series of questions for participants. Roopa and Rani (2012) highlight that there are different ways in which questionnaires can be administered, such as online surveys and paper-based forms. In this study, an online questionnaire was employed. One of the advantages of using online questionnaires is that the data collection process is expedited, as participants can respond at

their convenience (Roopa & Rani, 2012). Thus, no mailing or manual data entry delays lead to faster results. In addition, online questionnaires can significantly reduce costs associated with printing, postage, and manual data entry. The efficiency derived from these advantages facilitates a timelier research outcome and aligns with contemporary cost-effective research practices (Roopa & Rani, 2012). Roopa and Rani (2012) explain that online questionnaires consist of closed and open-ended questions. Closed-ended questions consist of a set of predetermined response options or categories from which the participants must choose (Roopa & Rani, 2012).

In this study, a specific closed-ended question inquired about participants' confidence levels in utilizing the ICT tools available on Canvas LMS. Respondents were presented with five options for their ratings: very confident (rated 5), confident (rated 4), moderate (rated 3), not confident (rated 2), and not confident at all (rated 1). On the other hand, Roopa and Rani (2012) explain open-ended questions as those that provide a free-form or open-text response, allowing the participants to express themselves without being constrained by the predetermined answer choices. An example of an open-ended question used in this study asked the participants about a specific ICT tool available on Canvas LMS that they find most beneficial for teaching their STEM course. In addition, participants were prompted to elucidate the reasons behind their choice. In this question, the participants were not given options, but rather, they had to write their answers. Overall, there were seven questions in total, with five closed-ended questions and two open-ended questions.

3.5.2 Semi-structured interviews

An interview is generally regarded as a one-on-one conversation between the researcher and the participants. It aims to gain a deeper understanding of the interviewee's experiences, motivation, and feelings concerning the phenomena to be investigated. Henderson (2016) identified and distinguished three types of interviews: unstructured, semi-structured, and structured interviews. In this study, the focus, however, was based on semi-structured interviews. According to Scott and Morrison (2005), semi-structured interviews provide a balance between structured and unstructured interviews. Therefore, the research questions are non-standardized, thus allowing the researcher to explore more questions and ask further in instances where the interviewee is not clear or gives insubstantial comments (Henderson, 2016).

One of the advantages of a semi-structured interview is that it allows the participants to express and elaborate on their responses and provide detailed accounts of the investigated phenomena without being limited. This depth of information can help the researcher gain a comprehensive understanding of the research question and provide insight into how STEM lecturers use ICT tools on canvas LMS. During the interview, the conversation between the researcher and the participants was recorded. Audio recordings during interviews ensure the accuracy of information as it allows the researcher to play it multiple times and ensure that information is not misinterpreted or misquoted (Stockdale, 2002). Thus, minimizing biases. In addition, it allows for a comprehensive and precise transcription of the dialogue without relying solely on memory or note-taking (Stockdale, 2002). Moreover, in instances where there are arguments about what was said in the interview, the recording can be used as a reference (Stockdale, 2002). Therefore, it can help settle the issue and preserve the integrity of the interview. Overall, there were about seven questions for each participant (see [Figure AC in the appendix](#))

3.6 Data analysis

3.6.1 Analysis of the Questionnaires

In this study, there were two groups of questions on the questionnaire, open-ended and closed-ended. The closed-ended questions consisted of 4 questions while the open-ended ones were 3 questions. Below, I explain how I analyzed these various questions.

3.6.1.1 Analysis of responses to closed-ended questions.

Step 1: Familiarize myself with the data by reading through each questionnaire at least three times.

Step 2: I analyzed the participants' responses, highlighting any noteworthy aspects observed in the statistics. This process was carried out for all the questions. For instance, if the participant responds by selecting the announcement tool on the question that requires when to indicate which tool they are familiar with, I will take note of their response.

Step 3: Following that step, I categorized the participants' responses based on similarities. For example, if three out of fifteen STEM lecturers expressed confidence in using New Analytics, I noted this and categorized their responses together. Similarly, if the remaining twelve indicated less confidence with the same ICT tools, I also recorded that information.

Step 4: Lastly, I compared the data across the various categories I had made. For instance, I would say, all 15 STEM lecturers utilize the announcement tool in their teaching, whereas 8 out of 15 STEM lectures employ Studio, and so forth.

The responses from the closed-ended questions were presented in various formats, including tables, pie charts, and bar graphs. The online survey questionnaire automatically generated these visual representations of the data. See figure B on chapter 4 and Figure C on chapter 4 page 36. So, I just extracted them how they are and interpreted them.

3.6.1.2 Analysis of the responses to open-ended questions

Step 1: Familiarize myself with the data by reading through each participant's response three times.

Step 2: Used deductive coding to code the data. According to McKibben et al. (2020), deductive coding is a coding approach that involves applying pre-existing concepts, theories, or a predetermined coding scheme to analyze and categorize data. See Figure A below, which shows the coding scheme.

Step 3: Following step 2, the coded data was categorized into themes. The themes used in this study were informed by the components of the conceptual framework outlined in Chapter 2, which are content delivery and management, assessment and feedback, data and analytics, and communication and collaboration.

Figure A: The picture below illustrates the coding of responses obtained from one of the open-ended questions.

Figure A is an example of how the open-ended questions from the questionnaire were coded. The covers used here correspond with the colors of the conceptual framework highlighted in Chapter 2. For instance, codes colored green represents the content delivery and management component, orange-colored codes represent the data and analytics component, sky blue represents the assessment and feedback component, and navy blue represents communication and collaboration.

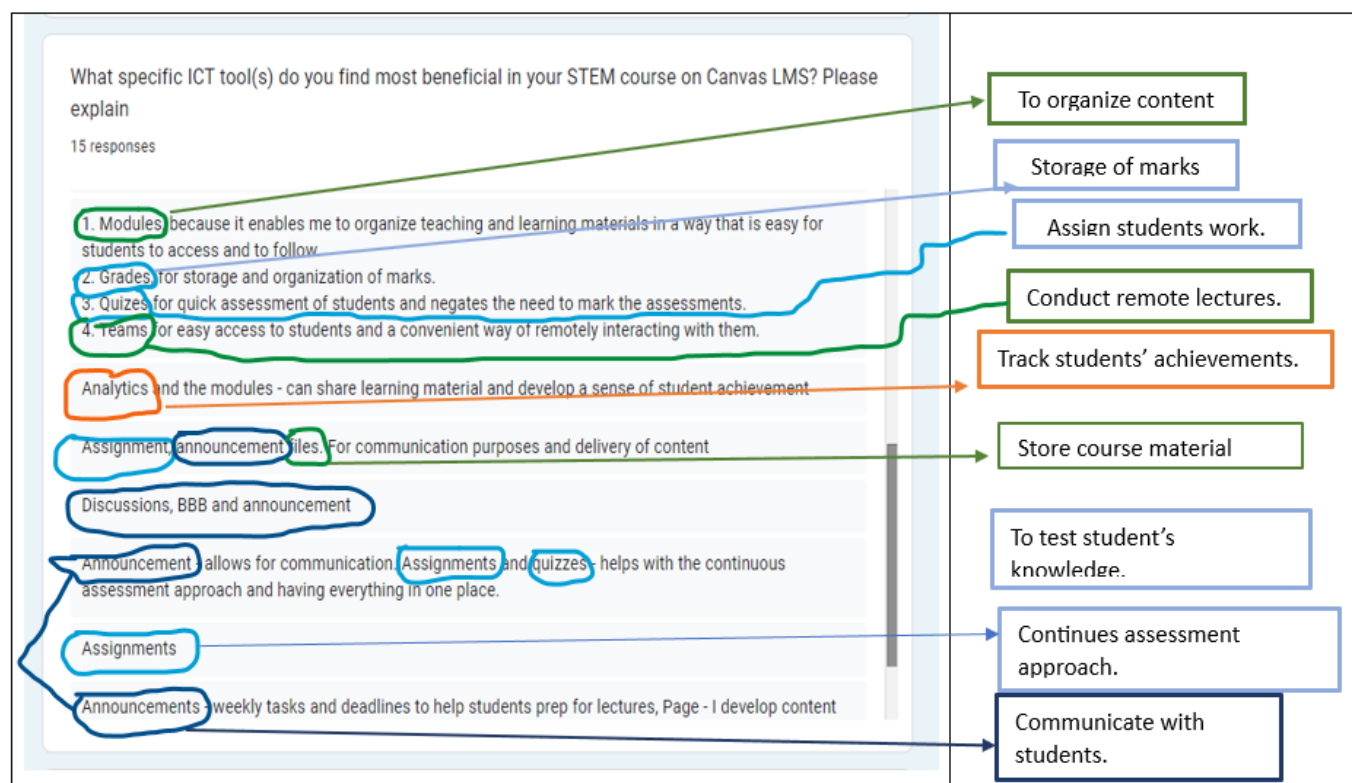


Figure A: Coding of the open-ended questions. The colors used correspond to the color of the components of the conceptual framework outlined in Chapter 2.

2.3.6.2 Analysis of semi-structured interviews

This section describes how the semi-structured interviews were analyzed, and it is explained in steps.

Step 1: Transcribing Data

All participants' interviews were audio recorded using a recording app on their mobile cellphones. This was to ensure an accurate representation of the participant's responses, allowing the researcher to capture the exact words, and preventing potential distortion or misinterpretation that may occur when relying solely on note-taking. The interviews were transcribed.

