

# Primary school teachers using mobile smartphone applications for professional development in Monduli District, Arusha Region

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**Abstract.** This study explored the challenges primary school teachers face in incorporating mobile smartphone applications into their professional development in Monduli District, Tanzania. Using a mixed-methods approach, the research combined quantitative data from structured questionnaires with qualitative insights from face-to-face interviews. 68 teachers, chosen through simple random and purposive sampling, participated from ten government primary schools. Quantitative data were analysed using descriptive statistics in SPSS, while qualitative data underwent thematic analysis to identify significant patterns. Results show that although mobile applications have the potential to support professional learning, their adoption is limited by several challenges, including restricted internet access (mean = 1.85), high data costs, a lack of digital training (mean = 1.66), and inconsistent access to development programmes. Interview responses highlighted the roles of school leadership, peer collaboration, and recognition in influencing teachers' utilisation of mobile tools. The study emphasises the necessity for context-specific interventions, such as enhancing digital infrastructure, providing affordable internet packages for educators, and offering regular, ongoing training programmes. The findings contribute to both local and global conversations on mobile learning, providing theoretical, practical, and methodological insights for education policymakers and stakeholders.

**Keywords:** challenges, mobile smartphone, professional development, primary school teachers

## 1. Introduction

Education continues to evolve as new technologies emerge [26]. Mobile applications are now a big part of learning in today's digital world. Integrating mobile applications into education underscores the importance of their potential to revolutionise learning [24]. In Greece, the efforts rely on developing computational thinking (CT) and coding skills among young children; as a result, appropriate mobile applications are increasingly practical in cultivating these skills at preschool and pre-primary levels. Though many apps claim educational value, only a limited number are genuinely designed to foster CT fluency in early learners. Therefore, Teachers should be careful when selecting mobile applications, ensuring they are research-based, developmentally appropriate, and support learning goals, particularly in areas such as CT and STEM [21].

Further research in Greece reveals that, while many teacher training institutions provide basic technical instruction, there is often a significant gap in pedagogical training. Many teachers may know how to operate mobile devices but often lack the necessary skills to integrate them meaningfully into their teaching practices [9]. From the Turkish context, the study shows a strong link between academic self-efficacy, professional motivation, classroom management anxiety, and attitudes toward

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Received	Accepted	Published	Version of record
2025-05-19	2025-09-05	2025-09-16	2026-03-21



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teaching. Notably, teachers with positive professional attitudes also reported higher anxiety about managing classrooms [10].

Previous studies in Africa have highlighted infrastructural and economic challenges as key barriers to adopting mobile learning [16, 17]. In Kenya, research shows that teachers' limited digital literacy and training constrain effective use of ICT tools [19]. In Tanzania, however, little is known about how these challenges manifest locally in rural districts such as Monduli. Primary school teachers face significant challenges in utilising mobile smartphone applications for professional development. While mobile devices can provide real-time access to instructional materials, pedagogical strategies, and interactive learning tools, their potential remains underutilised [23]. In areas such as Monduli District Council in the Arusha Region, geographical barriers, limited access to resources, and insufficient training opportunities hinder teachers' ability to engage in continuous professional development [8]. Despite the government's efforts to integrate digital devices into education through the ICT Policy for Basic Education, the practical application of mobile smartphone applications remains challenging for many educators [16].

One key challenge is the limited digital literacy among some teachers. Without proper training on how to use mobile applications effectively, educators may struggle to navigate digital platforms and utilise them for professional growth [2]. Moreover, restricted internet connectivity and inadequate infrastructure, especially in rural areas, further limit access to online resources and interactive learning opportunities [18]. Financial constraints also present a barrier, as some teachers might be unable to afford smartphones, mobile data, or subscription-based applications [22]. Even when devices are available, the expense of maintaining internet access can be a significant obstacle.

Furthermore, the absence of institutional support and guidance discourages teachers from using mobile smartphone applications for professional development. Many educators lack mentorship or professional networks to help them explore the potential of digital tools in enhancing their teaching practices [15]. Teachers' attitudes and perceptions also play a role. Some may resist adopting new technologies due to unfamiliarity or scepticism about their effectiveness [1]. Additionally, the lack of locally relevant content on mobile applications limits their applicability in the Tanzanian educational context [20].

