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Understanding teachers' technological and pedagogical knowledge at the University of Dar es Salaam in the New Normal Era: Situating teaching in the TPACK Framework

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Abstract
This study investigates the integration and application of Technological Pedagogical Content Knowledge (TPACK) within the University of Dar es Salaam during the transformative phase of the COVID-19 pandemic, termed as the 'New Normal'. The research seeks to explore how instructors have adapted to the abrupt transition to digital learning platforms, with a focus on the interplay between technology, pedagogy, and content. Utilizing both qualitative and quantitative analyses with 111 instructors across 16 colleges, the study assesses the proficiency and challenges faced by instructors in integrating TPACK in their teaching methods. The findings demonstrate a significant impact of TPACK on enhancing teaching effectiveness and student engagement in a digitally-driven academic setting. Furthermore, the study highlights critical barriers to the adoption of TPACK, including infrastructural constraints and the necessity for continuous professional development. The paper concludes by providing insights into the prospects of TPACK in higher education, underscoring its role in fostering resilient and adaptable educational frameworks to confront global challenges such as the COVID-19 pandemic.

Keywords: Technological pedagogical content knowledge, TPACK, new normal, digital learning transition, instructors digital integration
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Background

The University of Dar es Salaam (UDSM) has actively embraced technological advancements to enhance educational access, quality, and cost-efficiency. Since 1998, the University has consistently installed ICT infrastructure across colleges and halls of residence (Mtebe & Twaakyondo, 2012). A notable enhancement in 2008 was the connection to the SEACOM optic fibre cable, boosting internet speed to 155Mbps. This upgrade included extensive wireless

installation across the campus and in student residences, as well as equipping public access rooms with internet-connected computers.

The University's journey in the integration of technology in teaching and learning began in 1998 with the Blackboard system, training over 16,000 users and uploading 402 courses (Mtebe *et al.,* 2011). In 2008, facing escalating annual license fees of approximately US$ 18,000, UDSM transitioned from Blackboard to Moodle, a more cost-effective solution. This shift coincided with the introduction of blended distance postgraduate programs: Postgraduate Diploma in Education (PGDE), Postgraduate Diploma in Engineering Management (PGDEM), and Master Degree in Engineering Management (MEM) delivered through regional centers and combining face-to-face instruction with Moodle's online resources. (Mtebe, 2015).

In 2005, UDSM established the Center for Virtual Learning (CVL) to further enhance technology integration in education (Twaakyondo & Munaku, 2012). This strategic initiative recognized the increasing importance of digital proficiency in higher education. The CVL has been pivotal in developing blended learning programs and supporting instructors with effective course facilitation. It serves as a hub for innovative technology integration in education, continuously exploring new methods and technologies to enhance the learning experience at UDSM.

The COVID-19 pandemic forced the closure of universities across Africa, leading UDSM to adopt a technology-enhanced teaching approach, already part of its long-term ICT strategy (Mtebe et al., 2021). Proactive measures ensured continuity of teaching and learning. An initial audit of the University's ICT infrastructure led to the implementation of digital platforms like Moodle LMS, Zoom, and the Postgraduate Information Management System (PGMIS) for managing postgraduate supervision and assessments.

Additionally, 340 instructors across 15 colleges and directorates received training in developing quality online resources and effective use of Moodle and Zoom for teaching (Mtebe *et al.,* 2021). This training resulted in the creation of 369 new Moodle courses, significantly enhancing the University's online educational offerings. This preparation was crucial for the smooth transition to online learning during the pandemic.

Amidst the "new normal," the University remains unwavering in its mission to provide superior education, prioritizing the safety and well-being of its students and staff. This period demands a deep re-evaluation of traditional teaching methods, advocating for the integration of digital technology into teaching and learning. This shift goes beyond simple technological adoption; it involves a synergistic blend of technological acumen, pedagogical insight, and subject-specific knowledge, as epitomized by the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006a).

As the UDSM aims for greater digital technology use in education as envisioned in its 2061 vision, it is crucial to ensure that instructors effectively use these digital technologies to enhance teaching and learning. This study investigates how instructors at the UDSM apply digital technologies in their teaching, adapting elements of TPACK. A mixed sequential design was adopted collecting and analyzing quantitative data first, followed by qualitative data from interviews with selected instructors. A total of 111 instructors completed usable questionnaires, and 16 participated in interviews. The study's findings will shed light on instructors' technological pedagogical knowledge, evaluate the effectiveness of digital technology use by instructors, and identify knowledge gaps and misconceptions.

A key question this study addresses is the effectiveness of instructors in using these tools in the new normal. The research explores the strategies educators use to integrate technology while

preserving the integrity of subject content and effective pedagogy. The study aims to identify successful practices, and challenges, and provide TPACK-based teaching recommendations. These insights will be valuable not only for UDSM but for other higher education institutions globally.

The study's implications are both academic and practical, offering significant contributions to technology-enhanced learning. Academically, it provides UDSM educators with proven strategies for effectively integrating technology, pedagogy, and content knowledge, following the TPACK framework. This aligns with current trends in blending technological advancements with teaching methods. The study also highlights the importance of addressing equity and access in technology integration, essential for inclusive education. Its findings will guide policymakers and educational leaders in creating equitable digital learning environments.

Practically, the study highlights the potential of blended learning in Tanzania, promoting approaches that are culturally sensitive and technologically adaptive. Through the lens of TPACK, it augments existing research and provides new insights into technological integration in higher education, particularly in the wake of the 'new normal' post-COVID-19. The study contributes to shaping guidelines that support effective technology integration, addressing the challenges of the new era. Its broader relevance lies in its potential to influence positive change, enhance access to quality education, shape policies, and stimulate discussions about seamless technology integration in education at both local and global levels.