Step 2: Data familiarization

Following that process, I read the transcription more than three times to familiarize myself with the data. While reading through the transcribed data, I would take note of any aspects of interest.

Step 3: Coding the Data

Next, I proceeded with data coding, employing deductive coding in a similar way to how I analyzed questionnaire responses. In this study, deductive codes were shaped by insights from the literature review and the conceptual framework expounded in chapter two. Following the coding process, I enlisted the assistance of two colleagues who are well-versed in deductive coding and Canvas LMS tools. They coded two interview transcripts using the same conceptual framework to evaluate the reliability of my coding. The agreement reached was 89 percent. Subsequently, we deliberated on any disparities and reached a consensus.

Table 2 shows how various themes emerged.

Table 2 provides a sample of the codes and themes used in this study. Since there were 15 interviews in total, the table only included a few expressions along with the participants they came from. These expressions have been sorted into different categories, called codes, and then grouped into themes.

Expressions from participants	Codes	Themes
<i>"Participant 1: I frequently use the discussion forums on Canvas for communication with my students. It helps facilitate class discussions and allows for quick feedback on their queries."</i>	Quick feedback	Communication and Collaboration
<i>"Participant 7: Sure. I find communication tools really helpful. I often use the announcement feature to update students about upcoming deadlines and important information".</i>	Communicative purposes	
<i>Participant 2: Canvas's assignment tool is incredibly useful. It streamlines the submission process and provides a centralized platform for grading and feedback."</i>	Student submission	Assessment and Feedback
<i>"The assignment tool comes with that grade automatically, where when students submit the marks, they are captured under grades, so it is a way of documenting or recording the marks which are easier and easily accessible so should anything happen to me, people do not need to come to me and look for the marks but can just go straight to Canvas, and that information will be there."</i>	Capturing marks	
<i>"Participant 3: The analytics tools on Canvas are invaluable. I regularly track student progress, identify areas for improvement, and tailor my teaching approach accordingly."</i>	Usage statistics	Data and analytics
<i>"Participant 11: The most used tools are files and ...because we have to keep uploading some teaching materials there."</i>	Storage purposes	Content delivery and Management

3.7 Validity and reliability

Two key concepts in research that evaluate the quality and accuracy of findings are validity and reliability (Cope, 2014). Cope (2014) identifies them as crucial aspects for ensuring credibility and trustworthiness in research's findings. Below is an overview of each concept.

Validity: According to Cope (2014), when a study is said to be valid, it means that it accurately measures what it intended to measure. It is interested in determining whether the study's conclusions and findings make logical and significant connections to the study's objectives.

Reliability: Reliability refers to the consistency and repeatability of the findings (Cope, 2014). This implies that if the study was to be conducted by another researcher, they would obtain the same results. To ensure that validity is established in this study, the questionnaires were piloted with a subset of STEM lecturers to identify and address potential issues related to clarity, relevance, or interpretation. In addition, triangulation was utilized, and quantitative data from the questionnaires and qualitative data from the interviews were combined to provide a more comprehensive understanding of ICT tool usage.

3.8 Ethical consideration

Ethics is described by Bashir et al. (2008) as a subfield of philosophy that deals with the dynamics of moral judgment. According to Parveen and Showkat (2017), the researcher is obligated to look out for the participants' welfare, safety, and other rights and obligations during the research process. As a result, this research study requested ethical consideration from the university's ethics committee. Integral to the ethical framework employed, no data were procured without approval or acknowledgment from the ethics committee. Participants were given a comprehensive consent form that delineated the nature of the study and its objectives. In addition, emphasis was placed on the voluntary nature of their participation, and participants were unequivocally informed of their right to withdraw from the study at any juncture without obligation. To fortify participant confidentiality and protect identities, pseudonyms were employed to replace the names of the participants.

3.8 Conclusion

This chapter outlined the research design and the data collection process employed in my study, offering a comprehensive overview of the procedures undertaken in the research. In addition, this chapter addressed how it will ensure that the data is reliable and repeatable.

Chapter 4: Presentations and Discussions of findings/results

4.0 Introduction

The study aimed to investigate how STEM lecturers use the ICT tools available on Canvas LMS. This chapter presents and discusses the results of the questionnaire and the semi-structured interviews. To achieve the aim of the study, the following questions were used as a guide:

1. What knowledge do STEM lecturers have about the tools found on Canvas LMS?
2. Which ICT tools do STEM lecturers use in their teaching?
3. What do STEM lecturers use the tools found on Canvas LMS for?
4. What challenges have STEM lecturers encountered while using the tools found on Canvas LMS?

4.1 Presentation and discussion of the results

This section presents and discusses the results derived from analyzing the administered questionnaire and the semi-structured interviews. Each finding will be discussed in its subsection, offering a thorough and detailed presentation of the results.

4.1.1 Presentation of results from the analysis of the questionnaire

4.1.1.1 Results from the analysis of closed-ended questions.

STEM lecturers employ a diverse array of tools within the Canvas LMS. Table 2 below provides statistical representations of the utilization patterns of ICT tools offered on the Canvas LMS by STEM lecturers.

Table 1 below presents the results of the questionnaire on the ICT tools that STEM lecturers use on Canvas LMS. The STEM lecturers were asked to indicate the ICT tools they use on Canvas LMS. The results are presented in a tabular format consisting of the ICT tools' names and the number of participants who indicated they would use the tool. Lastly, the results were written as a percentage. In addition, the results are presented according to the four categories informed by the conceptual framework highlighted in Chapter 2, namely, content delivery and management, assessment and feedback, data and analytics, and communication and collaboration.

Table 3: Results from the questionnaire analysis on the ICT tools that STEM lecturers use on canvas LMS.

Name of ICT tool found on Canvas LMS	Number of participants using the tool (n=...)	Percentage
Category 1-Content Delivery and Management		
Studio	8	53.3 %
Pages	8	53.3 %
Files	15	100%
Syllabus	9	60%
Modules	14	93.3%
My mediasite	0	0%
Category 2-Assessment and Feedback		
Assignment	15	100 %
Quizzes	15	100 %
Rubric	8	53.3 %
Item banks	5	33.3 %
Peer review	1	6.7 %
Grades	15	100%
Gradebook	8	53%
Category 3-Data and analytics		
Calendar	8	53.3 %
Attendance	7	46.7 %
Badges	0	0%
Outcomes	3	20 %
People	15	100 %
New analytics	2	13.3 %
Groups	9	60 %
Analytics	6	40 %
Category 4- Communication and Collaboration		
Announcement	15	100%
BigBlueButton	9	60%
Groups	9	60%
Discussions	11	73.3 %
Chats	7	46.7%

Familiarity with ICT tools on canvas LMS

The pie chart below shows participants' familiarity with the various tools on canvas LMS. Participants were presented with four options: blue, denoting high familiarity with all tools; red, indicating high familiarity with some tools; yellow, representing low familiarity; and green, indicating no familiarity. The outcomes were summarized in a pie chart, revealing that 80 percent of participants reported high familiarity with some tools, while the remaining 20 percent reported high familiarity with all tools.

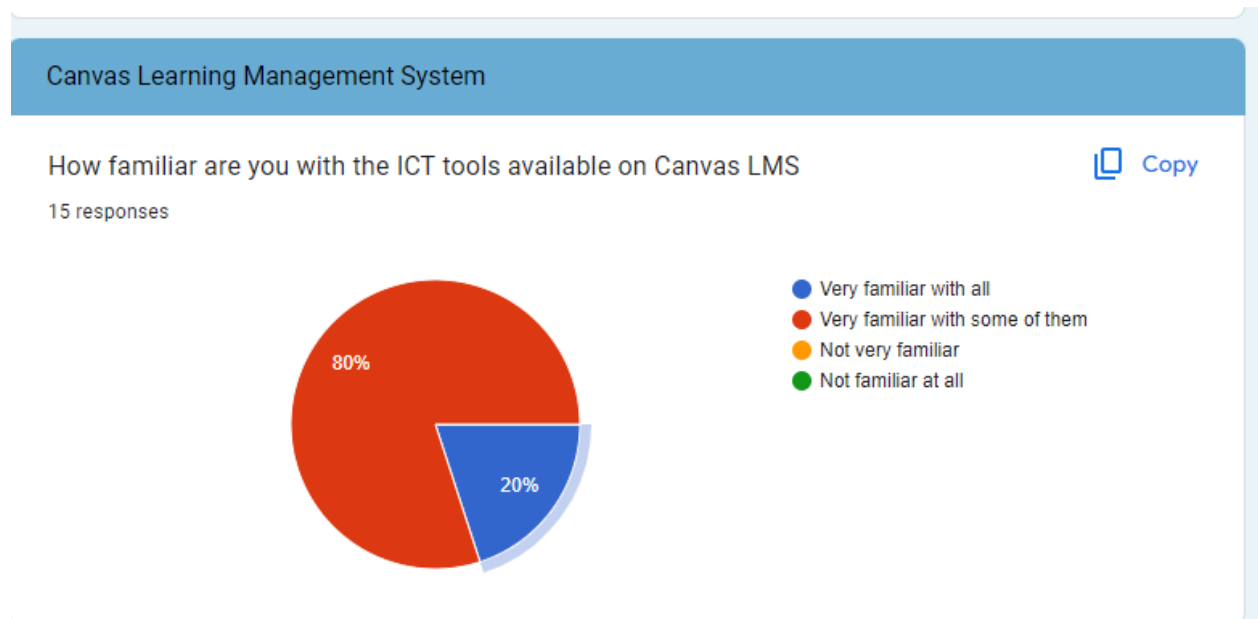


Figure B: Participants' familiarity with the ICT tools offered on Canvas LMS.

