



The role of educational technology in enhancing professional development and teaching competence among secondary school teachers

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Abstract

The main purpose of this qualitative study was to identify the significance of technology in the professional development of teachers at secondary schools in Lagos. The study engaged 12 teachers and 6 principals across the 6 education districts in Lagos. The semi-structured interview guide was developed to elicit in-depth information from the participants. The data collected from the participants were thematically analysed, and interpretively interpreted, to present findings for the study. Findings revealed that educational technology enhances professional competence of teachers and provides opportunities for them to use available learning technologies for teaching and learning purposes. It was further revealed that despite the critical role of technology in education, there are various challenges or barriers that have influenced the use of technology effectively in schools. The study therefore recommends adequate capacitation of teachers in technology for classroom practices, while provision of adequate and appropriate resources for adoption and use of technology should be enhanced.

Keywords: Technology; Teaching; Classroom; Technical Knowledge; Professional Development

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1. Introduction

The Fourth Industrial Revolution (4IR) has infiltrated every aspect of life, making it more meaningful and comfortable. This surge of technologies has driven digital transformation, leading to significant societal advancements. Integrating technology into education is seen as a crucial factor in modernizing teaching methods and enhancing educational outcomes. Educational technology includes various tools like digital documents, internet platforms, and interactive software. Selwyn (2011) argues that these tools have the potential to transform traditional teaching approaches. Recently, there's been a notable increase in using technology in education, attributed to the improved availability of digital resources and the need for innovative methods to meet diverse educational needs (Bates and Sangrà, 2011).

Research shows that effectively integrating technology in education can boost student engagement, motivation, and academic performance (Ajani, 2024; Gamede et al., 2021; Maphalala and Ajani, 2024; Hattie, 2009). Technology allows teachers to enhance instructional methods, customize learning experiences, and access a wide range of educational resources (Koehler and Mishra, 2009). However, the realization of these benefits largely depends on teachers' proficiency and willingness to incorporate technology into their teaching techniques (Ertmer and Ottenbreit-Leftwich, 2010). In many countries, teacher professional development now includes training on adopting and using various technologies in classroom practices. Professional development is crucial for equipping teachers with the necessary skills and knowledge to integrate technology effectively. Desimone (2009) suggests that effective professional development programs should include continuity, collaboration, and a clear focus on specific teaching strategies. These initiatives help teachers improve their technology skills, understand its educational potential, and develop innovative teaching and learning methods (Darling-Hammond et al., 2017).

Studies indicate that technology significantly impacts teaching and learning processes (Ajani, 2023; Khoalenyane and Ajani, 2024). Means et al. (2010) highlight innovative techniques for conveying information, fostering collaboration, and assessing student understanding. Schmid et al. (2014) found that using interactive whiteboards, educational apps, and online learning platforms can boost student engagement and academic achievement. Additionally, technology supports individualized instruction, allowing teachers to tailor their methods to meet each student's specific needs (Tomlinson, 2001). Despite the benefits of technology in education, several challenges hinder its integration. Teachers may face issues such as limited resources, inadequate training, and resistance to new methods (Ertmer, 1999). Digital equity issues, like disparities in technology access and internet connectivity, can exacerbate educational inequalities (Warschauer, 2004). Addressing these issues requires a comprehensive approach, including infrastructure investment, enhanced professional development, and policy support (Tondeur et al., 2008).

In Lagos, Nigeria, integrating instructional technology in secondary schools has yielded mixed results. While technology has the potential to improve educational outcomes, significant barriers to its effective integration remain (Ololube et al., 2013). Similar challenges exist in other developing nations, such as insufficient funding, limited technical support, and poor training (Farrell and Isaacs, 2007). This study examines the significance of technology in the professional development of secondary school teachers in Lagos. It aims to identify how technology enhances teachers' proficiency, its potential for teaching and learning, and the barriers to its effective use. By addressing these objectives, the study contributes to the ongoing discourse on educational technology and offers valuable insights for policymakers and educators facing similar challenges.

