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Usage patterns of Teachers' Continuous Professional Development Learning Management System in Primary schools in Tanzania

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Abstract

This study aims to understand how primary school teachers in Tanzania use the Teachers' Continuous Professional Development (TCPD) Learning Management System (LMS). There is currently limited information about how effectively the LMS supports teachers' ongoing professional development through structured Communities of Learning. Without clear data on usage patterns, it is difficult to identify barriers to access and measure the success of the LMS in improving teacher training. To fill this knowledge gap, the study examined LMS log data over a period of one year (July 2023–June 2024). It specifically looked at how often teachers logged into the system, which modules they enrolled in, what resources they accessed, and from which regions they logged in. The analysis revealed that usage was highest during key academic periods, such as the start of school terms and exam preparations, suggesting that teachers engage more actively with the LMS during these critical times. Teachers predominantly accessed practical modules, including those related to curriculum guidelines and foundational education training. This indicates that teachers prefer resources directly applicable to their teaching tasks. There was also a noticeable increase in LMS access through mobile devices, highlighting the growing importance of mobile technology in teacher professional development. However, significant challenges remain, such as limited internet connectivity and varying digital literacy levels, particularly in rural areas. These issues create obstacles for equitable LMS usage. The study recommends targeted efforts to enhance internet infrastructure, provide digital literacy training, and improve mobile accessibility. Addressing these challenges can increase the effectiveness of the TCPD LMS, ensuring equitable and widespread professional development support for primary school teachers across Tanzania.

Keywords: *Communities of Learning; Digital Literacy; Educational Outcomes; Educational Technology; Internet Infrastructure; Learning Management System; Teacher Collaboration*

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Introduction

The Ministry of Education, Science and Technology (MoEST) of Tanzania, in collaboration with the President's Office - Regional Administration and Local Government (PO-RALG) and the Tanzania Institute for Education (TIE), has been implementing the

Teachers' Continuous Professional Development (TCPD) program for primary education. This decentralized program is designed to facilitate teacher learning within schools and clusters, focusing on semi-structured Communities of Learning (CoLs) where teachers can gather weekly to discuss relevant school issues and improve their pedagogical skills (Koomar *et al.*, 2023). The TCPD program aims to build a culture of collaboration, reflection, and continuous improvement among teachers, ultimately enhancing student learning outcomes (Chachage and Thakrar, 2023). The importance of this program is underscored by research showing that ongoing, school-based professional development is more effective in improving teaching practices compared to traditional, one-off workshops (Chachage *et al.*, 2024).

The implementation of CoLs is supported by the use of the Learning Management System (LMS) which has been developed by TIE with technical assistance from EdTech Hub and the College of Information and Communication Technologies of the University of Dar es Salaam (Kondoro *et al.*, 2023). The LMS serves as a platform for teachers to access various professional development materials, participate in online training modules, and collaborate with peers through discussion forums and shared resources. The use of LMS in TCPD enhances the reach and effectiveness of professional development efforts by providing easy access to resources and facilitating continuous learning, regardless of geographical barriers. For example, teachers can engage with training materials and peer discussions asynchronously, allowing them to balance their professional development with their teaching responsibilities (World Bank, 2023). The integration of digital tools in CoLs not only supports the professional growth of teachers but also aligns with the broader goals of the National Framework for TCPD to leverage technology for improving educational outcomes across Tanzania (Koomar *et al.*, 2022).

The LMS was a customized open-source Moodle platform which is available under the General Public License to meet the specific needs of TCPD activities and primary school teachers. During the customization process, several user studies were conducted involving over 100 teachers from various regions, including Lindi, Kigoma, Mwanza, Arusha, and Dar es Salaam (Kondoro *et al.*, 2023). These studies provided valuable insights and requirements that guided the customization. As a result, the LMS now includes features such as multilingual support, with Swahili set as the default language, and a simplified login process that allows users to log in using their mobile phone numbers instead of email addresses. These enhancements ensure that the platform is more accessible and user-friendly for primary school teachers across Tanzania, ultimately supporting more effective and inclusive professional development.