The results from the questionnaire reveal that all STEM lecturers are familiar with the ICT tools available on Canvas LMS, as evident in [Figure B](#). Despite this familiarity, a distinct subset of the ICT tools has been identified as relatively new or unfamiliar. This observation is supported by the data presented in [Figure B](#), where 80 percent of STEM lecturers indicated familiarity with some ICT tools. Lecturers' familiarity with the tools does not necessarily mean they use them in teaching. Instead, it may suggest that they have seen the tool before while browsing on Canvas LMS or that they have heard about it. This concurs with John (2021), who indicated that some tools are known but not used.

Among the array of ICT tools, tools such as Modules find usage among 14 out of 15 STEM lecturers, representing a 93.3% utilization rate ([see the above table](#)). This adoption indicates a prevalent awareness of the tool and its perceived utility in teaching STEM subjects. As highlighted on the Canvas website, the module stores and organizes course material so students can access it (Canvas, 2021). Access to course materials is one of the essential aspects of

teaching and learning; therefore, it is not surprising to see that 14 out of the 15 lecturers use it. The lecturer who indicated not using the Module tool preferred the File tool.

Furthermore, tools like BigBlueButton, Groups, and Syllabus show a 60% familiarity and usage rate among STEM lecturers, with 9 out of 15 utilizing them. All nine lecturers indicated that they use the BigBlueButton for virtual lectures. This tool allows for real-time interaction with students, enabling them to ask questions, participate in discussions, and engage in the lesson actively (Canvas, 2021); hence, most lecturers use it.

Notably, Studio, Pages, Rubric, and Calendar are utilized by 8 out of 15 STEM lecturers, constituting a 53.3% adoption rate. These statistics highlight a discernible level of awareness and integration of these ICT tools into the pedagogical practices of STEM lecturers—the Studio tool, as explained in section 2.4.2 of chapter 2, functions to record lectures. Unlike BigBlueButton, this tool does not conduct live lectures, and recorded lectures are saved in a video format. Thus allowing students to access it multiple times. One of the technology lecturers indicated that he is using this ICT tool. This preference may be because topics such as programming and coding in technology involve a lot of technical terminology and jargon that may be unfamiliar to many students. Therefore, the ability to replay recorded lectures multiple times can aid students in comprehending complex terminologies used in this discipline.

However, certain tools, such as Outcomes, are used by only 3 STEM lecturers, while My Mediasite and Badges do not find utilization among any of the lecturers. Thus contributing 0%. One of the functions of the Badges tool is to award students. The absence of usage, represented by 0%, may suggest that lecturers do not perceive Badges as relevant to their course objectives or teaching methodology. Additionally, it may imply that lecturers are unaware of the tool's existence or its potential benefits for enhancing student engagement or understanding of content. On the other hand, the Mymediasite tool allows users to capture, manage, and share multimedia content, including lectures, presentations, and other educational materials (Canvas, 2021). Given the availability of alternative tools offering similar functionalities, the absence of utilization might suggest that lecturers prefer other tools over MyMediasite for fulfilling their media-related content.

Conversely, tools such as File, Assignments, Quizzes, Grades, People, Announcements, and Notifications are adopted by all STEM lecturers ([see the above table](#)). The empirical data underscores this widespread adoption, revealing that the entire cohort of 15 STEM lecturers

incorporates these tools into their teaching practices. This widespread adoption is expected, given that these tools are essential for assigning tasks, facilitating communication, and providing students with access to course materials, all of which are fundamental aspects of every course.

Lecturers' use of the ICT tools found on Canvas LMS.

Figure 5 below illustrates the extent to which the STEM lecturers use the ICT tools found on Canvas LMS. The varying colors in the figure represent the extent of usage, where blue indicates frequent use (always), red signifies regular use (often), orange suggests occasional use (sometimes), green denotes infrequent use (rarely), and purple signifies non-utilization (never). The x-axis denotes the name of the ICT tool, while the y-axis indicates the number of participants.

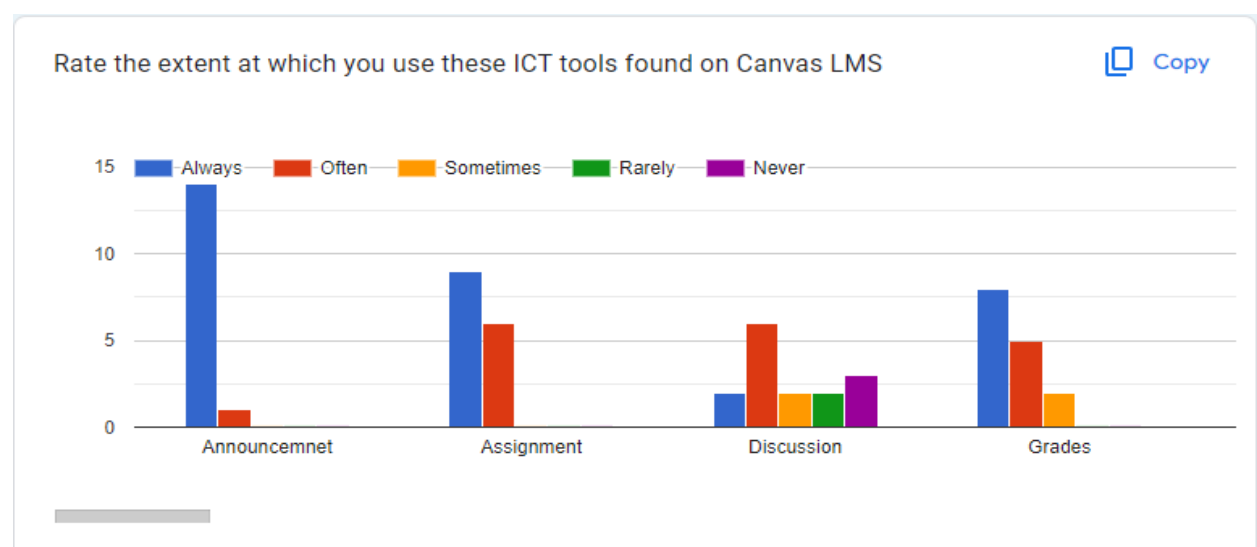


Figure C illustrates the extent to which the STEM lecturers use the ICT tools found on Canvas LMS.

When asked about the extent to which they use the ICT tools available on Canvas LMS, the findings reveal that the announcement tool predominates, with 14 out of 15 respondents consistently using it and 1 out of 15 utilizing it often (refer to Figure C). This outcome suggests the significance of communication in education, highlighting the necessity for constant interaction between students and lecturers. This aligns with Mpungose and Khoza's (2020) paper, whose participants revealed the significance of the announcement tool in teaching and learning. Subsequently, the Files tool appeared as the second most frequently used tool, with

11 out of 15 lecturers stating that they always use it and 4 out of 15 indicating frequent use. The Assignment tool was followed closely, with 9 out of 15 lecturers indicating that they always use it.

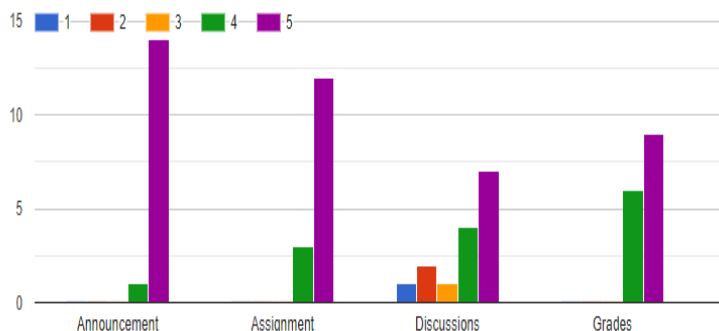
Moderate usage patterns were noted for tools such as Grades (8 always, five often, two sometimes), People (3 always, seven often, five sometimes), Quizzes (7 always, five often, one sometimes, two rarely), BigBlueButton (4 always, 3 often, 3 sometimes, 2 rarely, 3 never), Calendar (2 always, 5 sometimes, 4 rarely, 1 rarely, 3 never), and Groups (2 always, 7 often, 4 sometimes, 2 never).

In contrast, the utilization of LockDown Browser and Office 365 tools were found to be considerably low among respondents. Only one out of the 15 lecturers reported occasional usage, while the remaining 14 indicated that they never integrated these tools into their instructional practices (refer to Figure 5). As highlighted in section 2.4.1 of Chapter 2, Canvas allows the integration of external programs such as Office 365. This low utilization of the Office 365 tool may insinuate that lecturers are unaware of the availability of this tool or Canvas or prefer to use the actual program. Looking at the data, the participant who indicated to be using it is a technology lecturer with 10-15 teaching experience. Therefore, the teaching experience and discipline may probably be one of the contributing factors to their usage of the tool.

STEM lecturers' level of confidence

The STEM lecturers were required to rate their confidence on a scale of 1 to 5, with distinct colors representing different levels: purple for very confident, green for confident, orange for moderate confidence, red for low confidence, and blue for no confidence at all. The x-axis denotes the names of the ICT tools, while the y-axis represents the number of participants.