The research is guided by the following questions:

- How does technology enhance the professional proficiency of secondary school teachers in Lagos?
- What are the potential benefits of technology for teaching and learning in secondary schools?
- What barriers hinder the effective use of technology in these schools?

Understanding the role of technology in improving teacher professional development is crucial for enhancing educational practices and achieving desired outcomes. The findings of this study provide valuable insights for designing professional development programs, guiding policy decisions, and improving efforts to integrate technology in education. By analyzing the conditions in Lagos, this study offers perspectives that can be applied to other developing regions facing similar challenges.

2. Theoretical framework

The Technology Acceptance Model (TAM), developed by Fred Davis in 1989, is an adaptation of the Theory of Reasoned Action (TRA) by Ajzen and Fishbein (1980). TAM is widely used in information systems to understand and predict technology adoption behaviours, focusing on perceived usefulness (PU) and perceived ease of use (PEOU) (Davis, 1989; Venkatesh and Davis, 2000). Over the years, TAM has been refined to include more components, enhancing its explanatory power (Venkatesh and Bala, 2008).

TAM is selected for this study due to its proven efficacy in explaining technology adoption behaviours across various contexts, including education. Numerous studies have validated TAM's components, demonstrating its effectiveness in understanding user acceptance of diverse technological tools (King and He, 2006; Lee et al., 2003). Within education, TAM provides valuable insights into how teachers perceive and integrate educational technologies, crucial for designing effective professional development and ensuring successful technology implementation (Teo, 2011).

Using TAM in this study helps understand the psychological and behavioural factors influencing teachers' acceptance and use of educational technologies. Research shows that teachers' perceptions of technology's effectiveness and ease of use significantly impact their willingness to adopt these tools (Holden and Rada, 2011). By employing TAM, this study identifies areas where teachers may need further support, allowing for more targeted professional development initiatives (Scherer et al., 2015).

The core concepts of TAM, including PU and PEOU, are essential for understanding technology adoption. PU refers to the belief that using a system will enhance job performance, while PEOU indicates the belief that using the system requires minimal effort (Davis, 1989). Empirical studies consistently confirm these concepts' validity, making them critical for assessing teachers' attitudes towards educational technologies (Teo et al., 2008).

TAM has evolved to include additional components like subjective norms, facilitating conditions, and self-efficacy, leading to models like TAM2 and UTAUT (Venkatesh and Davis, 2000; Venkatesh et al., 2003). These enhancements address social and organizational factors affecting technology acceptance, providing a comprehensive framework for understanding teachers' behaviours in adopting technology (Venkatesh and Bala, 2008). Including these variables offers a nuanced view of the factors influencing technology use in educational settings. Empirical research validates TAM's relevance in education, with studies showing that PU and PEOU significantly influence teachers' technology adoption decisions (Teo, 2011; Holden and Rada, 2011).

While TAM provides a robust framework for understanding technology adoption, it is crucial to consider specific contextual factors in Lagos' educational environment. Factors like infrastructure, resource availability, and cultural attitudes towards technology can significantly influence technology acceptance and use (Bagozzi et al., 1992). This study analyses TAM in the context of Lagos, offering in-depth insights and practical recommendations for enhancing teachers' technology adoption.

Professional development plays a critical role in shaping teachers' views on technology. Training programs focusing on the practicality and ease of use of educational technology can positively influence teachers' attitudes and increase their willingness to use these tools (Inan and Lowther, 2010; Khoalenyane and Ajani, 2023). This study aims to improve teachers' acceptance and use of technology by integrating TAM into the design and evaluation of professional development activities. Identifying effective strategies for enhancing teachers' technology adoption is a key objective.

Despite technology's potential benefits, various barriers hinder its successful integration into teaching practices (Ajani, 2021). Common challenges include inadequate infrastructure, limited technical support, and resistance to change (Ertmer and Ottenbreit-Leftwich, 2010). TAM provides a valuable framework for identifying and addressing these issues, offering recommendations for developing interventions to overcome these barriers (Teo, 2011).