Research Questions

1. In what ways are instructors' expertise in various technological domains – including Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK) – demonstrated in the realm of digital teaching and learning in the current era of the "new normal"?
2. How do the instructors' proficiencies with digital tools, institutional support, and their combined technological and instructional knowledge contribute to shaping their methods in digital teaching and learning?
3. Which challenges and collaborative efforts, along with considerations of time and space, are essential in determining the success of digital teaching and learning strategies at a Tanzanian university in the context of the "new normal"?

Situating Pandemic Teaching in the TPACK Framework: Navigating the New Normal at UDSM: Theoretical Framework

The adoption and effective application of digital technologies in educational settings are extensively studied topics. These technologies have continuously evolved and become more accessible to educators across all educational levels. These technologies possess unique characteristics, potentials, affordances, and limitations, making them suitable for specific tasks (Koehler & Mishra, 2005). The challenge lies in leveraging these technologies to enhance the quality of teaching and learning. The Technological Pedagogical Content Knowledge (TPACK) framework for teacher knowledge has gained significant recognition as a comprehensive model addressing the knowledge required to effectively integrate technology into teaching environments (Koehler & Mishra, 2005). According to the TPACK framework, effective

technology-based teaching involves a blend of content knowledge, pedagogical knowledge, and technological knowledge, along with the interplay among these components. Figure 1 illustrates the TPACK framework and its constituent knowledge components.

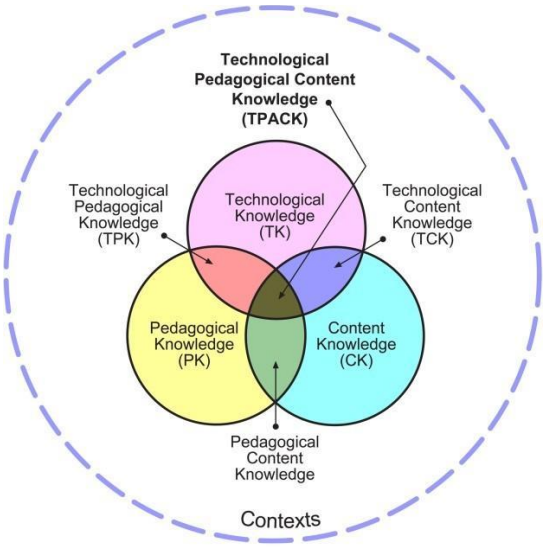

Figure 1: The TPACK framework and its knowledge components (Koehler & Mishra, 2013)

In many African universities, instructors often possess strong Content Knowledge (CK) and Pedagogical Knowledge (PK) of their respective courses. However, they may lack the Technology Knowledge (TK) and the ability to effectively apply it in educational contexts. This includes Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and overall Technological Pedagogical Content Knowledge (TPACK), as outlined in the TPACK framework. This study aims to identify variations in instructors' knowledge of technology-related TPACK components (i.e., TK, TCK, TPK, and TPACK) during the application of digital technologies in teaching.

For instance, the TK is a prerequisite for any instructor who wants to use digital technologies to facilitate teaching and learning. TK is the instructor's understanding of the possibilities and constraints of certain technology and the skills to utilize such technology efficiently (Mishra & Koehler, 2006b). In the context of this study, it involves the skills required to use Moodle system, Zoom, and the PGMIS, and other related technologies. During the pandemic, instructors were equipped with the skills to be able to use these technologies. It remains to be seen if they acquired the required skills to be able to use the majority of features of these technologies.

Another critical aspect is Technological Content Knowledge (TCK), which pertains to how technology and content influence each other (Koehler et al., 2013). This knowledge is crucial for instructors to understand how course content (e.g., database, sociology, mathematics) can be transformed through the use of digital technologies (Mishra & Koehler, 2006). In this study, instructors' understanding of how technologies such as OER, Moodle, PGMIS, and Zoom can modify the presentation and comprehension of course content is evaluated.

Additionally, Technological Pedagogical Knowledge (TPK) is vital for effectively applying digital technologies in teaching. It refers to the understanding of how different technologies can be utilized in teaching and the recognition that the use of digital technologies can alter traditional

teaching methods (Schmidt *et al.*, 2009). Instructors should be aware of the constraints and affordances of the technologies they are trained in, such as Moodle, Zoom, PGMIS, and OER, and how these technologies function within their disciplinary contexts (Koehler *et al.*, 2013).

Collectively, the TPACK model offers a framework to comprehend the interdependence of pedagogical and technological knowledge in instructors' use of technology for teaching. It challenges simplistic notions that merely introducing technology will automatically enhance learning outcomes (Hamilton & Friesen, 2013). Furthermore, it opposes prevalent misconceptions about educational technology by emphasizing the importance of teacher evaluation of technological use for pedagogical effectiveness, encouraging regular iteration of technological and pedagogical interactions (Breines & Gallagher, 2023).

Methodology

Study Design

This research employed a mixed sequential design, incorporating both quantitative and qualitative data collection methods. The quantitative phase involved administering a questionnaire, followed by qualitative data collection through interviews with selected respondents. In this design, qualitative data primarily complement and enrich the quantitative findings, with integration typically occurring during data interpretation and discussion stages (Hanson et al., 2005). The quantitative approach utilized a self-administered questionnaire, adapted from existing TPACK instruments. Various methods exist for measuring TPACK, including standardized self-report scales, open-ended questionnaires, interviews, and performance assessments (Abbitt, 2011). Due to its straightforward nature and cost-effectiveness, this study opted for a self-reported method to collect quantitative data regarding instructors' use of digital technologies within the TPACK framework. For the qualitative component, interviews were conducted with instructors who had completed the questionnaire. This method aimed to validate the questionnaire data and gather diverse viewpoints and insights about the instructors' use of digital technologies in teaching and the challenges identified in the questionnaire.