The system is currently accessible through both web and mobile platforms, available at https://tcpd.tie.go.tz/. It serves over 120,000 teachers across all 26 regions of Tanzania, providing access to 37 modules. Among these modules are Communities of Learning modules and Self-Learning Modules (Maro *et al.*, 2024).

Although the system has been operational for over a year, key stakeholders—such as government institutions including MoEST, TIE, and PO-RAL), along with various partner organizations—have expressed interest in evaluating how actively and effectively teachers are using the platform. Understanding precisely how teachers engage with the system is essential for generating empirical evidence demonstrating the system's effectiveness in supporting the implementation of the TCPD program.

This study aims to analyze log data collected from the TCPD LMS focusing specifically on the usage patterns of primary school teachers across Tanzania. By examining these patterns, the study seeks to provide stakeholders with actionable, data-driven insights to guide informed decision-making related to the LMS. Ultimately, these findings will play a crucial role in identifying and addressing potential barriers, thereby optimizing system usage and enhancing the overall impact and effectiveness of the TCPD program.

Materials and Methods

The study utilized log data extracted from the TCPD LMS (https://tcpd.tie.go.tz/) to analyze

teachers' interactions with the platform. The system logs captured the following engagement metrics:

- Frequency of logins per month: The number of times teachers logged into the LMS each month.
- Page visits per month: The total number of pages accessed by teachers.
- Resource downloads: The number of times different resources (e.g., PDFs, videos, assessments) were downloaded.
- Module enrollments and access patterns: Identification of the most frequently accessed modules.
- Geographical usage distribution: Analysis of LMS access across different regions based on IP addresses.
- Web vs. Mobile access: Comparison of engagement levels between users accessing the LMS via web browsers and those using the mobile application.

Data extraction was conducted through secure database queries, ensuring the confidentiality and anonymity of user data. Personally identifiable information (e.g., usernames, emails, or phone numbers) was removed to comply with ethical research standards.

Formal approval for accessing and analyzing the data was obtained from TIE, which owns and manages the system. Access was restricted to authorized researchers, and all analyses adhered to data protection policies.

Data Analysis

The extracted data were processed and analyzed using Metabase, an open-source business intelligence tool. The following analytical steps were undertaken:

Usage Patterns Analysis

- Login trends: Monthly login trends were visualized to identify seasonal variations in system use, including peaks and dips in engagement.
- Regional login distribution: Logins were categorized by location using IP addresses, with data mapped to geographical regions using the IPInfo service.
- Time-based engagement: LMS usage variations were examined based on different academic periods (e.g., term starts, exam preparations, and holidays).

Content Engagement Analysis

- Most Accessed Modules: The study identified the top 10 most accessed modules by analyzing the number of enrollments and visits per module.
- Resource Access Patterns: Different content types, including videos, PDFs, discussion forums, and quizzes, were analyzed to determine their popularity.
- Download Frequency: The study assessed the number of times various resources were downloaded, indicating their perceived usefulness among teachers.

Device Access Analysis

- The study compared LMS engagement across different devices, distinguishing between web-based and mobile app access.
- Trends over a three-year period (2022 – 2024) were analyzed to assess shifts in platform preference.