Although prior research has consistently identified challenges such as poor infrastructure, high data costs, and limited training opportunities as significant barriers to mobile learning for educators, these studies often overlook how such factors interact within rural Tanzanian settings. Moreover, a limited understanding of how teachers perceive and experience these challenges firsthand exists. This gap in the literature forms the basis for the central research question of this study: *What challenges do primary school teachers encounter when utilising mobile smartphone applications for professional development in Monduli District?*

## 2. Theoretical framework

The study was guided by the technology acceptance model (TAM). The TAM comprises various components that represent the process of users' acceptance of ICT. The process includes behavioural intention, perceived usefulness, and perceived ease of use (figure 1). While perceived usefulness refers to the degree to which a person believes in the benefit of using a particular technology, perceived ease of use refers to the importance of the technology in being user-friendly for the users [13]. Generally, TAM was developed to measure the effectiveness or success of technology in helping users understand the value and efficacy of a particular system. It is also considered one of the most influential theories in contemporary information systems research [12]. However, the theory has evolved, with more specific variables explaining how a user can accept a technology.

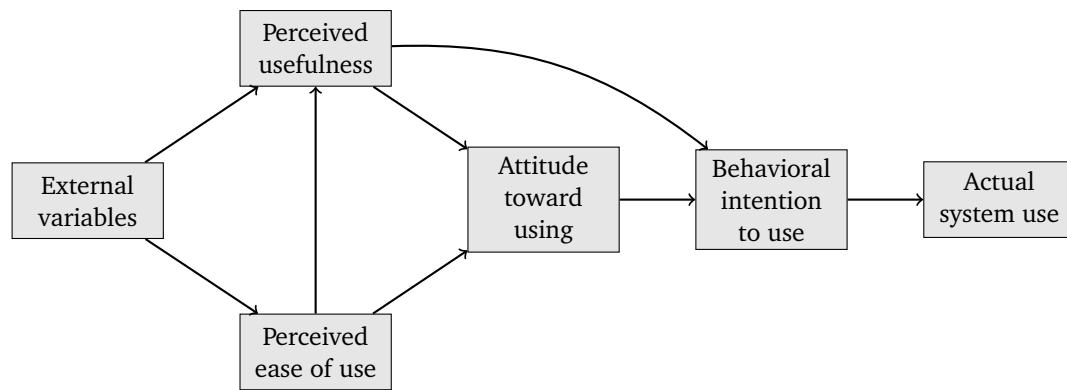


Figure 1: Technology acceptance model (adapted from [25]).

### 3. Methods

#### 3.1. Research approach and research design

The current study employed embedded procedures within a mixed-method research approach, in which the researcher sought to collect qualitative and quantitative data simultaneously, with quantitative data supporting the qualitative data. Therefore, the study employed two research methods of data collection: interviews and questionnaires. These data collection methods were intended for complementary purposes [4].

#### 3.2. Participants

The population of this study consisted of all primary school teachers in Monduli District Council, focusing on ten peripheral primary schools: Enguiki Primary School, Laiboni Primary School, Lengijape Primary School, Lepurko Primary School, Losikito Primary School, Mfereji Primary School, Monduli Juu Primary School, Mswakini Juu Primary School, and Mti Mmoja Primary School, with a total of 82 teachers. The primary aim of the pilot was to encourage the use of mobile smartphones by examining teachers' knowledge of how to use them for professional development. Specifically, the study identified challenges in choosing and using mobile smartphone applications for professional development.

The sampling unit of this study was purposively selected based on the information required from respondents. The sample size was calculated using Slovin's formula  $n = N / (1 + N \cdot e^2)$ , where  $n$  is the sample size,  $N$  is the total population size, and  $e$  is the desired margin of error (commonly 0.05 for a 95% confidence level). For  $N = 82$  and  $e = 0.05$ ,  $n \approx 68$ .