Participant Selection

The study's participants encompass instructors registered within the Moodle system by June 2021. Out of the 500 instructors who were invited to participate through email, 111 instructors (39% females) representing diverse disciplines across 16 colleges of the University of Dar es Salaam completed the questionnaire. Additionally, 16 instructors (9 females) were purposefully selected to participate in follow-up interviews, offering a rich tapestry of viewpoints and experiences

Quantitative Data Collection

The quantitative aspect of the study centered on a self-administered questionnaire based on the TPACK framework. Comprising 17 items, the questionnaire covered dimensions such as Technological Knowledge (TK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK). While these items were adapted from the original TPACK instrument, their phrasing was tailored to fit the specific context of the University of Dar es Salaam. Respondents rated each statement

on a five-point Likert scale, from "Strongly Disagree" to "Strongly Agree," enabling a structured collection of views on their technological capabilities, content integration, pedagogical strategies, and the interplay among these elements.

Qualitative Data Collection

The qualitative data were collected through in-depth interviews with selected instructors. These interviews serve a twofold purpose: to validate the insights obtained from the questionnaires and to provide a comprehensive exploration of the intricacies surrounding instructors' utilization of digital technologies in teaching activities. The interview script is meticulously crafted based on the quantitative data collected, ensuring that follow-up questions are tailored to the specific contexts and nuances revealed through the survey.

Data Analysis

Quantitative data from the questionnaires were analyzed using the Statistical Package for the Social Sciences (SPSS). Key descriptive statistics such as means, frequencies, and percentages are computed and presented in diverse formats such as tables, graphs, and narratives. The interpretation of the TPACK-related data followed a weighted mean approach, categorizing participants' perceptions into distinct levels— "low," "moderate," or "high"—in line with the scaling framework suggested by (Yurdakul et al., 2012)

Findings

The study's findings encompass a range of thematic categories, addressing both technology use and non-use, institutional drivers of such use, incentives, and the core focus on technological and pedagogical knowledge and its impact on teaching practices. These findings highlight the dynamic nature of technology integration in the 'new normal,' revealing insights into the predominant applications used in teaching and administrative activities and underscoring technology as an enabler of pedagogical strategies and institutional adaptability amidst challenges.

Navigating the Technology Landscape

The new normal necessitated a reevaluation of instructional methodologies, leading to the provisioning of specific technologies to instructors. Notably, the prominent technologies provided included video conferencing applications, the Moodle platform, and a repository of open educational resources (OER). However, the findings underscore the nuanced nature of technology integration and non-integration, suggesting that this complexity extends beyond the confines of pedagogical practices to encompass multifaceted interactions encompassing individual behaviors, physical environments, and local cultures (Castañeda & Williamson, 2021). This study endeavors to contribute to unravelling this intricate web of relationships, ultimately fostering a more comprehensive understanding.

Video Conferencing applications

Instructors were asked to indicate the Web conferencing applications they mainly use for teaching activities and other related collaboration activities. Of the 111 instructors surveyed, 85% used Zoom, followed by Skype (37%), with GoToMeeting being the least used. However, the majority used these applications rarely (68%), with only 3% using them all the time. Interviews revealed challenges in managing online classrooms and unreliable Internet

connectivity, especially for undergraduate students. Despite these challenges, video conferencing was found useful for postgraduate activities, such as research defenses and student support, and for meetings. This is well illustrated in Figure 2.

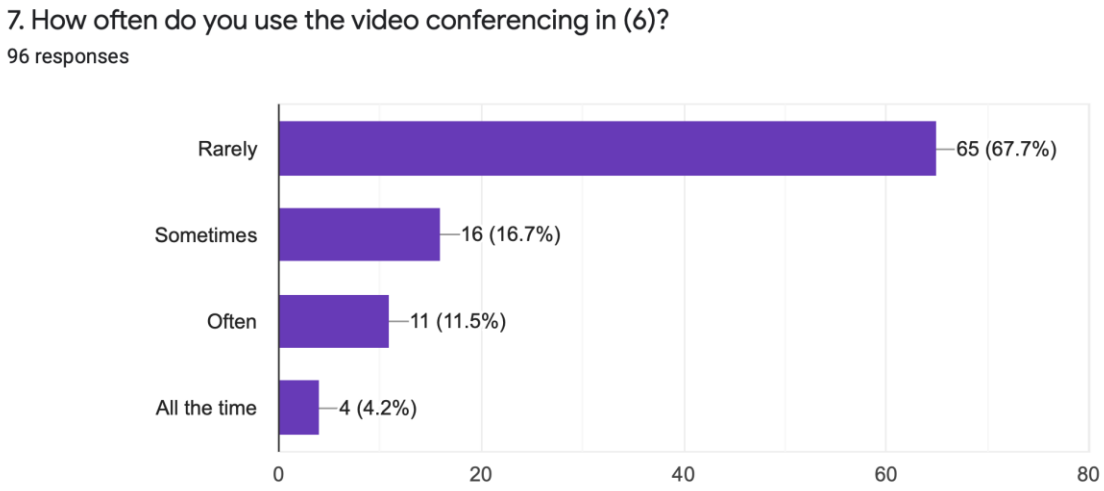

Figure 2: Frequency of use of video conferencing applications

When they were interviewed to find out how they use these applications, it was found that few instructors use these applications for teaching activities citing managing the classroom in an online session being a major challenge. Another limiting factor mentioned by many instructors was unreliable Internet connectivity, especially for undergraduate students. However, for those who use them, it was found that they helped facilitate postgraduate studies such as students' presentations, research defense ('I use ZOOM but not for teaching; we use it for research defense for postgraduate students'), and supporting students' research. In addition, some instructors used these applications for meetings (Because it helps me to participate in any meeting anytime, anywhere. Also, it helps to cut some of the movements from the office or home to the place where the meeting takes place').