Results

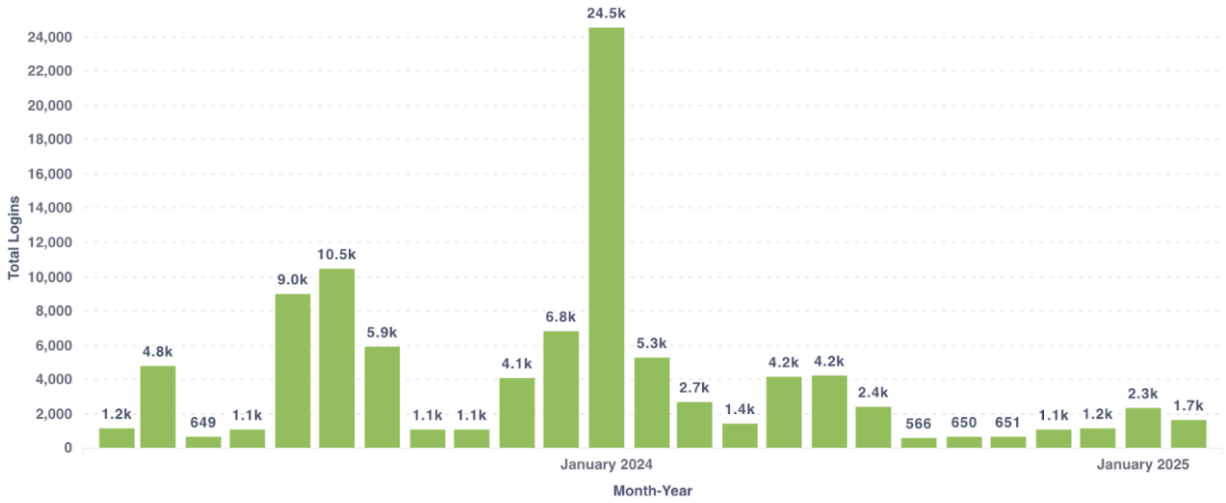
Analyzing Usage Patterns

Frequency of Logins per Month

It was found that logins per month for the January 2024 month (24,527) was the highest frequency compared to other months followed by July 2023 and December 2023. On the other hand, September 2023 and October 2023 had the lowest login frequency as shown in Figure 1.

Figure 1

Frequency of Logins per Month for 12 months for Teachers in Tanzania

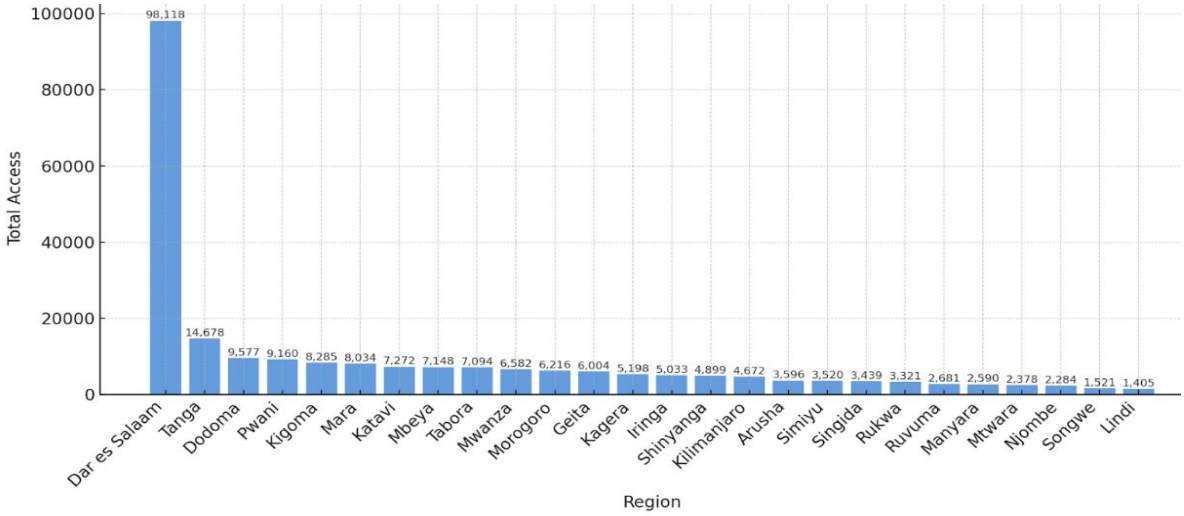


Frequency of Logins per Location

To illustrate user engagement across the country, user logins were categorized according to geographical regions. IP addresses were utilized to identify user locations, which were then accurately mapped to specific regions using the IPInfo service (IPinfo, 2018). Figure 2 shows the distribution of user logins by region, representing the percentage of system access per geographical area.