On a scale of 1-5, how confident are you in your ability to use these ICT tools on Canvas LMS (1=not confident at all, 5= very confident)



On a scale of 1-5, how confident are you in your ability to use these ICT tools on Canvas LMS (1=not confident at all, 5= very confident)

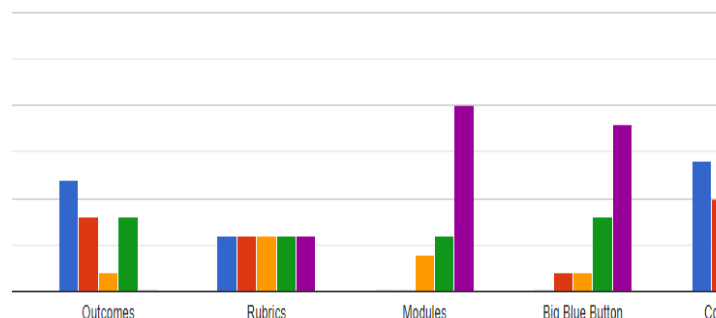


Figure D illustrates the confidence levels of STEM lecturers in utilizing the various ICT tools available on Canvas LMS.

A predominant trend surfaced in the evaluation of STEM lecturers' confidence levels in the utilization of ICT tools within the Canvas LMS. Among the 15 participants, 14 demonstrated heightened confidence in employing the announcement tool, whereas only one participant reported a proficient level of competence with this particular tool (refer to Figure D). This establishes the announcement tool as the most confidently employed ICT tool on Canvas LMS by lecturers. This underscores the announcement tool as the most confidently utilized ICT tool on Canvas LMS. This inclination could be attributed to lecturers' frequent utilization of this tool, as outlined in the preceding paragraph. Notably, the assignment tool elicited significant confidence, with 12 out of 15 lecturers attesting to a very high confidence level and three expressing a high confidence level. A similar pattern was observed with the file tool, where 12 out of 15 lecturers exhibited a very high degree of confidence, while three maintained a high confidence level in utilizing the tool.

In contrast, the Discussion tool yielded distinct results compared to the aforementioned tools. Seven out of 15 lecturers conveyed high confidence in using the Discussion tool; four were confident, one reported a moderate confidence level, two expressed a low confidence level, and one lacked confidence altogether. Results from the grading tool indicated that 9 out of 15 lecturers were highly confident in its usage, while the remaining six were moderately confident.

This underscores the prevalent integration of this tool in the teaching practices of STEM educators.

Concerning the rubric tool, there was a balanced distribution among participants, with three each being very confident, confident, having moderate confidence, low confidence, and expressing no confidence at all (see Figure D). Conversely, the confidence in using the outcome tool showed an uneven distribution among STEM lecturers, with four being confident, 1 having moderate confidence, 4 having low confidence, and 6 having very low confidence. Lastly, lecturers lacked confidence in using My Mediasite, My Mediasite, and Badges, where 14 out of 15 indicated a very low confidence level, and 1 expressed moderate confidence. This lack of confidence corresponds with the extent to which lecturers use these tools.

4.1.1.2 This section presents and discusses the results derived from the open-ended questions in the questionnaire.

When asked about the tools they find most beneficial for teaching STEM discipline, the participants indicated different tools. However, the announcement tool was the most common. For example, Clement indicated its efficacy in facilitating communication, while Sphephelo underscored its capability to incorporate attachments. Other tools deemed beneficial to STEM lecturers were the Module and Assignment tools, with 6 out of 15 affirming their utility (see Figure C in the appendix). These tools were highlighted to have a higher utilization level than the other tools in their respective components. For instance, all 15 lecturers use the announcement tool within the communication and collaboration component. These results substantiate the significance of these tools in teaching and learning, as indicated in the previous paragraphs. This observation aligns with Mpungose and Khoza's (2022) research, indicating a preference for ICT tools serving communicative, storage, and assignment purposes.

4.1.2 Presentation of results from semi-structured interviews

This section presents the results obtained from the semi-structured interviews. The results will be organized using subheadings formulated from paraphrased questions asked during the interviews. These subheadings encompass the lecturer's understanding of the ICT tools in education, what influences the lecturer's choice and use of ICT on Canvas LMS, and challenges experienced by the lecturers while using the ICT tools on Canvas LMS. This structure aims to provide clarity and coherence when presenting the research outcomes.

Lecturers' understanding of ICT tools in education.

STEM lecturers have varied understandings of ICT tools in education. For example, 1 out of the 15 participants views ICT tools in education as technology used for teaching and learning. Another one, Neo, explained ICT tools as modern ways of teaching and learning that help the teacher to mediate or put across what to teach. In addition, Katlego understands ICT tools in education as things that can enhance teaching and learning, and he gave an example using PowerPoint. On the other hand, Clement views ICT tools as anything that facilitates communication. Kamogelo views ICT tools as those teachers use to teach, whether online or face-to-face. Overall, these are just a subset of the explanations provided by the 15 participants.

Although all participants understand and recognize ICT tools as beneficial for education, they differ in their specific interpretations and conceptualization. Neo's conceptualization of ICT tools, for instance, is limited to modern ways of teaching and learning that mediate the learning process. Siphephelo recognizes that ICT tools also include both software and hardware, but this is still different from Clement, who identified them as facilitators of communication. This may suggest that the lecturer's understanding of ICT may influence how they interact with the tools and the extent to which they use them.

What influences lecturers' choices and use of ICT tools on Canvas LMS.

The results reveal several factors influencing the STEM lecturer's choice and use of the ICT tools on Canvas LMS. These factors include the lecturer's knowledge of the ICT tools, preferred methods of teaching and learning, and convenience of use. In his study, Bindu (2019) highlighted that teachers who know technological tools are more likely to integrate them into their teaching than those who do not. This is because they often feel more comfortable and confident in using them. This aligns with the results highlighted in section 4.1.1 and what was expressed during the interviews. One of the participants, Lerato, acknowledged employing tools based on her confidence level. According to Lerato, she only uses tools which she is well acquainted with. Thus contributing to her confidence level.

"I use the tools that I am confident with. The last you want to do is confuse your learners, so if you do not know how to use something, don't unless you have time to learn how it works."

Moreover, Neo indicated prior experience as a factor that contributed to his knowledge of the tools. The following expression exemplifies this.

"We used a similar LMS at the previous university I worked at, so it was easy for me to navigate through Canvas."

This suggests that past exposure to comparable systems can ease the transition and utilization of new platforms, emphasizing the importance of prior experience in enhancing one's competency with technological tools.

Kamogelo, on the other hand, attributed their disciplinary background to his knowledge of the different tools. He articulated himself in the following manner.

“Given my background, I come from a computer science environment. So, I learned a lot about LMS and other technological tools. Also, I am a technology teacher. I am compelled to know how to use these tools”.

Kamogelo's perspective highlights the significant influence of disciplinary background on their familiarity and proficiency with various technological tools. His statement suggests that his educational and professional background has equipped him with a robust understanding of LMS and other technological tools. Moreover, being a technology teacher further reinforces his imperative to utilize these tools effectively. This highlights the connection between one's disciplinary knowledge and ability to utilize technology to meet their teaching objectives.

Palesa, on the other hand, emphasized aligning tool usage with his teaching objectives. For instance, if she wants to measure students' understanding of content, she uses the grade tools, and if she wants students to work in groups, she opts for the collaboration tool. Sharing the same sentiment is Simphiwe, elucidating his approach to selecting ICT tools based on specific objectives; *“It honestly depends on what I want to achieve at the time, so if I want to give the students a test or assignment, I use the assignment tool and grades for marking. If I want to send out communication, I use notification, and to do lectures, I use BigBlueButton or Microsoft Teams, so it just depends”.* This underscores a strategic and needs-driven approach to selecting ICT tools in alignment with pedagogical objectives.

Convenience of use appeared to be one of the factors influencing lecturers' choice of ICT tools. Four out of 15 participants indicated using some ICT tools due to convenience. Munash, for instance, opts to use the announcement tool due to its efficiency in saving time. The lecturer highlighted that the announcement tool streamlines communication by automatically reaching all students without the need to input each student's email or student numbers individually. This approach is particularly advantageous given the substantial enrollment of over 100 students on the course. *“More than 100 students are registered for the course, so I cannot afford to insert every student's email address whenever I want to communicate with them. Whereas with the announcement tool, I do not have to insert; instead, it reaches out to all the students who have*

registered for the course.” Similarly, Palesa prefers the module tool for its capability to systematically organize resources, facilitating easy access for students. Additionally, Katlego emphasized the use of the grade tool due to its automated marking feature, stating, "The grade tool automatically marks and captures the student's marks. So, it is a way of documenting or recording the marks which are easier and easily accessible so should anything happen to me, people do not need to panic; they can go straight to grades and search for the marks."

Overall, these results indicate that lecturers' decisions about using ICT tools are influenced by the tools' functionalities and affordances, the disciplinary context, the objectives of teaching and learning activities, and their preferred pedagogical strategies.

Challenges experienced by STEM lecturers while using the ICT tools.