Moodle

Central to the University's approach to the integration of technology in teaching and learning is the use of Moodle, a comprehensive learning management system adopted since 2008 (Twaakyondo & Munaku, 2012). The CoVID-19 pandemic prompted a renewed focus on university-wide training to equip instructors with the requisite skills for effective utilization of the Moodle platform. This deliberate effort aimed to ensure seamless knowledge transfer amid the global crisis. This study delved into the usage patterns of Moodle, shedding light on its role in the new normal's educational fabric.

In our research, our initial objective was to ascertain the number of courses that instructors uploaded to the Moodle system. Fascinating findings were revealed upon analyzing the courses that instructors had uploaded to Moodle. It was observed that about 54% of the

instructors were actively involved with the platform, with each uploading at least one course. Additionally, a significant 21% of the instructors went beyond this, each contributing more than two courses. Conversely, a small number of instructors (6%) had not uploaded any courses to Moodle. Figure 3 effectively illustrates the distribution of instructors in terms of the number of courses they uploaded to the Moodle platform.

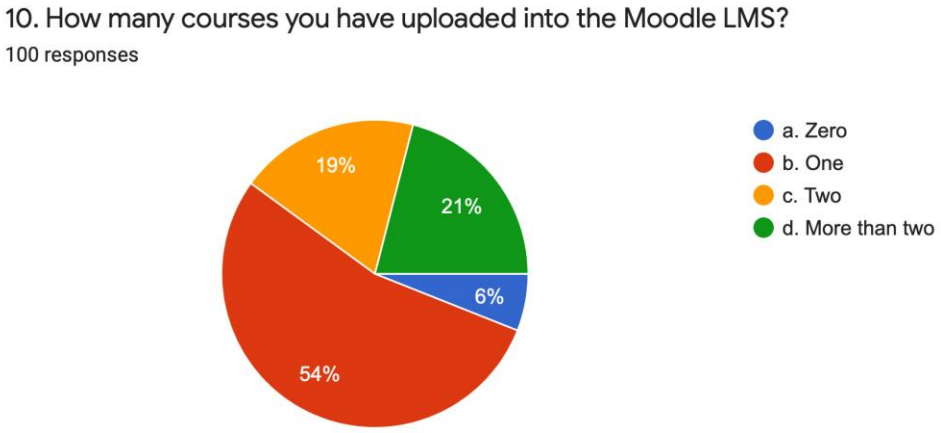

Figure 3: Percentage distribution of respondent use of Moodle system

Additionally, our research aimed to determine whether there was an increase in the usage of the Moodle system both before and during the CoVID-19 pandemic. Analysis reveals that a significant portion of instructors (81%) who currently utilize Moodle had already been using it prior to the onset of CoVID-19. In contrast, a smaller group of instructors (19%) began using the system amidst the pandemic. When inquired about their frequency of using Moodle for teaching and learning purposes, over half (64%) of the respondents who completed the survey reported using it often or occasionally. Only a small fraction of instructors (11%) stated they used it frequently.

In this work, we also sought to identify the most commonly used features within the Moodle system. According to the data presented in Figure 4, the feature predominantly used by instructors is the uploading of notes, with a substantial 70% utilizing it regularly. This is followed by discussion forums and assignment modules, utilized by 32% and 31% of the instructors respectively.

Interestingly, the study also uncovered that certain features of Moodle are significantly underutilized. The majority of instructors reported never using the wiki (84%), blog (74%), and chat (58%) functionalities. This finding suggests a potential area for further training or system enhancement to encourage broader usage of these interactive and collaborative tools, which could enhance the learning experience.

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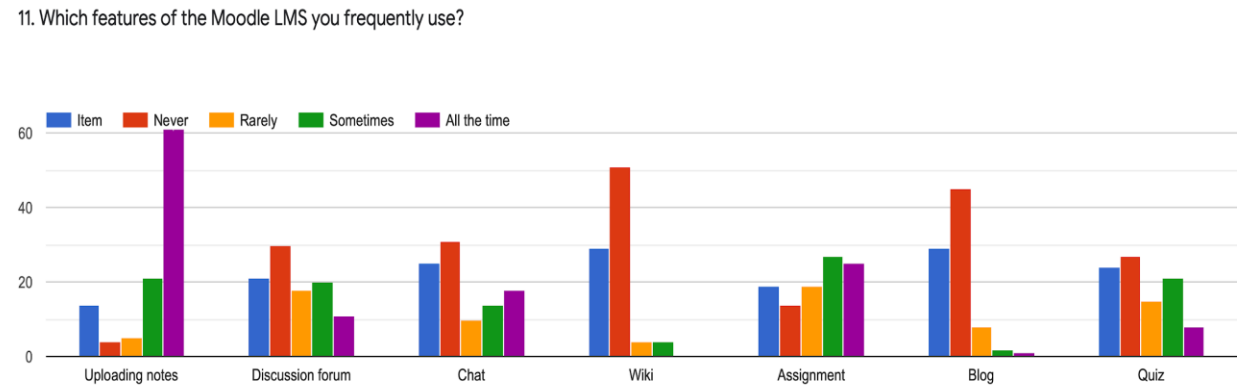

Figure 4: Use of Moodle by functionality

Open Educational Resources

The recent advent of open educational resources (OER) offers a significant opportunity to enhance the quality of learning materials uploaded into Moodle system. This study aimed to explore the extent of OER utilization by instructors to enrich course quality within the Moodle system. Our findings indicate a high level of engagement, with a notable 88% of instructors incorporating OER into their courses, while only a minority (12%) do not use these resources.

Among those who utilize OER, a substantial proportion (33%) reported frequent use (either always or often), while 31% indicated rare usage. This variation in usage frequency highlights the diverse approaches to integrating OER in academic settings. The study further investigated the specific types of OER preferred by instructors. Data revealed that PDFs and PowerPoint presentations are the most commonly used OER formats, with instructors regularly relying on them for course content. Conversely, audio and video resources emerged as the least used types of OER, suggesting possible barriers to their integration or a preference for more traditional formats.

Figure 5 in the study visually represents the percentage distribution of instructors' preferences for different types of OER.