Figure 2

The percentage of users accessing the LMS per region in Tanzania



Content Engagement

The Most Accessed Modules

The findings of this research revealed the top 10 most accessed modules within the past 12 months, providing insights into teachers' preferences and needs in TCPD programs. As indicated in Table 3, the most accessed module was "*Miongozo Ya Utekelezaji Wa MEWAKA,*" with 17,914 enrollments. The second most accessed module was "*Mafunzo Elimu ya Msingi,*" which had 10,798 enrollments. The significant enrollment numbers for "*Miongozo Ya Utekelezaji Wa MEWAKA*" reflect its role as a comprehensive guideline outlining standardized procedures and policies required for all teachers participating in TCPD programs.

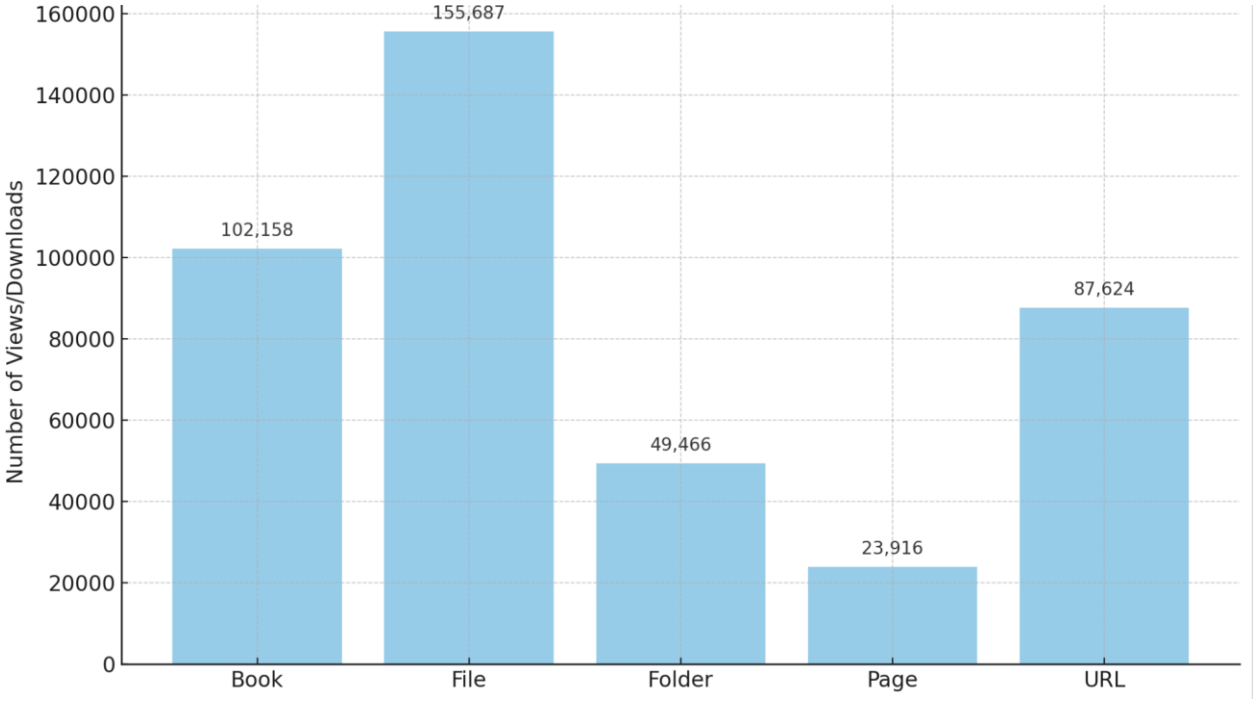
Table 1

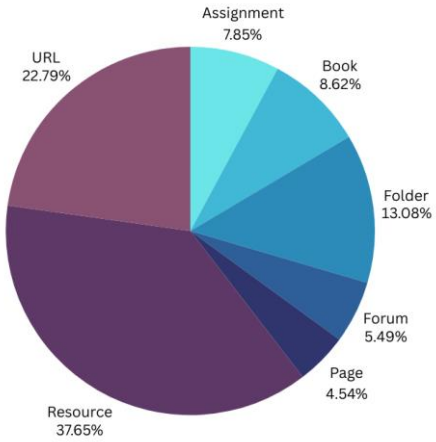
The most accessed modules in 12 months of the LMS in Tanzania