Like any technological appliance or tool, LMS also has limitations and shortcomings (Naz & Khan, 2018). These limitations give rise to challenges encountered in using such tools, as evident in the context of this research. The challenges observed in this study pertain to both pedagogical and technical issues. This observation resonates with the insights of De Silva and Wickramasinghe (2022), who emphasized that STEM subjects encompass a wide range of disciplines, each requiring a unique teaching requirement. Thus, if the ICT tools on Canvas do not accommodate the discipline's needs, the STEM lecturers may struggle to create engaging and effective learning experiences that align with the nature of their disciplines. In this study, six out of fifteen participants expressed dissatisfaction, attributing it to tool misalignment with STEM disciplines. Caiphus, a mathematics lecturer, expressed his dissatisfaction in the following way:

You know mathematics has a lot of equations and symbols. So, it is very difficult to type an assignment here because the tools do not have mathematical expressions. So, I use platforms such as GeoGebra whenever I want to type equations or formulas. This is inconvenient because you have Canvas, which you are supposed to use, but you opt for other platforms. I would want us mathematicians to be able to type mathematical expressions on Canvas without doing it on the other apps.

According to Caiphus, the tools on Canvas LMS lack subject specialization, thus affecting the efficiency of mathematics instruction. The inability to annotate or write mathematical expressions using these tools suggests that lecturers might need to change their teaching methods. For example, suppose the lecturer wants the students to take a geometry test where they must draw and write equations. In that case, the lecturer may be compelled to opt for

multiple-choice questions due to the tool's absence of essential equations and annotations needed for geometry. This poses a challenge as it not only affects the lecturer's preferred teaching methods but also does not allow the lecturer to see if the students know the different equations required for different questions and their understanding of content in general.

Moreover, the physical science lecturers in this study could not do hands-on practicals due to the misalignment of tools with science discipline. *"Science includes a lot of practicals and equations, and I honestly do not see how some of the tools here on Canvas can achieve that"* – Palesa. The mismatch between generic tools and the specific needs of science hindered the lecturers from equipping students with experimental skills that would prepare them for future endeavors, as highlighted in the Physical Science IV course outline. This could affect how the students teach in the future as they do not have the necessary skills and experience required in science education.

Another pedagogical issue experienced by the participants of this study pertained to the inadequacy of specific tools to accommodate a large audience, exemplified by the Chat tool. According to the information presented on the Canvas website, the chat tool accommodates a large audience (Canvas, 2021). However, the lecturers in this study expressed concerns about its efficiency. They noted that the tool delays the publication of responses, and the following quotes exemplify it.

Clement: Sometimes, I want to use the chat tool, but we cannot because it is so slow.

Koketso: I would post sometimes on the chat tool and ask my students to respond. The students would complain that they did not see the question, or even if some did, they usually saw them after a long time.

As a result, this instills the belief that the tool may not be designed to facilitate multiple users. A similar issue was identified with another Canvas ICT tool, BigBlueButton. Kamogelo expressed that during peak usage times, such as Monday mornings, there is often heavy traffic on the university server, leading to slow response times or system crashes:

Kamogelo: "BBB gave us some serious problems. It gave us problems because if you have a Monday morning lecture or 8 am session, there is much traffic on the university system. I think that's when many people are

busy as it is the first slot of lectures during the week and the system keeps crashing”.

Helen encountered a similar issue with the BigBlueButton tool, where students occasionally struggled to join meetings, or the tool presented obstacles in utilizing the microphone; *“Some students could not join using the mic, and as a result, they could not participate fully during the lesson.”* This issue affected the lesson since the students could not use a mic- an important feature used for participation. Consequently, lectures were sometimes delayed or rescheduled to alternative platforms such as Microsoft Teams, which consume more data than BigBlueButton. As a result, some students may miss the lecture as they cannot afford to buy data to join the lesson on Microsoft Teams. Consequently, this may affect their understanding of the content as they may miss the discussions or information presented during the lecture.

Another issue related to teaching and learning is the inability of the Grade tool to recognize different explanations or answers. According to Koketso, the tool does not recognize various methods or steps of solving a problem unless explicitly inserted by the instructor. To elucidate this, Koketso expressed this by saying the following.

"The problem with the Canvas grading tool is that it does not recognize the steps or methods of solving if I had not inserted them, even if the answer is correct. It only recognizes the answer that I have inserted. For instance, if the inserted answer is 0.9 and the student writes 1, it will mark it as incorrect."

Therefore, this issue challenges the pedagogical approach employed by the participant. The tool's failure to recognize various methods or steps in problem-solving creates a potential discrepancy in assessing students' understanding of content. Therefore, this may result in a narrow evaluation that focuses solely on the final answer, overlooking the diverse approaches students may take to reach the correct answer. As highlighted by Dube (2020), the unreliability of technological tools for teaching poses challenges, a sentiment affirmed by the findings of this study. Therefore, schools need to prepare and alert both the students and lecturers to the inadequacies of these tools so they can prepare themselves for cases like this.

Lawrence and Tar (2018) assert that technical issues hinder the seamless integration of ICT in teaching and learning. The STEM lecturers experienced technical issues while using the ICT tools on Canvas LMS. Power failure was a common issue experienced by all fifteen participants. According to Princess, the absence of electricity affects internet access, preventing

lecturers from using the Canvas platform and its embedded ICT tools; the following expression exemplifies this, “When there is load shedding, *we obviously cannot access Canvas, thus meaning we cannot access the tools*”. Compounding this issue, the university lacks a reliable backup plan, leading to disruptions in teaching and learning. This issue has disrupted teaching and learning as lectures had to be canceled and assignments had to be postponed or extended. Similarly, a study by Mthanti (2023) revealed that extensive load-shedding disturbs students from submitting their assignments on time, ultimately affecting their academic performance. To address this, the university proposed shifting from remote to venue-based classes; however, this solution is not universally accommodating, particularly for students facing travel challenges related to taxi fees and safety concerns.

Another technical issue experienced by the participants is connectivity. As highlighted in section 2.5 of Chapter 2, a stable internet connection is essential for the effective utilization of ICT tools (Balanskat et al., 2007). Yet, the participants faced difficulties due to unstable internet. For instance, one of the participants (Sphelele) said, “*Since Canvas LMS and its associated ICT tools operate remotely, connectivity problems lead to delays in lessons, preventing students and lecturers from accessing the ICT tools.*” Thus, according to Sphelele, one cannot successfully utilize the ICT tools if the network reception is unstable. In addition, Munash highlighted that the process of downloading course materials is slow when the connectivity is unstable and, in some cases, users cannot access the platform at all. This affects the students as they cannot access course materials, thus interrupting their studying.

Balanskat et al. (2007) point out that connectivity challenges may arise from poor network reception, particularly in areas lacking cell towers, and could be linked to power failures. To address these challenges, some lecturers in this study opted to print notes and course materials for students. This measure aimed to enable students to continue their studies despite experiencing connectivity issues.

Despite facing challenges, STEM lecturers expressed that they receive help from colleagues and the technical team whenever they encounter challenges with the ICT tools. This support serves to mitigate the challenges they encounter. However, as articulated by Helen, certain challenges necessitate individual solutions, as complete reliance on external assistance may not always be feasible. Helen emphasizes the importance of practice in overcoming challenges and mastering these diverse tools.

“Some challenges are beyond our control, for example, load-shedding and connectivity. However, if I cannot use a certain tool, it is my responsibility to do research, practice, or seek help. If you give yourself some time and practice, you can use these tools.”

4.2 Conclusion

This chapter presented the results obtained from the questionnaire and the semi-structured interview. In doing so, the data was discussed, making reference to the literature review. As indicated in the methodology section, the questionnaire responses informed the semi-structured interviews, facilitating a comprehensive exploration of how STEM lecturers employ ICT tools for teaching and learning, ultimately providing insights into their experiences. The findings reveal that the participants are familiar with the tools on Canvas. Their familiarity and use of the tools are influenced by factors such as the nature of their discipline, convenience of use, the lecturer’s knowledge of the tool, and their teaching objectives. Despite this, the lecturers have encountered several challenges on the platform. These issues are related to pedagogy and technical issues. Recommendations for addressing these challenges have been proposed and hope to be resolved.

Chapter 5: Conclusions, recommendations, limitations, and implications of the study

5.0 Introduction

In this section, a summary of the research will be outlined. Secondly, the research questions will be answered, followed by recommendations, the study's limitations, and a conclusion.

5.1 Summary of the research

The use of ICT tools in education has been proven to significantly impact teaching and learning by several scholars (Agaci, 2017; Bradley, 2021). One key aspect of this impact is the provision of tools that empower educators to enhance the overall quality of teaching and learning. Therefore, this study saw the need to investigate the ICT tools that STEM lecturers use on Canvas LMS. The selection of the STEM lecturers was influenced by the desire to find out what tools they use, considering the abstract nature of the content of STEM disciplines. Fifteen lecturers consented to participate. A mixed-method approach was employed to achieve the aim of the study, which consisted of a questionnaire and a semi-structured interview. No theoretical framework was used in this study; instead, a conceptual framework was developed. This is because no theoretical framework was most suitable for the study. The conceptual framework consists of the ICT tools of Canvas, which are arranged into components. The components are informed by the similarities of the functions of the tools, and they are communication and collaboration, content delivery and management, data and analytics, and assessment and feedback. The questions that guided the study were the following.

1. What knowledge do STEM lecturers have about the tools found on Canvas LMS?
2. Which ICT tools do STEM lecturers use in their teaching?
3. What do STEM lecturers use the tools found on Canvas for?
4. What challenges have STEM lecturers encountered while using the tools found on Canvas LMS?

5.2 Answering the Research Questions

This section addresses the research questions, and the questions will serve as subheadings.

What knowledge do STEM lecturers have about the tools found on Canvas LMS?