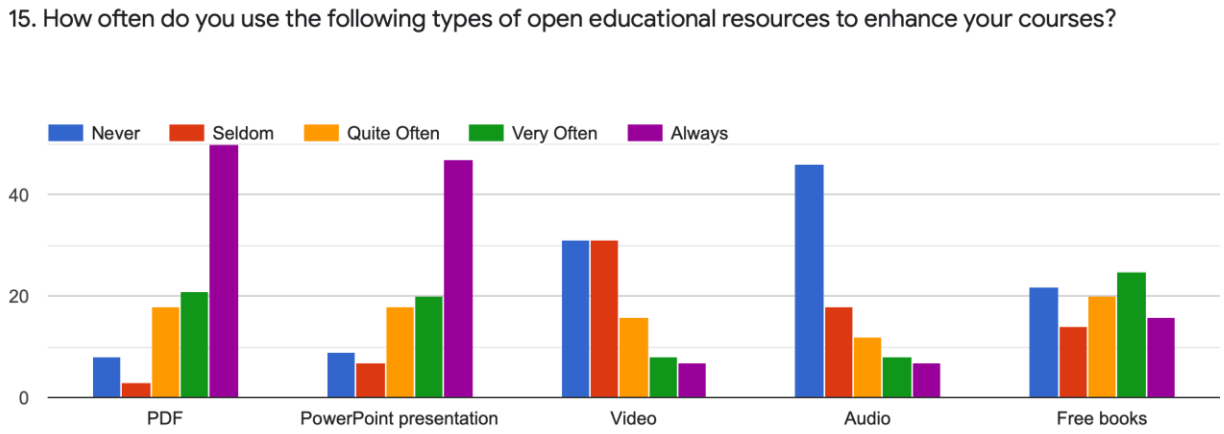

Figure 5: Percentage distribution of OER use by type of resource

In the course of conducting interviews for this study, a noteworthy trend emerged regarding the use of Moodle by instructors for disseminating learning materials to students. A significant number of instructors reported frequently utilizing Moodle as a platform for sharing various educational resources. These resources predominantly include PowerPoint presentations, lecture notes, and materials sourced from the Internet. Such practices highlight Moodle's role as a central repository and distribution point for course-related content. To provide a more understanding of this phenomenon, a selection of comments from the instructors is presented below.

> *For me, uploading notes enables me to share materials with students. These might be articles and PowerPoint presentations. Assignments allow the teacher to assess students and get feedback about a topic.* (Instructor 1)

> *I use materials from the Internet and share them with students in Moodle, for example, PowerPoint presentations. In addition, In case I find a good video from YouTube I share it with students via Moodle system, I just put a link.* (Instructor 7)

It was also noted that those with large classes, quizzes and assignments are the preferred features that enable instructors to administer assessments easily compared to face to face approach. For instance, one instructor commented:

> *Quizzes and assignment administration are simplified due to the huge number of students. I do not need to mark; the system marks automatically, so with my 400 students, I can set a quiz, and within a short time, I have all the marks from the system.* (Instructor 4)

For the features that are rarely used, many instructors pointed out that the lack of skills and awareness was the reason behind not using these features, suggesting the importance of technological knowledge on pedagogical execution. This lack of technological knowledge was centered on a lack of skill in using authoring applications as in the following.

> *I have never used the audio and free books because I am unaware of the technologies*

> *used to create them, particularly the audios. Similarly, I have not used the free books because I have no idea about the free books and the Open Educational Resources. I use videos very rarely.* (Instructor 9)

When awareness of a resource was present, a lack of technological knowledge to obtain the resource was lacking.

> *Lack of knowledge on the official location where such free books could be obtained. The UDSM Library could not provide links of free books which I could use to improve my course in the LMS.* (Instructor 6)

This suggests that technological knowledge is multi-faceted, involving both an awareness of a resource's existence, an awareness of where that resource can be found, and a technological capacity to use authoring applications to generate their pedagogical resources. The lack of this technological knowledge, particularly in these instances, inhibits any sort of pedagogical experimentation as the two (pedagogy and technology) are so closely intertwined.

Perceived incentives

In the realm of integrating digital technologies into teaching and learning, a significant challenge identified is the lack of appropriate incentives for instructors. This study identified the types of incentives that instructors deem necessary for effective use in their pedagogical practices. A predominant view among the instructors (78%) was the necessity for the University to provide technological devices as a fundamental incentive. Additionally, 41% of instructors cited financial incentives as crucial for facilitating the use of digital technologies in their teaching.

Notably, the prospect of incorporating the use of digital technologies as a criterion for academic promotion was perceived as a lesser incentive, with only 35% of instructors recognizing it as a motivating factor. This finding suggests a potential misalignment between institutional recognition strategies and the practical needs of instructors in the digital age.

Furthermore, the study revealed that instructors frequently rely on their personal resources, including internet bandwidth and personal devices, to develop and deliver quality educational content. This reliance underscores the necessity for institutional support to alleviate the financial and resource burdens borne by instructors. Such support, as indicated by the participants, could take the form of compensatory incentives to offset the costs associated with the use of digital technologies. Some of the instructors' comments are:

> *I put a lot of effort into creating course content and sometimes later the course was assigned to another lecturer who was not involved in creating the content in the system. I also use many resources to make the content. I use the Internet to create the course materials. So, we need incentives for what we do. They should compensate for the cost I use for the Internet.* (Instructor 3)
>
> *Because the preparation of online course materials is time-consuming, regular updating of online course materials is required and connectivity costs are involved, so it requires the devices and financial incentive.* (Instructor 1)

The instructors' responses during the interviews reinforced these perspectives, highlighting the critical intersection of resource availability, technological access, and pedagogical effectiveness. These insights collectively point to the need for a more supportive infrastructure that not only recognizes the use of digital technologies in teaching but also actively facilitates it through tangible incentives. This approach could lead to enhanced digital engagement in teaching practices, ultimately benefiting the educational process.