S/N	Module	Number of enrolments
1	Miongozo Ya Utekelezaji Wa MEWAKA	17,914
2	Mafunzo elimu ya msingi	10,798
3	Mafunzo MEMKWA	5,145
4	English language module	3,244
5	Mafunzo Elimu ya Awali	2,513
6	PHYSICS	2,003
7	Mafunzo ya Mtaala Mpya Darasa la Awali	1,917
8	Chemistry	1,660
9	Mwongozo wa Mwalimu wa Kufundishia Elimu ya Stadi za Maisha zinazolenga Afya ya Uzazi, VVU/UKIMWI na Jinsia kwa Elimu msingi Tanzania Bara	1,649
10	Basic Mathematics	1,601

Figure 3

Distribution of types of resource downloaded by users from the LMS in Tanzania





Type of Resources Accessed

To identify how teachers engaged with various types of content on the TCPD LMS, the frequency of resource access was retrieved from system logs. Teachers interacted with multiple types of resources, including assignments, books, folders, forums, pages, general resources, and URLs. Figure 3 illustrates the frequency of access for each resource type on the platform.

General resources were the most frequently accessed, recording a total of 155,687 interactions. These general resources include diverse educational materials such as documents and presentations, indicating their significance in teachers' professional development.

URLs were also accessed extensively, with over 87,624 interactions, suggesting that teachers

regularly engaged with external content integrated within the LMS.

Structured resources, such as content organized within folders, and assignments also showed notable engagement, highlighting that teachers actively interacted with organized and interactive content, which facilitated applied learning and participation in professional development activities.

Number of Downloads

The distribution of downloads for different modules on the TCPD LMS reveals varying levels of interest and need among teachers, reflecting the overall total of 18,573 downloads over the past 12 months. As indicated in Table 2, the "Curriculum and Syllabus for Pre-Primary Education (English Medium)" module, with 4,043 downloads, stands out as the most downloaded resource. This high download count likely results from significant changes in content and pedagogy in the new curriculum for pre-primary and primary education. Consequently, this module has been crucial in orienting teachers to the new curriculum thereby supporting their ability to implement these changes effectively.

Table 2

Top 10 downloaded modules in 12 months

S/N	Module	Number of downloads
1	Curriculum and Syllabus for Pre - Primary Education (English Medium)	4,043
2	Mwongozo wa Kutekeleza Mafunzo ya Mewaka	326
3	Mwongozo wa Kusimamia Utekelezaji wa Mpango wa Mafunzo Endelevu kwa Walimu Kazini	326
4	Kiongozi cha mwalimu Sayansi na Teknolojia	300
5	Moduli ya Ufundishaji Mahiri	268
6	Upimaji na Tathmini	261
7	Kiongozi cha mwalimu English	247
8	Kiongozi cha mwalimu Sayansi na Teknolojia	228
9	Ujifunzaji na Ufundishaji	225
10	Matini ya Mwezeshaji Rika	214

The other modules, such as "Mwongozo wa Kutekeleza Mafunzo ya Mewaka" and "Mwongozo wa Kusimamia Utekelezaji wa Mpango wa Mafunzo Endelevu kwa Walimu Kazini," each with 326 downloads, have high download count and this could be due to the fact that these are modules that are compulsory for every teacher in implementing the TCPD program. These guides offer essential instructions for implementing TCPD programs and ensuring compliance with new education policy and revised pre-primary, primary and secondary education.