68 primary school teachers were drawn from selected government schools within Monduli District, located in the Arusha Region of northern Tanzania. The sample size was determined based on practical and ethical considerations, including participant accessibility, resource availability, and formal permissions from relevant educational authorities. Although the study does not aim to represent all primary school teachers across Tanzania statistically, the selected sample offers a credible and contextually grounded basis for exploring the challenges and opportunities associated with mobile learning in a district-level rural setting [5].

During the quantitative data collection phase, simple random sampling was employed to select classroom teachers who owned or had regular smartphone access. A complete list of eligible teachers was compiled from school records obtained through collaboration with school heads. Each teacher was assigned a unique identification number, and selection was conducted using a random number generator in Microsoft Excel. This procedure ensured that all qualified participants had an equal chance of being selected, thereby minimising selection bias and enhancing the study's internal validity [11].

For the qualitative component, purposive sampling was employed to select and interview headteachers as key informants. Their inclusion was based on their formal administrative and instructional roles outlined by the Tanzania Ministry of Education, Science and Technology in the School Management Guidelines. According to these guidelines, headteachers are responsible for overseeing curriculum implementation, supporting teacher professional development, and managing the use of school resources, including ICT tools. Their strategic leadership perspectives offered valuable insights into how mobile applications are, or are not, being incorporated into teacher learning and broader school management practices.

It is important to acknowledge that while the sample selection was systematic and appropriate for the study's scope, it may not fully reflect teachers' experiences across Tanzania. Monduli is a largely rural area, and the challenges encountered there, such as limited infrastructure, economic constraints, and cultural factors like language and nomadic lifestyles, may differ from those in urban or better-resourced regions. However, since many Tanzanian schools operate in similar rural conditions, the findings from this district still offer relevant insights for national education planning and policy development.

### **3.3. Research instruments and measures**

Teachers were given an open-ended questionnaire to gather demographic information and background details. The second part of the questionnaire included closed-ended statements to identify teachers' knowledge gaps in mobile phone applications. A five-point Likert scale was used (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

The questionnaire was developed based on established instruments from similar studies and adapted to the Tanzanian context. This method was considered suitable for gathering in-depth information regarding teachers' experiences, opinions, and attitudes [4]. The interviews helped to explore the effectiveness of selected mobile phone applications as instructional tools and to identify sustainable strategies to enhance teachers' competence in using mobile technology for teaching. Interview sessions were conducted after receiving participants' consent and were audio-recorded using a tape recorder. All recorded interviews were later transcribed and analysed thematically [22].

### **3.4. Validity and reliability**

The tests and questionnaires were thoroughly reviewed and refined before being employed in the field to ensure that the tools utilised in this study were both valid and reliable. The initial step involved evaluating each item for clarity, appropriate language, and relevance to the study's aims. This process helped identify any confusing or repetitive questions early on. Subsequently, the instruments were shared with four experienced education experts – two from the University of Dodoma and two from the University of Dar es Salaam. Their insightful feedback enhanced the content and confirmed that the questions were appropriate within the context of Tanzanian primary education. This expert input was crucial in reinforcing the validity of the tools' content.

To further evaluate the effectiveness of the tools in practice, a pilot study was conducted in Enguiki Primary School and Laiboni Primary School. Ten teachers participated in this small trial, helping to assess how well the questions were understood and whether any adjustments were necessary. Their involvement was vital in identifying areas that required refinement before the main study commenced.

### **3.5. Data analysis process**

This study adopted a mixed-methods approach, integrating quantitative and qualitative techniques to understand the research problem comprehensively. Given the complexity of analysing data from different methodologies, careful consideration was given to selecting appropriate analytical tools for each data type. Quantitative data, derived from closed-ended questionnaires, were analysed

using the Statistical Package for Social Sciences (SPSS), version 26. Descriptive statistics were used to summarise and interpret the data, including means, standard deviations, frequencies, and percentages. For qualitative data, thematic analysis was used to examine interview responses. This involved coding the data, identifying recurring patterns, and developing key themes. The findings were presented narratively and supported by relevant literature. To enhance credibility, validation strategies such as triangulation and member checking were applied [3]. This process ensured the findings were accurate and grounded in participants' experiences.