Technology Knowledge: Navigating Digital Possibilities

Technology Knowledge (TK) refers to instructors' understanding of the capabilities and limitations of digital technologies, coupled with the proficiency to employ these tools effectively (Koehler & Mishra, 2005). In this study, an analysis of instructors' self-reported competence levels in TK, as detailed in Table 1, revealed a notably high overall score (M=3.84).

To contextualize these findings, it is important to consider the established interpretive framework for mean scores: a mean score ranging from 1 to 2.33 is indicative of a "low" level of perception; a score between 2.34 and 3.67 signifies a "moderate" level of perception; and a score from 3.68 to 5.00 corresponds to a "high" level of perception, as delineated by Yurdakul *et al.*, (2012).

Particularly noteworthy in Table 1 is the instructors' self-assessment regarding their ability to rapidly learn and effectively utilize digital technologies. A significant number of instructors expressed confidence in their capacity to quickly adapt to new digital technologies, followed by possessing the necessary technical skills for their efficient use. This finding underscores a high level of technological literacy among instructors, reflecting their readiness to integrate digital tools into their pedagogical practices effectively.

Table 1: Weighted mean of instructors' responses on TK

	Weighted Mean
I have the technical skills to use digital technologies (e.g., LMS, web conferencing facility, OER) effectively	4.06
I can learn (e.g., LMS, web conferencing facility, OER) easily.	4.25
I know how to solve my technical problems when using (e.g., LMS, web conferencing facility, OER)	3.38
I keep up with important new digital technologies (e.g., LMS, web conferencing facility, OER).	3.66
Overall TK (M = 3.84)	

Although the weighted average indicated that instructors' self-reported competence on TK was high, using some features was still a challenge. Some of the comments from instructors are

shown below which indicate that technological knowledge here is directly impacting pedagogical application:

> *I face challenges in grading students' work in Moodle. I also face difficulties in integrating ZOOM and Learning Management Systems.*
> *Setting up tests/quizzes on an LMS takes a long time because there are so many tiny details to take care of before the test/quiz is ready* (Instructor 4)

Technology Pedagogical Knowledge

In addition to their technological skills, instructors were queried about their perception of the effectiveness of digital technologies and how these tools might transform their teaching methodologies. The results of this inquiry, as illustrated in Table 2, revealed that instructors' self-reported competence in Technological Pedagogical Knowledge (TPK) was assessed to be at a moderate level, with a mean score of 3.66. This evaluation aligns with the classification system proposed by Yurdakul et al. (2012), which categorizes mean scores in this range as moderate. Table 2 provides a detailed breakdown of the descriptive statistics for the instructors' responses to each item concerning TPK.

Table 2: Weighted mean of instructors' responses on TPK

	M
I can select digital technologies (e.g., LMS, web conferencing facility, OER) to use in courses that enhance what I teach, how I teach, and what students learn.	3.71
I can use strategies that combine content, technologies, and teaching approaches that I learned about in teaching my courses.	3.68
I can provide leadership in helping others to coordinate the use of the content, digital technologies, and teaching approaches at my department	3.59
I can design lessons that appropriately integrate content, digital technologies, and pedagogy for student-centered learning.	3.67
Overall TPK (M = 3.66)	

These statistics offer a nuanced view of how instructors perceive the intersection of technology and pedagogy, highlighting their understanding of the potential impact of digital technologies on their teaching practices. The moderate level of competence suggests a recognition of the importance of integrating technology in pedagogy, yet also indicates room for growth and further

development in this area.

An interview with selected instructors found that video conferencing applications such as Zoom, and Skype were used as a replacement for face-to-face teaching while sharing their lecture notes into Moodle. This was common for instructors who were teaching postgraduate courses. For instance, one instructor claimed:

> *Zoom supports live presentation during a lecture while Moodle enables me to share learning materials with my students that are used during live lectures and others obtained from the Internet. Both platforms allow chat sessions in the class, making my teaching activities easier.* (Instructor 4)

Another instructor commented:

> *I use PowerPoint presentations to share my Lecture notes. I teach in class and share the materials in the Learning Management System. I used a forum that promoted discussion among students.* (Instructor 8)

However, it was difficult to run video conferencing application classes for most of the undergraduate courses due to large class size and challenges related to Internet connectivity. In the Moodle system, discussion forums were preferred to facilitate asynchronous discussions with students. For instance, one instructor commended:

> *The majority of instructional approaches/methods are compatible with these technologies. I frequently utilize discussion methods or chats, and I am well-versed in creating many forms of discussion forums.* (Instructor 2)

Technology Content Knowledge

Technological Content Knowledge (TCK) is the understanding instructors have of how subject matter can be transformed through the application of digital technologies (Koehler & Mishra, 2005). This study sought to find instructors' self-confidence in their TCK, revealing a moderate level of self-assessed competence (M = 3.45), according to the evaluative scale developed by Yurdakul et al. (2012). Specifically, the study identified certain areas where instructors perceived their knowledge as less robust. Particularly, as indicated in Table 3, instructors reported lower confidence in their ability to use digital technologies to elucidate complex content within their courses. Additionally, their familiarity with the digital tools used by professionals in their respective fields also received a lower weighted mean score.

These findings suggest that while instructors recognize the potential of digital technologies to enhance subject matter delivery, there is a notable need for further development in their understanding and application of these tools, especially in contexts where complex course content is involved or where alignment with professional standards is required. The moderate overall confidence level in TCK points towards a significant opportunity for targeted professional development, aiming to deepen instructors' proficiency in integrating technology with subject matter expertise to optimize teaching outcomes.