Subject-specific teaching guides, such as "Kiongozi cha Mwalimu Sayansi na Teknolojia" (300 downloads) and "Kiongozi cha Mwalimu English" (247 downloads), have recorded a significant number of downloads. This high download rate likely reflects the essential role these resources play in equipping teachers with the specialized content knowledge and instructional strategies needed for subjects that are often considered challenging, both for

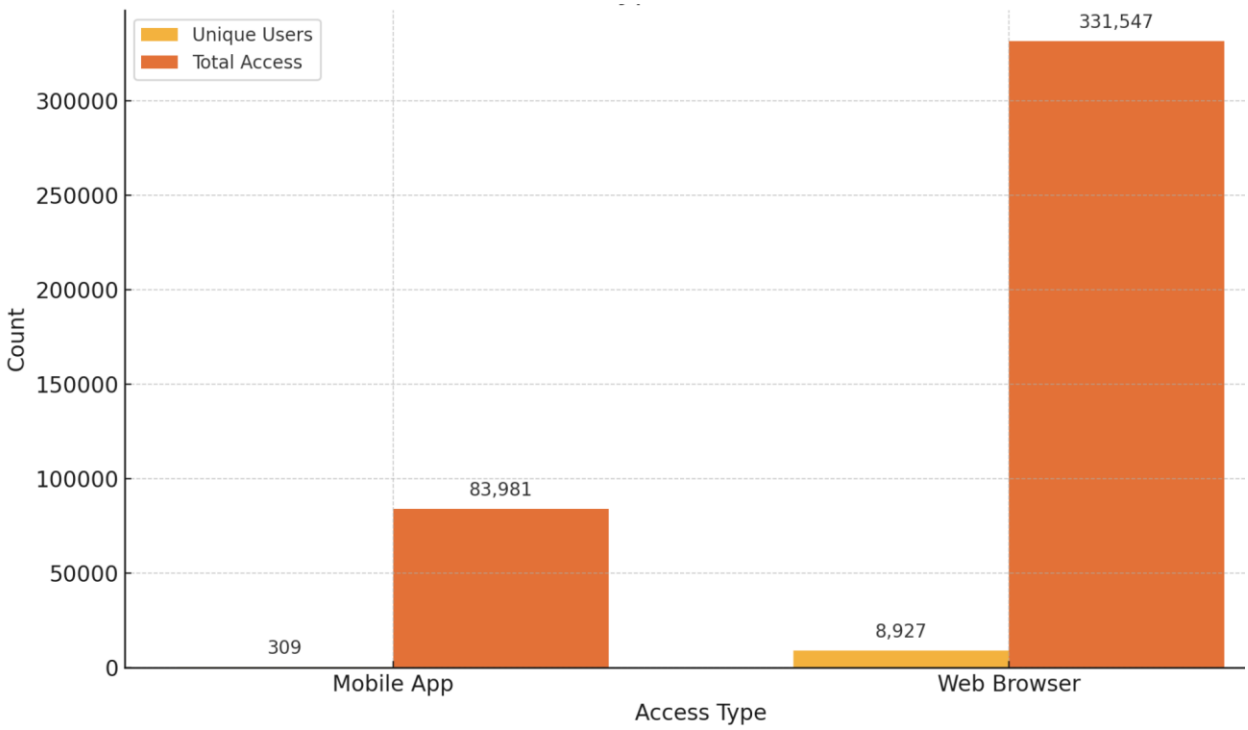
educators and students.In contrast, the "Matini ya Mwezeshaji Rika" module, with only 214 downloads, had the lowest download rate among the top 10 modules. This lower engagement could suggest that peer learning sessions are less frequent or that there is a smaller pool of teachers assigned as peer facilitators.

Access Method

Users were categorized based on their access method, either via web (desktop, tablet and mobile) or mobile app, and the total number of records for each category was calculated. This approach provides a clear comparison of the engagement levels between the two platforms. Figure 4 shows the summary of the web versus mobile app access for the past 3-year period (2022 - 2024). The dataset includes the number of unique users accessing the LMS via web/mobile unique users and the total number of access via web/mobile total access for each year.