The insights gained from applying TAM in this study have significant policy and practical implications. Policymakers and educational leaders can use the findings to develop initiatives that promote effective technology integration in education, enhancing teachers' professional development and improving educational outcomes (Scherer et al., 2019). This study contributes to the broader discourse on technology-enhanced education, facilitating the development of more efficient and sustainable teaching practices in Lagos and similar regions. By leveraging TAM, this study provides valuable observations and actionable recommendations for maximizing educational technology's impact on teaching and learning outcomes.

2.1. Application and justification of TAM

While TAM is well-explained, its application to this study could be clearer by detailing how its components—perceived usefulness (PU) and perceived ease of use (PEOU)—were operationalized during the study and analysis. Specifically, the study could elucidate how PU and PEOU were measured and interpreted in the context of secondary school teachers in Lagos. For instance, surveys or interviews could have included questions that directly assessed teachers' beliefs about the utility of technology in enhancing their teaching effectiveness (PU) and their perceptions of the ease with which they could integrate these technologies into their daily instructional practices (PEOU). Furthermore, data analysis should have explicitly linked responses related to PU and PEOU to the observed levels of technology adoption and integration, thus providing a clear picture of how these TAM components influenced teachers' behaviour and attitudes toward educational technology.

Despite its robustness, TAM has limitations in explaining technology adoption in educational contexts that should be discussed. One significant limitation is that TAM primarily focuses on individual attitudes and does not fully account for external factors such as infrastructure, institutional support, and socio-economic conditions that can significantly impact technology adoption in schools. Additionally, the model may not adequately capture the complex, context-specific barriers and facilitators of technology use in educational

settings, such as cultural attitudes towards technology and the availability of continuous professional development. These factors can be critical in understanding the real-world challenges faced by teachers in integrating technology. Therefore, while TAM provides a useful framework for exploring the psychological and behavioural aspects of technology acceptance, its application should be complemented by other models and theories that consider the broader educational environment.

3. Literature review

The theoretical framework guiding this study is the Technology Acceptance Model (TAM), proposed by Davis (1989). TAM posits that perceived usefulness and perceived ease of use significantly influence users' attitudes toward technology and their subsequent adoption behaviours. This model has been widely applied in educational settings to understand teachers' acceptance and integration of technology (Teo, 2011). In addition, Venkatesh et al.'s (2003) Unified Theory of Acceptance and Use of Technology (UTAUT) further expands on TAM by incorporating factors such as social influence and facilitating conditions. These theories provide a robust foundation for examining how teachers in Lagos perceive and utilize educational technology in their professional development.

Technology has transformed education by providing innovative tools that enhance teaching and learning. According to Selwyn (2011), educational technology includes digital resources, online platforms, and interactive software that can significantly improve educational outcomes. Bates and Sangrà (2011) argue that effective use of technology can foster active learning, facilitate access to information, and support diverse learning styles. Moreover, the integration of technology in education has been linked to increased student engagement, motivation, and achievement (Hattie, 2009). As technology becomes increasingly ubiquitous, understanding its role in education is essential for modern pedagogical practices.

According to Ajani and Govender (2023), professional development is critical for helping teachers integrate technology into their teaching practices effectively. Darling-Hammond et al. (2017) emphasize that high-quality professional development should be ongoing, collaborative, and focused on specific instructional strategies. Desimone (2009) notes that such programs can build teachers' confidence in using technology, enhance their pedagogical skills, and improve their overall instructional effectiveness. Professional development that includes hands-on training, peer collaboration, and continuous support can empower teachers to harness the full potential of educational technology (Ertmer and Ottenbreit-Leftwich, 2010).

The impact of technology on teaching and learning is profound. Means et al. (2010) found that technology can enhance instructional methods, facilitate differentiated instruction, and provide new ways to assess student learning. For example, interactive whiteboards, educational apps, and online learning platforms have been shown to improve student engagement and academic performance (Schmid et al., 2014). Additionally, technology can support personalized learning by allowing teachers to tailor their instruction to meet the individual needs of students (Tomlinson, 2001). These benefits underscore the importance of integrating technology into educational practices.