The lecturers in this research possess knowledge of the tools available on Canvas LMS. This is substantiated by their ability to showcase knowledge that goes beyond mere recognition of the tools, as evidenced by their ability to articulate the capabilities and utilities of various ICT tools integrated into Canvas LMS. For instance, all 15 lecturers expressed that the announcement tool is a communicative feature that allows them to send information to the students. This indicates their knowledge of the capability of the tool. In addition, they know that the Quiz tool can be used to assign and grade students' marks. Furthermore, they recognized that some tools serve multiple functions, a point also highlighted on the Canvas website (Canvas, 2021). One of the lecturers, for instance, highlighted that the Discussion tool is versatile and can be used for various learning objectives. In this tool, students can collaborate by discussing in groups with their peers. The tool can also be used for assessment purposes where the lecturer poses a question, and the students answer.

Which ICT tools do STEM lecturers use in their teaching?

To address the second research question concerning the ICT tools used by STEM lecturers in their teaching, a variety of tools are used. In the content management and delivery component, lecturers reported to be using tools such as Studio, Pages, Files, Syllabus, and Modules. Within the assessment and feedback component, tools such as Assignment, Quizzes, Rubric, Item Banks, SpeedGrader, Peer Review, Grades, and Gradebook are used by the STEM lecturers. In the data and analytics component, STEM lecturers use tools such as Calendar, Attendance, People, New Analytics, Groups, and Analytics. Lastly, STEM lecturers engage with tools such as Announcement, Notifications, BigBlueButton, Groups, Discussion, and the Chat tool in the communication and collaboration component.

Notably, certain ICT tools exhibit higher usage rates than others. Tools such as Announcement, Grade, Quizzes, and Files are used by all STEM lecturers. Conversely, tools like Rubric, Calendar, Pages, and Studio are employed by half of the lecturers. My Mediasite and Badges, on the other hand, are not used by any participants. The findings also reveal a trend where tools falling under the communication and collaboration, as well as the assessment and feedback components, are more frequently used by the lecturers. This observation aligns with Mpungose

and Khoza's (2022) research, indicating a preference for ICT tools for communication and assignment purposes.

What do STEM lecturers use the tools found on Canvas for?

To answer this question, STEM lecturers use different ICT tools for different purposes. The announcement tool, for instance, is used by all 15 lecturers for communicative purposes. The STEM lecturers indicated that they would use this tool to send information to the students. Examples of the information sent to the students include reminding them of a test or an assignment, informing them of the publication of course material, and canceling or rescheduling lectures.

The STEM lecturers said they use the Group tool to facilitate small group discussions. As Agaci (2017) explained, this tool only allows a few participants. One of the STEM lecturers explained the significance of this tool in collaborative learning and how it helps students exchange ideas—an advantage when dealing with a large audience. On the contrary, some lecturers prefer large discussions; thus, they utilize the Chat tool for discussion purposes. STEM lecturers also employ the collaboration tool to facilitate group activities or discussions. This tool accommodates both small and large audiences. For storage and filing of course materials, STEM lectures use the File and Module tool.

To assess student's comprehension of the content, the STEM lecturers use the assignment tool. According to information presented on the Canvas website, this tool offers various assignment types, such as multiple-choice quizzes, essays, and short and long questions (Canvas, 2021). Some lecturers, particularly those in mathematics and physical science, prefer using multiple-choice questions. This preference stems from the absence of a tool on the platform that facilitates the writing of mathematical expressions or formulas inherent in these disciplines. In addition, the lecturers use the Collaboration tool whenever they want students to work in groups.

Lecturers conduct virtual classes using the BigBlueButton. This tool allows for real-time interaction with students, enabling them to actively ask questions, participate in discussions, and engage in the lesson. On the other hand, some lecturers used the Studio tool to record lectures. The studio tool, however, is different from the BigBlueButton because the lectures are in a video format, and they are not live. Moreover, the calendar tool is used by the lecturers to update students on upcoming events or any valuable event, such as due dates for tests and assignments. Lastly, STEM lecturers use the Attendance tool to track student's attendance.

An interesting finding from this study linked to this research question was that, the ICT tools that STEM lecturers use, and how frequently they use them is influenced by a number of factors. These factors include the lecturer's knowledge of the tool and level of confidence of using that tool, objectives of the lesson or the course, nature of the content being taught and the utility of the tool.

What challenges have STEM lecturers encountered while using the tools found on Canvas LMS?

To answer the fourth research question of this study. STEM lecturers experience two types of challenges. The challenges are related to pedagogy and technical issues. One of the pedagogical challenges was the lack of subject specialization of the tools. As a result, the STEM lecturers could not translate complex concepts and hands-on activities using the ICT tools found on Canvas. Another challenge was the inability of the Grade tool to recognize different methods of solving a problem and recognizing different expressions of an answer. Lastly, slowness in some of the tools was indicated as another issue experienced by the lecturers. It is believed that the slowness may be because the tool is not designed to accommodate a large audience.

On the other hand, technical challenges included connectivity issues and power failure. Lecturers could not access the Canvas and its ICT tools when there is power disruptions or failures. Consequently, it affected connectivity as it is dependent on the power supply. To navigate these challenges, STEM lecturers acknowledged receiving support from the university, colleagues, and the Canvas teams. Such support mechanisms proved instrumental in mitigating the encountered challenges. Notably, one notable recommendation emerged during the interviews: continuous self-practice. STEM lecturers emphasized the importance of engaging in regular practices through platforms like YouTube. This self-directed learning approach enables lecturers to enhance their familiarity with the tools, serving as a valuable resource in instances where assistance from the university or colleagues is not readily available.

5.3 Limitations

The primary limitation of this study stems from the shortage of Engineering in Education lecturers within the investigated school, where only two were available, and could not participate due to various reasons. Consequently, the findings may lack representation for the broader STEM discipline, as the study could not encompass the perspectives of these specific lecturers. In addition, it is important to note that the study focused on one specific school.

Therefore, the results are not representative of the entire STEM education lecturers in universities.

5.4 Recommendations

Based on the findings of this study, several suggestions for future research regarding the utilization of ICT tools by STEM lecturers on Canvas LMS are proposed. Firstly, due to the relatively small sample size and the limitation to a single case study, conducting research utilizing multiple case studies and expanding the sample size would be beneficial for obtaining a more comprehensive understanding of how STEM lecturers utilize ICT tools available on Canvas LMS. Secondly, future studies could observe how STEM lecturers actually use the ICT tools on Canvas and not rely on interviews only. Lastly, to avoid bias in results, future research should encompass all disciplines within STEM and beyond, ensuring representation of each discipline.

5.5 Conclusion

This study investigated how STEM lecturers use the ICT tools on Canvas LMS. The results obtained, hope to provide valuable insight into how STEM lecturers integrate these tools into their teaching approaches. Despite the advantages of the ICT tools, challenges such as technical issues and pedagogical constraints were identified. To advance STEM education, addressing these challenges is crucial. Therefore, this study suggests future research to explore effective strategies for integrating ICT tools, accounting for disciplinary variations and individual teaching preferences.

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SCHOOL OF EDUCATION ETHICS COMMITTEE

CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE

PROTOCOL NUMBER: 2023ECE34M

PROJECT TITLE

Investigating the use of ICT tools available on Canvas Learning Management System by STEM lecturers at a South African University

INVESTIGATOR

MAPOULO BOITUMELO MADIMABE

SCHOOL/DEPARTMENT OF INVESTIGATOR

WSoE

DATE CONSIDERED

21 July 2023

DECISION OF THE COMMITTEE

Approved unconditionally

RISK LEVEL

Minimal Risk

EXPIRY DATE

Date of submission of the Research Report

ISSUE DATE OF CERTIFICATE

11 September 2023

CHAIRPERSON



Dr. Batseba Mofolo-Mbokane

cc: Prof Eunice Nyamupangedengu

DECLARATION OF INVESTIGATOR

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

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



12 09 2023
/ /

Participation information sheet

Dear Sir / Madam

My name is Mapoulo Madimabe. I am a Masters students in the School of Education, at the University of the Witwatersrand, Johannesburg. As part of my studies, I am required to undertake a research project, where I will be investigating the use of ICT tools available on Canvas Learning Management System (LMS) used by STEM lecturers at a South African University under the supervision of Prof Nyamupangedengu.

I am inviting you to take part in an interview where I will be investigating how STEM lecturers use ICT tools available on canvas to teach. With your permission, I would like to record the interview. The information obtained from the audio recording will be completely confidential and anonymous, as I will not disclose your name, the name of the institution or any identifying information in the research report. There will be no personal cost on you, neither will you receive any direct benefits if you decide not to participate in the interview. In addition, there will be no disadvantages or penalties if you choose not to participate in the study. You are allowed to withdraw at any time you prefer to. Lastly, the information obtained the audio recording will be kept securely on my personal computer and it will only be accessible to the researcher and the supervisor.

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

Yours sincerely,

Miss Madimabe

Researcher:

Name: Mapoulo Madimabe

Wits email: 1872790@students.wits.ac.za

Phone number: 072 754 7986

Consent Form for participating in research

Dear prospective participant,

Kindly complete this form to indicate your willingness to participate in this research project.

Title of project: Investigating the use of ICT tools available on Canvas Learning Management System (LMS) used by STEM lecturers at a South African university.

Name of researcher: Mapoulo Madimabe

I,, agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please make a **cross against** the relevant options below).