#### **4. Results and discussion**

This study examined primary school teachers' challenges in using mobile smartphone applications for professional development within the Monduli District Council. Through a combined analysis of quantitative survey results and qualitative interview narratives, the study identified four key barriers: inadequate internet access, high data costs, insufficient training, and limited access to training opportunities. These are now interpreted through the lens of the TAM, which provides a theoretical foundation for understanding low adoption rates.

##### **4.1. Internet access as a barrier**

One of the most pressing challenges is the lack of reliable Internet access. When asked whether they have reliable internet access to use mobile smartphone applications for professional development, most respondents strongly disagreed (30 respondents) or disagreed (25 respondents), totalling 80.9% of the participants. The mean score of 1.85 confirms that internet connectivity is a significant issue for most teachers. Through an interview, it was revealed that:

Most of the time, we struggle even to open a basic teaching website. Without reliable internet, it is hard to explore apps or take online training. (Respondent 4, 14th October 2023)

This situation diminishes the perceived usefulness (PU) of mobile applications. When technology is seen as inaccessible or unreliable, its perceived benefits become irrelevant. Teachers may believe that the apps could be helpful, but conclude that such tools are impractical in their context. This challenge suggests that poor infrastructure and limited internet coverage severely restrict teachers' access to online resources and their ability to engage in digital learning. The limited access to stable Internet limits professional growth and reduces the opportunities for teachers to adopt innovative teaching methods facilitated by mobile technology.

This finding mirrors that of Kabasiita et al. [7], who emphasised the negative impact of unreliable internet on ICT use in education. The inability to access reliable connections prevents teachers from downloading learning materials, participating in webinars, or collaborating with peers. Rural teachers are disproportionately affected, widening the digital divide compared to their urban counterparts with better connectivity. Equitable access will remain out of reach without targeted interventions, such as community Wi-Fi hubs or partnerships with telecom providers.

##### **4.2. High cost of internet data**

The affordability of internet data emerged as another significant obstacle. When asked if the cost of internet data is a barrier to using mobile applications for professional development, 38 respondents (55.9%) agreed or strongly agreed with this statement. The mean score of 3.46 reflects that more than half of the teachers perceive internet data costs as a significant impediment. This issue is particularly concerning in regions where Internet services are expensive relative to income levels. For many teachers, high data costs discourage the consistent use of educational mobile applications, limiting their ability to access professional development materials, online courses, and collaborative

learning platforms. Addressing the financial burden associated with internet access is crucial for encouraging the regular use of digital resources.

Through an interview, it was quoted that:

Sometimes, using new technology feels like extra work. However, if the school recognised or rewarded teachers who use mobile apps effectively, more of us would be willing to try them out; moreover, incentives, even small ones, would motivate us to invest more time learning and using these applications. Recognition for innovative teaching methods could encourage many teachers to explore mobile applications. (Respondent 6, 14th October 2023)

In TAM terms, high data costs reduce perceived usefulness and ease of use. Even if teachers believe apps might be helpful to them, the effort and expense required to use them undermines their willingness to engage with findings that align with Mushimiyimana et al. [17], who noted that high internet costs limit the adoption of technology in Rwanda's education sector. Reducing internet costs or subsidising teacher data could significantly enhance mobile app usage.

This issue reflects a broader economic challenge: while smartphones may be accessible, ongoing data costs are not. In contrast, countries like Kenya have introduced subsidised teacher data plans through partnerships with telecom providers, which could be replicated in Tanzania.

### 4.3. Insufficient training on mobile applications

Another critical barrier highlighted in the findings is the lack of training on using mobile smartphone applications effectively. A staggering 88.2% of the respondents, comprising 35 strongly disagreed and 25 disagreed, reported not having received sufficient training. The mean score of 1.66 is the lowest among all the surveyed challenges, underscoring the widespread absence of training opportunities. Without proper guidance and skill development, teachers are unlikely to explore and utilise mobile applications for their professional growth independently.