Despite its benefits, the integration of technology in education faces several challenges (Khoalenyane and Ajani, 2024). Ertmer (1999) identifies first-order barriers such as limited access to resources and inadequate training, as well as second-order barriers like resistance to change and lack of confidence. Warschauer (2004) highlights issues related to digital equity, including disparities in access to technology and internet

connectivity, which can exacerbate educational inequalities. Overcoming these challenges requires comprehensive strategies that address infrastructure, professional development, and policy support (Tondeur et al., 2008).

In Lagos, Nigeria, the adoption of educational technology in secondary schools has shown both promise and obstacles. Ololube et al. (2013) indicate that while technology has the potential to improve educational outcomes, significant barriers such as limited funding, insufficient training, and lack of technical support hinder its effective implementation. Similar challenges are observed in other developing countries, where educational systems struggle with inadequate resources and infrastructure (Farrell and Isaacs, 2007). These studies highlight the need for targeted interventions to enhance the use of technology in education. Research indicates that technology can enhance the professional competence of teachers by providing them with new instructional tools and resources (Ajani, 2024; Koehler and Mishra, 2009). For instance, digital tools can help teachers design more engaging and interactive lessons, access up-to-date information, and collaborate with colleagues and experts worldwide. Professional development programs that focus on technology integration can help teachers develop the skills needed to effectively use these tools in their classrooms (Ertmer and Ottenbreit-Leftwich, 2010).

Technology offers numerous opportunities for enhancing teaching and learning. According to Schmid et al. (2014), the use of interactive whiteboards, educational software, and online resources can make lessons more engaging and effective. Additionally, technology enables teachers to implement differentiated instruction, catering to the diverse needs of students (Tomlinson, 2001). Online platforms and digital tools also facilitate collaborative learning, allowing students to work together and share knowledge (Means et al., 2010). These opportunities highlight the potential of technology to transform educational practices. Despite its potential, several barriers hinder the effective use of technology in education. Ertmer (1999) categorizes these barriers into first-order and second-order challenges. First-order barriers include external factors such as limited access to technology, inadequate training, and lack of technical support. Second-order barriers involve internal factors like teachers' beliefs, attitudes, and resistance to change. Warschauer (2004) also emphasizes digital equity issues, such as disparities in access to technology and internet connectivity. Addressing these barriers is crucial for realizing the benefits of educational technology.

The successful integration of technology in education requires supportive policies and adequate infrastructure. Tondeur et al. (2008) argue that educational policies should prioritize technology integration and provide clear guidelines for its implementation. Additionally, investment in infrastructure, such as high-speed internet and reliable hardware, is essential for supporting the use of technology in schools. Policymakers must ensure that schools have the necessary resources and support to integrate technology effectively (Selwyn, 2011). Effective professional development programs are essential for helping teachers integrate technology into their teaching practices. Darling-Hammond et al. (2017) emphasize the importance of ongoing, collaborative professional development that focuses on specific instructional strategies. Desimone (2009) notes that professional development programs should include hands-on training, peer collaboration, and continuous support to build teachers' confidence and competence in using technology. Such programs can empower teachers to leverage technology to enhance their teaching and improve student learning outcomes.

Empirical studies provide valuable insights into the impact of technology integration on teaching and learning. For example, Hattie (2009) conducted a meta-analysis of educational research and found that technology can significantly enhance student engagement and achievement. Means et al. (2010) also found

that technology supports differentiated instruction and provides new ways to assess student learning. These studies highlight the importance of integrating technology into educational practices to improve student outcomes. In Lagos, the integration of educational technology faces significant challenges. Ololube et al. (2013) highlight barriers such as limited funding, insufficient training, and lack of technical support. Similar issues are observed in other developing countries, where educational systems struggle with inadequate resources and infrastructure (Farrell and Isaacs, 2007). These studies underscore the need for targeted interventions to enhance the use of technology in education in these contexts.

The literature review underscores the critical role of technology in enhancing the professional development of teachers and improving educational outcomes. Theoretical frameworks such as TAM and UTAUT provide a foundation for understanding the factors influencing technology adoption. While technology offers significant opportunities for teaching and learning, several barriers must be addressed to realize its full potential. Empirical studies highlight both the benefits and challenges of technology integration, particularly in developing contexts like Lagos. Addressing these challenges requires comprehensive strategies that include professional development, supportive policies, and adequate infrastructure. This review provides a foundation for further research on the effective integration of technology in education, particularly in contexts with similar challenges.