University of Dar es Salaam Library Journal
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Table 3: Weighted mean of instructors' responses on TCK

	M
I know digital technologies (e.g., OER, MOOCs) for learning more content about the courses I teach	3.53
I know digital technologies and digital content (e.g., OER, MOOCs), which are used by professionals in the courses I teach.	3.42
I know digital technologies and digital content (e.g., OER, MOOCs), which I can use to understand better the content of the courses I teach	3.44
I know digital technologies and digital content (e.g., LMS, OER, MOOCs) which I can use to illustrate difficult content in the courses I teach	3.41
Overall TCK (M = 3.45)	

Technological Pedagogical Content Knowledge

According to the findings, instructors reported a moderate level of confidence in their TPACK abilities, with a mean score of 3.49. This assessment aligns with the evaluative scale developed by Yurdakul *et al.*, (2012). Based on Table 4, the instructors identified certain areas where they felt less adept. Notably, they expressed the lowest confidence in their ability to guide students in using digital technologies for constructing various forms of knowledge representation. Additionally, facilitating student collaboration activities through digital technologies was another area where instructors felt less proficient. Table 4 presents the descriptive statistics for instructors' responses to each TPACK component.

Table 4: Weighted mean of instructors' responses on TPACK

	M

I can facilitate my students to use digital technologies (e.g., LMS, OER, MOOCs) to find more information on their own.	3.50
I can facilitate my students to use technologies (e.g., LMS, OER, MOOCs) to plan and monitor their learning.	3.41
I can facilitate my students to use technologies (e.g., LMS, OER, MOOCs) to construct different forms of knowledge representation.	3.50
I can facilitate my students to collaborate with each other using (e.g., LMS, OER, MOOCs).	3.55
Overall TPACK (M = 3.49)	

These statistics offer a comprehensive view of instructors' perceived strengths and areas for improvement within the TPACK framework. The moderate overall confidence level suggests a recognition of the importance of integrating technology with pedagogy and content, yet also highlights the need for ongoing professional development to enhance these skills and apply them more effectively in the educational context.

Overall Results

In this study, a comparative analysis was conducted on instructors' self-reported confidence levels across four key domains of the Technological Pedagogical Content Knowledge (TPACK) framework. The domains under scrutiny were Technology Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and the comprehensive integration of these components, TPACK.

The findings revealed several patterns. Instructors reported a high level of confidence in their Technology Knowledge (TK), indicating strong proficiency in understanding and utilizing digital technologies. However, their self-assessed confidence in the other three domains of TPACK - namely, TPK, TCK, and the overarching TPACK integration - was categorized as moderate as shown in Figure 6.

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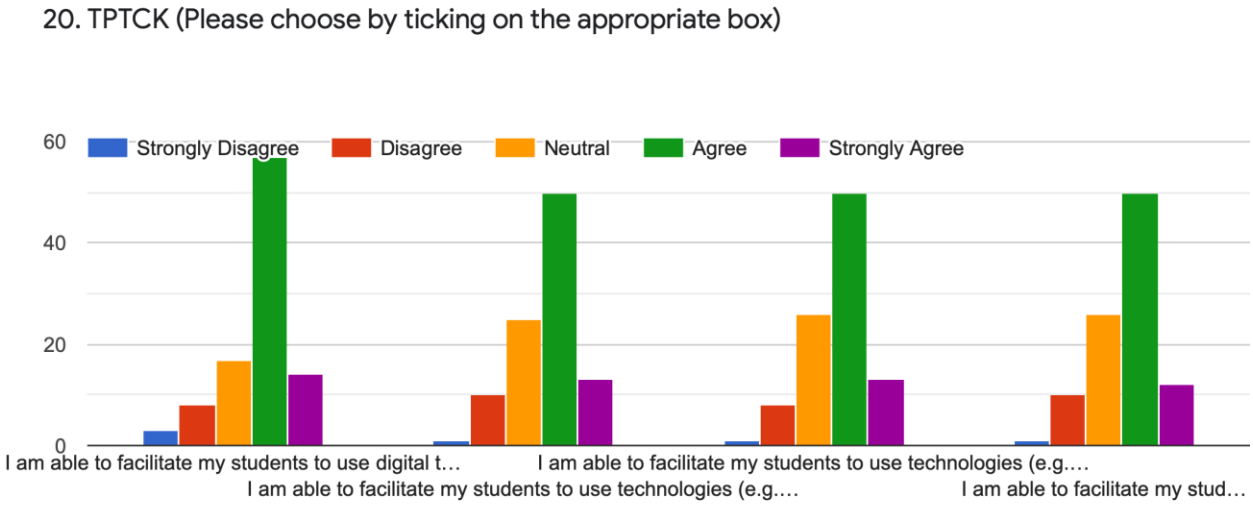

Figure 6: Overall instructors' responses on the TK, TPK, TCK, and TPACK domains

This disparity in confidence levels suggests that while instructors feel adept in the technical aspects of digital technologies, there is a perceived need for further development in effectively integrating these technologies with pedagogical strategies and subject matter expertise. The moderate confidence in TPK, TCK, and TPACK domains highlights potential areas for targeted professional development, aiming to enhance instructors' skills in the holistic application of technology in educational contexts. This insight is crucial for informing institutional strategies focused on fostering comprehensive technological literacy among educators.

Discussion

This study offers critical insights into the integration and application of TPACK during the COVID-19 pandemic, the 'New Normal'. The findings highlight the significant impact of TPACK in enhancing teaching effectiveness and student engagement in a digitally-driven academic environment, aligning with Mishra and Koehler's perspectives on the synergy between technology, pedagogy, and content.