I understand that my participation will remain anonymous	YES	NO
---	-----	----

I understand that the researcher may use anonymous quotes in his / her research report	YES	NO
---	-----	----

I understand that the interview may be audio recorded	YES	NO
--	-----	----

I understand that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES	NO
--	-----	----

I confirm that I been informed of my right to withdraw from the study and not to answer any questions that I am uncomfortable with.	YES	NO
---	-----	----

..... (Participant's signature)
 (name of participant)
 (date)



..... (Researcher's signature)
 Mapoulo Madimabe..... (Name of researcher)
 26/June /2023..... (Date)

Appendix C (AC)

Semi-structured Interview Questions

Question 1

What is your understanding of ICT in education?

Question 2

From the survey, I saw that you use these tools (name tools according to lecturer's response). What do you use them for?

Question 3

How often do you use these tools for?

Question 4

Does one need to have a specific skill in order to use the tools you mentioned?

Question 5

Can you describe any challenges or obstacles you have encountered while using ICT tools on Canvas?

The image shows a digital questionnaire form with a light blue background. It contains three main sections, each in a white box with rounded corners. The first section is titled 'STEM Division *' and has four radio button options: Science, Technology, Engineering, and Mathematics. The second section is titled 'Years of teaching experience *' and has four radio button options: 0 - 5 years, 5 - 10 years, 10 - 15 years, and More. The third section is titled 'How familiar are you with the ICT tools available on Canvas LMS' and has four radio button options: Very familiar with all, Very familiar with some of them, Not very familiar, and Not familiar at all. A blue header bar with white text reads 'Canvas Learning Management System'. Below this bar, a white box contains the instruction: 'Please answer the following question honestly and to the best of your knowledge.'

STEM Division *

☐ Science

☐ Technology

☐ Engineering

☐ Mathematics

Years of teaching experience *

☐ 0 - 5 years

☐ 5 - 10 years

☐ 10 - 15 years

☐ More

Canvas Learning Management System

Please answer the following question honestly and to the best of your knowledge.

How familiar are you with the ICT tools available on Canvas LMS

☐ Very familiar with all

☐ Very familiar with some of them

☐ Not very familiar

☐ Not familiar at all

AD1: First Question of the Questionnaire.

What ICT tools available on Canvas LMS do you use? *

- ☐ Announcement
- ☐ Assignment
- ☐ Discussions
- ☐ Grades
- ☐ People
- ☐ Pages
- ☐ Files
- ☐ Syllabus
- ☐ Outcomes
- ☐ Rubrics
- ☐ Quizzes
- ☐ Modules
- ☐ Big Blue Button
- ☐ Collaboration
- ☐ New analysis
- ☐ Items Banks
- ☐ Chat
- ☐ Attendance
- ☐ Office 365
- ☐ Google Drive
- ☐ Studio
- ☐ Dropbox for Canvas

AD2: Second Question of the Questionnaire.

Rate the extent at which you use these ICT tools found on Canvas LMS *

	Always	Often	Sometimes	Rarely	Never
Announcemnet	☐	☐	☐	☐	☐
Assignment	☐	☐	☐	☐	☐
Discussion	☐	☐	☐	☐	☐
Grades	☐	☐	☐	☐	☐
People	☐	☐	☐	☐	☐
Pages	☐	☐	☐	☐	☐
Files	☐	☐	☐	☐	☐
Syllabus	☐	☐	☐	☐	☐
Outcomes	☐	☐	☐	☐	☐
Rubrics	☐	☐	☐	☐	☐
Quizzes	☐	☐	☐	☐	☐
Modules	☐	☐	☐	☐	☐
Big Blue Button	☐	☐	☐	☐	☐
Collaboration	☐	☐	☐	☐	☐

AD3: Third Question on the Questionnaire

Groups	☐	☐	☐	☐	☐
Outcome	☐	☐	☐	☐	☐

On a scale of 1-5, how confident are you in your ability to use these ICT tools on Canvas LMS (1=not confident at all, 5= very confident) *

	1	2	3	4	5
Announcement	☐	☐	☐	☐	☐
Assignment	☐	☐	☐	☐	☐
Discussions	☐	☐	☐	☐	☐
Grades	☐	☐	☐	☐	☐
People	☐	☐	☐	☐	☐
Pages	☐	☐	☐	☐	☐
Files	☐	☐	☐	☐	☐
Syllabus	☐	☐	☐	☐	☐
Outcomes	☐	☐	☐	☐	☐
Rubrics	☐	☐	☐	☐	☐
Modules	☐	☐	☐	☐	☐
Big Blue Button	☐	☐	☐	☐	☐

AD4: Fourth Question on the Questionnaire

What is your primary reason for using Canvas LMS

Your answer _____

What specific ICT tool(s) do you find most beneficial in your STEM course on Canvas LMS? Please explain

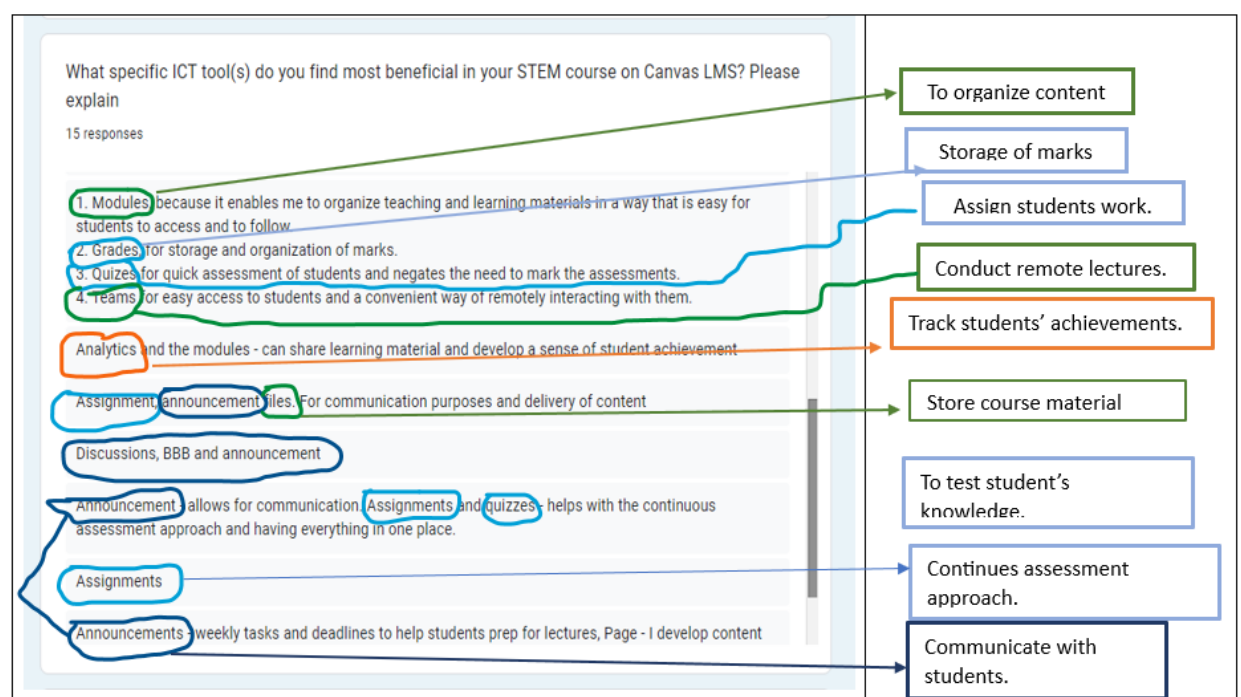
Your answer _____

Have you received training on how to effectively use ICT tools on Canvas LMS for ^{*} your STEM course?

☐ Yes

☐ No

AD6: Question 5, 6 and 7 of the questionnaire



AE: An example of an open-ended question from the questionnaire that is coded.

Interview 1

Q1: What is your understanding of ICT tools in education?

A: ICT in education refers to technology that can be used for instructional purposes. Basically, things that can enhance teaching and learning, an example is a PowerPoint.

Technology used for teaching and learning.

Q2: From your survey, I saw that you said you are very familiar with some of the tools on Canvas. What influences your knowledge of those specific tools and not all of them?

Misalignment of tool with discipline

A: Not all of the tools are relevant for teaching science for instance. I do not have to use them all because science is a, it includes a lot of practicals and lot of equations, okay sometimes we use discussions but some of them I do not really have to use them. Some I find them difficult to use because they are tricky to use and longer. So, I use the tools that I know will be effective and meet my teaching objectives.

Communicative purposes

Tools should align with teaching

Q3: What are those tools that you use the most?

Recording of marks

A: Announcement, Assignment, Modules, Files, Studio and Gradebook for recording my marks. Sometimes I use discussions. However, at times when I use discussions, because our classes are so long, I have to read all the responses. So, I opt to use it very rare. I would rather respond back using the Chat tool when I am in class, rather than using the discussion tool because I can manage to read all of them.

My classes are too big, so the discussion tool is not accommodative of large classes.

Not accommodative of large audience

Q4: With the tools that you use the most, does one need to have a specific skill for using them?

A: Yes, you do, cause after all they are technological tools, and you cannot use a technological tool if you don't have knowledge of technology. Besides we get training on how to use them. Also, you can ask a colleague to help whenever you encounter a challenge. Also, there is Canvas website that you can refer to, so it is not that complicated.

Q5: You mentioned that you attended training. Can you please describe the training, what exactly did you guys do during training?

A: The training comes on various occasions; your attendance depends on your needs. For instance, there will be training on 'the basic use of canvas tools'. So, it depends on you, what you want to know and you can even request the admin to help you whenever you need help. The courses are spread throughout the year, it is not a once-off training.