Figure 4

Web vs Mobile Users and Access for a 3-year period in Tanzania



The data on access type in the TCPD LMS over the past twelve months reveals a clear preference among teachers. Web browser access was significantly higher, with 331547 accesses, compared to 83,981 accesses through the mobile app. This indicates that most teachers preferred using desktop or laptop devices when interacting with the LMS.

Discussion

The analysis of teachers' usage patterns of the TCPD LMS in primary schools across Tanzania provides key insights into the factors influencing the system's utilization for professional development activities. One of the most significant findings is the pronounced impact of the academic calendar on LMS engagement. The observed seasonal variations in login frequencies, with peaks in January 2024 (24,527 logins), July

2023 (6,424 logins), and December 2023 (6,807 logins), coincide with critical academic periods such as the commencement of new terms, holiday preparation, and TCPD workshops. Conversely, lower login counts in September 2023 (1,059 logins) and October 2023 (1,069 logins) can be attributed to mid-term periods when teachers are more focused on classroom activities rather than using the system for TCPD engagement. Similarly, the dip in April 2024 (1,403 logins) aligns with the Easter holiday period, during which schools are typically closed, leading to reduced LMS activities.

There are two primary explanations for these trends. The first explanation is that the seasonal academic calendar and school terms influence LMS login frequencies among primary school teachers. The notable spike in January 2024 aligns with the start of the new academic year, when teachers access new curriculum updates, training materials, and preparatory resources. Similarly, December 2023, despite being a holiday month, exhibits higher login activity as teachers prepare for the upcoming school term. This pattern is consistent with findings from Mwalumbwe and Mtebe (2017) and Park and Jo (2017), who noted that LMS usage surges during academic preparation periods.

The second explanation relates to teachers accessing training modules and educational resources during TCPD workshops. Higher login counts in July 2023 and November 2023 may reflect periods when teachers were participating in these structured training sessions, which are often scheduled at these times to avoid disruption to regular classroom instruction. This aligns with research from Chachage *et al.* (2024), who observed that LMS engagement increased in response to structured learning interventions. Schools may be actively encouraging teachers to engage with LMS content during these workshops, further reinforcing engagement during these months.

Another critical finding is the disparity in LMS access across different regions in Tanzania, which is largely attributable to differences in internet infrastructure. LMS usage was higher in urban areas such as Dar es Salaam (14.2%), Tabora (9.4%), and Mwanza (6.4%), correlating with their superior internet infrastructure (Tanzania Communications Regulatory Authority [TCRA], 2024). According to TCRA (2024), Dar es Salaam, with over 14 million active telecom subscriptions, alongside Mwanza and Tabora, ranks among the top regions in terms of connectivity. In contrast, regions with lower LMS access, such as Rukwa (1.0%) and Songwe (1.5%), face severe limitations due to inadequate internet infrastructure. The scarcity of telecom towers and base transceiver stations (BTS) in these regions severely restricts connectivity and LMS access. For instance, Rukwa has only 327 telecom towers, significantly fewer than Dar es Salaam's 1,158 towers, further exacerbating the disparity in LMS adoption (TCRA, 2024). This infrastructural gap remains a fundamental challenge to equitable access to digital educational resources.

Beyond infrastructure, another factor contributing to the regional disparity in LMS access is the variation in digital literacy levels among teachers. Previous research indicates that teachers in rural areas tend to have lower ICT competencies than their urban counterparts (Lin *et al.,* 2023). The study by D'souza and Kumari (2016) further supports this, showing a positive correlation between secondary school teachers' digital literacy levels and their ICT usage in teaching. Given that effective LMS utilization requires a foundational level of digital literacy, targeted digital skills training for teachers in rural areas could help bridge this gap and enhance equitable LMS adoption.