A key observation from the study is the mixed proficiency of instructors in incorporating TPACK in their teaching methodologies. While there is a notable embrace of digital platforms such as Moodle and Zoom, challenges persist, primarily due to infrastructural limitations and the need for continuous professional development. This mirrors the observations by Koehler and Mishra (2005) regarding the complexities of applying digital technologies in educational settings. Similarly, the necessity of educators' competence in TPACK for effective technology integration is important as mere exposure to technology does not guarantee its successful pedagogical application (Voogt *et al.*, 2015). The disparity in TPACK skills among instructors could be further elucidated by the findings of (Tondeur *et al.*, 2017), who argue that factors such as prior experience, beliefs about teaching and learning, and institutional culture significantly influence educators' ability to integrate technology. The University of Dar es Salaam's long

journey in technology integration since 1998 (Twaakyondo & Munaku, 2012) has seen advancements, but the pandemic has expedited this process, echoing global trends towards online education. However, the COVID-19 pandemic has expedited this process, necessitating a rapid shift to digital teaching and learning methods. The findings indicate a substantial increase in the use of Moodle and other digital tools, echoing the global trend towards online education as a response to the pandemic (Hamilton & Friesen, 2013).

Despite progress, the study identifies barriers such as underutilization of certain Moodle features and uneven adoption of OER, suggesting a gap in technological knowledge among instructors. Additionally, these barriers could be due to a lack of training and support, as well as concerns about the quality and relevance of OER. These findings suggest a gap in technological knowledge among instructors, which is consistent with the challenges noted in the broader literature on technology integration in higher education (Breines & Gallagher, 2023; Mtebe, 2015)

While the study acknowledges the progress made, it also uncovers several impediments, including the limited use of specific features in Moodle and inconsistent implementation of Open Educational Resources (OER). This indicates a disparity in the technological proficiency of instructors. Such observations align with the challenges in integrating technology in higher education settings, as documented in the broader academic literature (Breines & Gallagher, 2023; Mtebe, 2015).

Additionally, these barriers could be attributed to a lack of adequate training and support for educators in utilizing these digital tools effectively, as suggested by Johnson (2016). Johnson emphasizes that without comprehensive training programs, educators might not fully exploit the capabilities of learning management systems like Moodle. Furthermore, the hesitancy in adopting OER can be linked to concerns about the quality and relevance of these resources, as noted by (Hilton *et al.,* 2013). They argue that addressing misconceptions about OER and providing guidance on its effective use are crucial steps in encouraging wider adoption.

The study further uncovers a noteworthy deficiency in adequate incentives for educators to comprehensively utilize digital teaching resources. This observation is in harmony with the research of Yurdakul *et al.,* (2012), which highlights the crucial role of institutional backing in fostering the effective integration of technology within educational frameworks. Moreover, this lack of motivation among instructors can be attributed to several factors, including insufficient training, lack of recognition, and inadequate technological resources (Ghasia *et al.,* 2021; Mtebe, 2015). These factors collectively impede the full-scale adoption and efficient use of digital tools in teaching practices.

Furthermore, the findings resonate with the broader discourse in educational technology, where scholars like Archambault and Barnett (2010) have noted that without proper incentives and support, educators may resist the transition to digital methodologies, regardless of the potential benefits. This resistance can be due to comfort with traditional teaching methods or a perception of digital technology as an additional workload rather than a facilitative tool (Ghasia et al., 2021; Tedre *et al.,* 2008).

To address these challenges, the study suggests the need for a multifaceted approach. This includes providing continuous professional development opportunities to enhance educators' digital literacy, aligning technology use with pedagogical goals, and recognizing and rewarding innovative teaching practices (Mtebe, 2020). Additionally, strategic investments in technology infrastructure and resources are essential to ensure that educators have the necessary tools to integrate technology effectively into their teaching (Bates & Sangra, 2011).

Conclusion

This study has illuminated the multifaceted nature of integrating Technological Pedagogical Content Knowledge in the era of COVID-19, often referred to as the 'New Normal'. The findings underscore the significant strides made by the University in embracing digital platforms such as Moodle and Zoom, which have been instrumental in navigating the challenges posed by the pandemic.

The research revealed that while there is a commendable level of engagement with these digital tools, disparities in their utilization point towards a need for enhanced professional development and infrastructure improvement. This echoes the concerns highlighted in the broader literature about the challenges of integrating technology in educational settings (Koehler & Mishra, 2005; Mtebe, 2015).

Moreover, the study's insights into the underutilization of certain Moodle features and the uneven adoption of Open Educational Resources (OER) reflect a gap in technological proficiency among instructors. This gap not only hampers the full potential of digital tools in enhancing teaching and learning but also indicates areas where additional training and resource allocation are necessary.

The University's proactive approach since 1998 in integrating technology into its teaching and learning processes, as well as the rapid adaptation to the pandemic-induced digital shift, demonstrates a commitment to maintaining educational quality and accessibility. However, the findings also highlight the importance of continuous innovation and support in ensuring that educators are well-equipped to utilize digital technologies effectively.

In conclusion, the University of Dar es Salaam, through its journey in the TPACK framework, offers a valuable model for other higher education institutions navigating similar challenges. The study's recommendations for ongoing professional development, infrastructural enhancements, and a focus on equitable access to technology are pivotal in shaping resilient and adaptable educational models in the face of global challenges like the COVID-19 pandemic.

Future Studies

Despite the findings from this study, suggestions for future research are explained. First, future research should investigate individual components of Technological Pedagogical Content Knowledge (TPACK) among instructors. A closer look at technological, pedagogical, and content knowledge would help identify specific strengths and areas needing development, guiding targeted training efforts. Additionally, conducting longitudinal studies to track the evolution of TPACK competencies over time would be valuable. This approach would provide insights into how educators' skills adapt to ongoing technological advancements and changing pedagogical landscapes, assessing the long-term impact of professional development programs.

In addition, future research could investigate the role of TPACK in non-traditional learning environments, such as online and blended learning contexts, which would provide valuable perspectives on the adaptability of the TPACK framework. This is especially relevant in the post-pandemic educational landscape where online and hybrid learning models have become increasingly prevalent. Lastly, analyzing the effectiveness of different instructor development programs in improving TPACK competencies can inform the creation of more impactful training modules and workshops, thereby enhancing the overall quality of education delivered by instructors.

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