Q6: since you mentioned that you use Announcement and Studio, how often do you use them? And what exactly do you use them for?

Communicative purposes

A: I use Announcement all the time and I use it to inform the students of anything that I want them to know. Basically, to remind them. For example, let's say I have a class tomorrow, I will send out communication of the topic that will be covered on that day and just to remind them what to bring to class. Sometimes if I want them to see something immediately, I will insert a file on the announcement.

Attach files

as well so they can access it faster instead of uploading it directly to Modules or Files. Also, if I have posted something in files, I will send them an announcement to let them know of it.

Q7: With the tools that you said you find them difficult to use, are you willing to learn how to use?

A: If they are relevant to my discipline and if they could help me better teach Science then yes, I am willing to learn how to use them. But if they are not relevant then I will stick to what I know. Also, there are too many of them. Remember Canvas was made generic for all the courses, so there might be some tools that are useful to other courses and not for science. Because here (in science) we are dealing with a lot of calculations and experiments- it is a practical subject, so I have to use the tools that are practical.

Q8: Is there a specific tool that is accommodative for the practical nature of your discipline?

A: Not really honestly.

Q7: So, are there any functionalities or tools that could be improved to better enhance the teaching of science?

A: Yes, maybe we can have space where we are able to write down equations because it is difficult on Canvas to write equations. I have to do it somewhere and copy them on the platform. So, that is so inconvenient because it is time consuming, and it makes the students to be lazy because they can just copy the equation on the internet and not write them themselves. So, you can never be sure whether the students know the equations or not.

Q8: Any challenges that you have encountered

Limit responses/answers.

A: I have encountered challenges while using assignment. For instance, the type of assignment that works best for me are your multiple choice like questions or true or false questions. Those are very simple to use, but if I were to give an assignment where there are calculations, you know in science we work with a lot of numbers and there are different methods of solving a problem, but you can still get the same answer regardless of the method one chooses to use. The problem with the assignment tool is that it does not recognize the different methods especially if the instructor has only inserted one method. So, the other methods that the students will use and are not inserted as correct methods or ways of solving the problem it rejects them and marks them as incorrect. Also, if the answer is 1.89 and the student gets the same answer but decides to round them off, it will make it incorrect. Lastly, if the question asks the student to define a law or something and they don't respond to how you wrote on the 'memorandum' then it will be marked incorrect. So, I can say that it takes word by word. So that is my challenge of working with tools like assignments.

Interview 2 (Mathematics, Male, 0-5 years of teaching experience)

Q1: What is your understanding of ICT tools in education?

Facilitate

A: ICT stands for Information Communication Technology, anything that facilitate communication. So, anything that is digital because effectively it is speaking to that digital version of these technologies, like we have in our system, like how we communicate with students. So that in itself make Canvas a type of communication tube.

Q2: I saw on the survey that tools such as announcement, assessment, grade and people you use them often. I just want to find out what influences your use and what do you use these tools for?

Inform students on upcoming events.

A: It is precisely what they are set are for. For announcement I use it to inform students about whatever that is coming up, often enough is what the schedule is for the week; what is going up for the week, what topics will be covered and what resources they need to use. So that is what I will be using the announcement for. So usually, the module is where we place our content from one week to the next and the content is often narrated which would have been created using screencast which is pretty much the technology that is embedded on Ulwazi, and it is referred as studios. So basically, it is a tool that has the same function as studio but of course you can save those clips and upload them on Ulwazi.

Storage for content

Q3: Does your discipline have an influence on the tools that are use the most?

A: They are very generic. I don't think these tools on Canvas are for a specific discipline. Anyone can use them honestly. I think though there is work that needs to be done to accommodate teaching and learning of Mathematics. This is because Mathematics is particularly a specialized field of study with a lot of symbols and characteristics. So, there is still more work to be done in that regard. The platforms (tools) themselves are a work in progress- it is still early days.

Need to align tools with the Maths discipline

Q4: You mentioned that Mathematics is a specialized discipline. Are there any functionalities or tools that you think could be improved to better enhance the teaching and learning of this discipline?

A: Yes, I think there is room for improvement. The Improvement is related to the content, I think it could be improved to help unpack the content, for instance making sense of the topic or concepts. For Mathematics we need more of the animating of Maths itself, a visual view of mathematical objects so that they can be seen for what they are instead of this static or rigid view that we see. I mean Mathematics has been evolving for the longest time, and truly speaking the content within technology needs to support the evolution as well. So, there is quite a lot that needs to be done.

Suggestion on how to improve the tool

Q5: Have you encountered any challenges while using the tools on Ulwazi?

A: Yes, I have.

Q6: Please explain or describe some of the challenges that you have encountered.

Not flexible to move between the different tools

A: On Canvas, it is quite challenging to move between the subs (tools). Let's say for instance, you are moving from Gradebook to speedgrader, there are things that could be improved there. For instance, the random-access nature of it. You don't have the ability to go randomly to a particular student in the speedgrader. So, whenever you click on that icon that takes you to a speedgrader, you are literally going

to the first person on the list, and you don't always want to do that. You want to go to those individual students so that you can see their mark instead of having to scroll down and go student by student. So, one of the features that could be improved with regard to that is to insert a little window that can be used to choose that particular student that you are looking for. Cause if you can imagine there are 200 students, and it always goes to the first and you always have to scroll down.

Q7: You highlighted on the questionnaire that you did not receive training. Were you invited for training or not?

A: No there wasn't training per say, obviously when the platform was introduced there was obviously something that was introduced- related to sharing how the platform (Canvas) works and we had to read that on our own so we could start working with it. There are programs that are offered by CLTD for the use of Ulwazi and are not compulsory. So, you know if something is left for you to either do it or not, you choose based on whether you have time or not and whether you prioritize it or not. But the point is really is to I would have expected that they would have been time put aside to introduce stuff. It could have been compulsory as compared to giving us an option of whether we want to attend or not. But basically, there wasn't time aside from the level of the school or the division, but time was set aside from the level of agency or the agency that was given the task to appoint staff with this. So again, it depends on one's needs to go on a course or any major presentation.

Q8: Was your decision of not attending influenced by the fact that you are well acquainted with using technological tools?

A: Most definitely. I just felt that I could navigate my way.

Interview 3 (Technology, 0-5 years of teaching experience, Male)

Q1: What is your understanding of ICT tools in education?

Technology used for improving teaching.

A: Is technology that can be used for instructional purposes. Things that can enhance teaching and learning, an example is a PowerPoint. It is a software tool that can be used to enhance teaching and learning. In short, tools that we use to support teaching and learning.

Q2: What tools do you use on Ulwazi to support teaching and learning?

A: I use BigBlueButton, Modules, Announcement, Assignment and Grades.

Q3: What do you use those tools for and how often do you use them?

Communicate with the students.

A: I use them differently; some I use more often some not so often. The most often used are things like announcements because we have to keep communicating with the students and then files, we have to keep on uploading some teaching materials there. Whenever there are some assignments, we upload them there. And the other ones that I use more often asides from Pages, Syllabus and Modules, there is what we call BigBlueButton to set up our virtual meeting if there is a need to. Within that again there is

Upload teaching materials

Conduct virtual meetings.

Not needed for teaching technology

a studio, that is where I record my lectures. I record my lecturers in advance and send it to them. However, there are other tools like collaboration. Because of the nature of my teaching, I do not much of discussion like people that re in educational philosophy and so forth. We hardly discuss things in my discipline. But perhaps we can use that tool to encourage students to work together or collaborate using that tool. And there are other tools like Item Banks I use them often. For instance, if I give them questions (quizzes) I can use the Item Banks and retrieve probably the first ten or twenty randomly and it makes them as an assignment.

Q4: Besides announcement is there another way you can communicate with your students? If there is, state it and why you

Canvas tools are time convenient.

A: Outside this platform I use emails. However, it is time consuming because I have to type every student's emails. There are more than 200 students registered for the course so I cannot afford to insert every student's email address whereas on Canvas (announcement) I do not have to type instead it reaches out all the students who have registered for the course. Also, sending communication via email is heavy. Again, on announcement I can simply attach any document I want to give student.

Q5: Were you trained on how to use these tools?

A: We were invited for training however I only attended the first few which were more on how to create assignments and quizzes. And also, how to structure our module but because of other commitments I could not continue with the training. I had to miss some of the sessions and as a result I had to practice on my own using the videos from YouTube. However, I cannot say the people there were not doing the right job. They did the right job because they even used to share some recordings so that we can re-listen or watch the videos at our own times. Overall, I managed to know the tools because I taught myself.

Q6: Why self-taught?

A: I had a lot of pressure and also given my background that I also come from computer science environment, I am acquainted with how to use ICT tools and for those that I did not know I had to do research and do more practice.

Prior encounter with the tools

Q7: With the tools that you don't use, why don't you use them?

A: Some of these tools according to my discipline I do not see how I can use them (not relevant to my subject). For instance, badges. What I know about it is just that I can use it to give awards, but I do not see how I can use it for enhancing teaching and learning of my discipline.

Misalignment of tool with discipline

Q8: Any challenges that you have encountered while using the different tools?

A: I did not encounter any challenges. The only ones I have encountered are technical and those are beyond my control.

Technical issues

Q9: Any particular tool that you think needs more improvements especially to help teach your discipline?

A: BigBlueButton, sometimes it disturbs our lecture. Besides that, I love it, it is effective for storing for storing information, you can go to the previous course, import documents and other amazing stuff.