The study also highlights the high engagement with specific LMS modules, particularly those related to curriculum guidelines and foundational education training. The increased engagement with these modules can be attributed to their critical role in supporting the implementation of the new curricula for pre-primary and Standard III education, which commenced in January 2024. These modules provided essential resources to help teachers understand and adapt to curriculum changes, ensuring they were well-prepared for effective implementation. Consequently, the relevance and timeliness of these modules contributed significantly to their high accessibility and usage among teachers.

Other notable modules include "Mafunzo MEMKWA," ranking third with 5,145

enrollments, and the "English Language Module," ranking fourth with 3,244 enrollments. These modules address specific educational needs by providing specialized training for teachers. The "Mafunzo MEMKWA" module is particularly critical as it supports the education of students who have been outside the formal education system, often due to various socio-economic factors. Teachers are strongly encouraged to utilize this module to better assist these students, which has led to its prominence as one of the most accessed modules. Similarly, the English Language Module provides targeted support for teachers seeking to improve their instructional competencies in English, which remains a crucial subject in the national curriculum.

An emerging trend in LMS engagement is the increasing adoption of mobile platforms among teachers. The rise in mobile access in 2024 reflects broader trends in educational technology, where mobile learning has become a convenient alternative, particularly in areas with limited desktop access (Mwalumbwe and Mtebe, 2017). This finding aligns with Whitmer (2012), who reported that mobile-friendly LMS platforms significantly enhance user engagement. However, despite the potential of mobile access, Chachage *et al.* (2024) noted that connectivity issues and the cost of mobile data remain significant barriers, with many teachers relying on personal mobile data to access TCPD materials. This highlights the need for policy interventions, such as zero-rated internet for teachers, to ensure that mobile access can be fully leveraged for sustained LMS engagement.

Overall, this study provides valuable empirical evidence on the factors influencing LMS usage in primary school professional development. The alignment of login patterns with academic cycles, the impact of regional infrastructure on access, and the importance of content relevance all point to the necessity of a nuanced approach to LMS implementation. Moreover, addressing regional disparities in digital literacy and connectivity is crucial to ensuring equitable engagement. Policymakers and educational stakeholders should consider these factors when designing digital learning platforms to support teachers' professional development.

To improve the TCPD LMS, it is important to invest in better infrastructure, provide digital literacy training, and make it easier to use on mobile devices. Solving these issues will help the TCPD program better support teachers, leading to improved education across Tanzania.

Future studies should focus on creating ways to keep teachers actively using the LMS throughout the school year. Continuous use of the LMS will help it become a regular tool for ongoing professional development, not just something used occasionally. Research supports this approach, showing that these improvements will make the TCPD LMS a valuable resource for teachers, similar to successful examples seen in secondary and higher education.

Conclusion

This study has provided valuable insights into the usage patterns of the TCPD LMS among primary school teachers in Tanzania, revealing key factors that influence the effectiveness of the system in supporting TCPD activities. The analysis showed that seasonal variations in login frequencies are strongly linked to the academic calendar, with increased engagement during critical periods such as the start of new terms and exam preparations. This finding underscores the importance of aligning LMS content and activities with teachers' immediate professional needs to maximize engagement and utility.

Furthermore, the study highlighted significant disparities in LMS access across different regions, with better-connected areas such as Dar es Salaam showing higher usage compared to regions with limited infrastructure like Rukwa. This disparity emphasizes the crucial role of infrastructure in the effective deployment of digital platforms for education. While strategies such as the provision of offline content have mitigated some of these challenges, the need for enhanced connectivity remains a priority to ensure equitable access to educational resources across all regions.

Lastly, the findings demonstrate that teachers are highly engaged with practical, directly applicable LMS modules, particularly those related to curriculum guidelines and foundational

education training. This preference for relevant content, combined with the growing trend of mobile platform adoption, suggests that the continued development and optimization of both content and access methods are essential for sustaining and expanding the impact of the TCPD LMS. Future efforts should focus on addressing the identified challenges, such as improving infrastructure and mobile access, to further enhance the effectiveness of the TCPD program and ultimately improve educational outcomes in Tanzania.

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