In an interview, respondents were once quoted as saying the following:

When we exchange ideas and show each other how to use different teaching apps, it becomes easier to adopt them. Sometimes, all it takes is seeing how another teacher uses an app for me to try it out myself. Group discussions and team projects can help us learn how to utilise mobile applications more effectively in our teaching. Also, collaborative learning among teachers is key. We learn faster when we work together. (Respondent 9, 14th October 2023)

This lack of exposure and guidance significantly diminishes perceived ease of use, a central TAM component. Teachers lacking basic digital literacy see mobile applications as complicated, time-consuming, or daunting. This indicates that formal training programmes are either scarce or inaccessible. The findings align with the study by Hennessy et al. [6], who affirmed that the absence of structured training programmes limits teachers' ability to navigate educational applications effectively and prevents them from fully leveraging digital tools in their teaching practices. Importantly, collaborative learning is emerging as a useful workaround, although not a replacement for institutional training.

### 4.4. Limited training opportunities

The issue of training scarcity was further examined with the statement that the lack of training opportunities is a significant challenge. Responses to this statement were more varied than those to the others. While 25 respondents (36.8%) agreed or strongly agreed, an equal number disagreed or strongly disagreed. The average score of 2.93 indicates a neutral stance, suggesting that some teachers have limited access to training opportunities, while others may have had occasional access.

In an interview, it was once said that:

We rarely have workshops focused on using smartphones for teaching. If we had regular training sessions, many of us would become more confident using educational apps for lesson planning and classroom management. I believe if we had continuous training, even the older teachers would feel more comfortable using smartphones in their teaching. (Respondent 3, 14th October 2023)

These reflections show that, without ongoing institutional support, attitude toward technology remains neutral or negative even when perceived usefulness exists. Teachers might only be willing to try new tools if they feel equipped and supported. Digital training initiatives are integrated into ongoing professional development frameworks in countries like South Africa. The findings above align with the study by Lohr et al. [14], who substantiated that inconsistency in training access points to the need for a more structured and inclusive professional development framework that ensures all teachers receive adequate support and resources to build their digital competencies.

#### 4.5. Regional and international comparisons

The challenges identified in this study mirror patterns observed in other sub-Saharan African countries. For example, in Rwanda, Mushimiyimana et al. [17] mentioned that although there is general openness to mobile technologies, infrastructural limitations often hinder practical implementation. Likewise, Kabasiita et al. [7] found that rural teachers in Uganda encounter similar challenges, especially regarding internet connectivity and institutional ICT support.

However, there are notable regional differences. South Africa has taken more systematic steps to integrate digital skills into teacher professional development, with some provinces offering regular ICT workshops and school-wide Wi-Fi access [14]. Similarly, in Kenya, public-private partnerships have provided subsidised data bundles for teachers, helping to lessen the financial burden linked to mobile learning. These examples present practical models for Tanzania, particularly in expanding access and affordability across rural districts.

#### 4.6. Cultural context and teacher practice

The study also emphasises the importance of local cultural factors in influencing the adoption of mobile applications. In rural districts like Monduli, many teachers come from pastoralist communities such as the Maasai, where traditional norms, generational gaps, or language barriers may affect technology use. Educational tools presented only in English or Swahili might not always be accessible to all teachers, especially where local languages are predominant.

Cultural emphasis on communal learning further influences professional development dynamics. Teachers often cite peer-to-peer learning, shared experiences, and collective responsibility as preferred ways of acquiring digital skills. For many, learning from colleagues is more effective than attending infrequent or formal training sessions. Furthermore, respect for hierarchical roles, especially those of headteachers, can affect the acceptance and success of technology-driven initiatives.

### 5. Implications of the study

This study offers valuable insights beyond its immediate findings (table 1). Theoretically, the study contributes to our understanding of mobile learning by focusing on a rural Tanzanian setting, which is often neglected in global discussions. It also helps broaden existing theories of teacher learning and technology use by demonstrating how these experiences are influenced by real-world factors such as school leadership and access to resources. The findings are particularly useful for education stakeholders like policymakers, school leaders, and teacher training institutions to enhance basic infrastructure, make mobile data more affordable, and provide practical training for teachers interested in smartphone applications for their professional development. On a methodological level, the study highlights the importance of combining both quantitative and qualitative approaches to

gain a more comprehensive understanding of the issue. Random sampling ensured a fair selection of classroom teachers, while purposive sampling of headteachers enabled the study to gather deeper insights from those in leadership roles. The thorough process of reviewing and piloting the tools underscores the importance of refining research instruments to ensure they are easy to understand and relevant to the local context.

**Table 1**

Summary of key challenges and mean scores.

Challenge	Mean score	% agreeing
Lack of reliable internet access	1.85	80.9%
High cost of internet data	3.46	55.9%
Insufficient training on mobile apps	1.66	88.2%
Limited training opportunities	2.93	36.8%

## 6. Limitations of the study

While this study provides important insights into using mobile smartphone applications for teacher professional development in Monduli District, it is not without limitations. First, the sample size, though contextually appropriate, was relatively small and limited to a single district, which may affect the generalisability of the findings to other regions in Tanzania or Sub-Saharan Africa.

Second, the study relied on self-reported data, which can sometimes be influenced by social desirability bias. Teachers may have felt obliged to give responses they believed were expected, especially when discussing their use of technology. Additionally, network issues and limited digital familiarity among some participants could have affected how openly and accurately they interacted with the tools or responded to mobile learning questions. Lastly, while valuable for capturing a broad range of insights, the mixed-methods design required balancing time and resources, particularly during data collection in rural schools. These constraints may have restricted the depth of qualitative engagement with some participants. Despite these limitations, the findings still provide meaningful contributions that can inform future research and interventions in similar contexts.

## 7. Conclusion

Mobile smartphone applications can potentially enhance teacher professional development, especially by improving access to learning resources and supporting modern, innovative instructional methods. However, findings from this study highlight that this potential largely remains untapped in many rural parts of Tanzania – particularly in the Monduli District Council – due to a range of deeply rooted challenges.

One of the most significant barriers is the lack of reliable internet access. Many teachers reported difficulties securing stable connections, preventing them from accessing digital content or participating in virtual training sessions. Closely related to this is the high cost of internet data, which further discourages regular use of educational applications. Data expenses often compete with basic living costs in low-income rural areas, creating a digital divide that excludes many teachers from digital learning opportunities. Equally urgent is the issue of insufficient training. Many teachers in the study stated that they had never received adequate instruction on using mobile applications for professional development. When training was provided, it was often sporadic and not enough to build confidence or practical skills. Many educators expressed a willingness to learn but stressed the importance of peer collaboration and institutional support as vital factors for sustainable digital engagement.

Rooted in the TAM, this research offers a theoretical explanation of how these barriers influence teacher behaviour. TAM suggests that individuals' adoption of technology is motivated by perceived ease of use and usefulness. This research implies that when external obstacles such as unaffordable

data, poor infrastructure, and a lack of support diminish these perceptions, teachers are less inclined to incorporate digital tools into their practice.

While earlier studies have discussed similar obstacles, this research strengthens the existing evidence by adopting a mixed-methods approach that combines quantitative data with qualitative insights from teacher interviews. This methodological integration provides a richer and more nuanced understanding of how structural barriers intersect with teacher attitudes, experiences, and motivations. Importantly, it captures the lived realities of teachers working in under-resourced, rural environments – voices often underrepresented in the broader discourse on educational technology in Africa.

### Data availability statement

The data supporting this study's findings are not publicly available due to ethical considerations and participant confidentiality agreements. However, the author may make anonymised data excerpts available upon reasonable request and with permission from the relevant institutional review board and participating schools. Researchers or stakeholders interested in accessing the data for academic or policy-related purposes are encouraged to contact the corresponding author directly.

### Acknowledgments

*James James Makula:* This paper is partly based on the build-up study data collected for a PhD study in 2025. Thanks to my employer, the Institute of Accountancy Arusha, for financial support. The study also would not have been possible without support from primary school teachers in the Monduli District.

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