4. Methods

A comprehensive interpretive qualitative research design was employed to investigate the influence of technology on the professional growth of teachers in secondary schools in Lagos. This approach leveraged the strengths of qualitative research to attain a deep understanding of the research problem (Creswell and Plano Clark, 2017). Qualitative methods were advantageous in educational research as they allowed for the collection of detailed, reliable information (Teddlie and Tashakkori, 2009). Qualitative interviews, in particular, captured a wide range of perspectives and experiences from participants, yielding valuable insights (Cohen et al., 2018). The interview guide was developed to explore various aspects of teachers' professional development, including their use of technology, perceived benefits, and encountered challenges. This approach provided rich, relevant data for the study (Brace, 2018).

Participants were selected using purposive sampling, targeting teachers and principals from schools with access to learning technology (Field, 2018). To ensure diversity and representation across the districts, specific criteria were established: participants were required to have at least two years of experience using educational technology and be actively involved in professional development activities. A total of 12 instructors were chosen—2 teachers from each of the 6 education districts in Lagos, along with 1 principal from each district. These districts included Education Districts 1 through 6, and participants were drawn from public secondary schools. Despite efforts to ensure a representative sample, limitations such as the exclusion of private schools and potential biases in participants' willingness to participate might have influenced the findings. These limitations were discussed further in the discussion section.

A qualitative approach was employed to examine the environmental and administrative factors influencing technology integration in educational institutions, gathering firsthand knowledge and perspectives from educational administrators (Kvale and Brinkmann, 2009). The semi-structured interview technique provided

flexibility in questioning, enabling in-depth exploration of relevant topics as they emerged (Merriam and Tisdell, 2015).

The qualitative data from the interviews were analysed using thematic analysis, a systematic process for identifying, analyzing, and reporting patterns (themes) within the data. This method resulted in a comprehensive interpretation of the findings (Braun and Clarke, 2006). The thematic analysis was conducted through a systematic process involving multiple stages: initial coding, identification of themes, evaluation of themes, definition and labelling of themes, and compilation of the final report. During the initial coding phase, each transcript was reviewed line-by-line to identify significant statements and assign preliminary codes. In the subsequent phase, similar codes were grouped to form initial themes. These themes were then reviewed and refined through iterative discussions among the research team to ensure consistency and reliability. Finally, the themes were clearly defined and labelled, and a comprehensive report was compiled to present the findings. This approach ensured a thorough and transparent analysis, facilitating a deep understanding of the data (Nowell et al., 2017).

The literature supported the use of a mixed-methods approach for addressing complex research questions in education (Creswell, 2015). This methodology allowed for a thorough understanding of data patterns and human experiences (Plano Clark and Ivankova, 2016). Employing this approach aligned with the study's objectives, enabling a comprehensive analysis of both the extent of technology use and the factors influencing its integration in professional development. The study adhered to principles of informed consent and other ethical considerations throughout. Data were analysed using thematic analysis, involving transcription, coding, and theme development (Braun and Clarke, 2006). The findings were then systematically presented and discussed.

The methods for this study were carefully chosen to ensure a comprehensive understanding of the impact of technology on the professional development of secondary school teachers in Lagos. Participants were selected using purposive sampling, targeting teachers and principals from public secondary schools across Lagos' six educational districts to ensure a diverse representation of experiences and perspectives. Specific criteria included schools with access to educational technology and teachers actively using these tools in their instruction. This approach aimed to capture a wide range of insights regarding the integration of technology in various educational settings. The selection criteria ensured that participants were directly relevant to the study's focus, though it may have introduced a bias towards schools and individuals already engaged with technology, potentially overlooking those facing greater barriers. By acknowledging these factors, the study aims to provide transparent and contextually rich findings that inform the broader discourse on educational technology integration and professional development.

5. Results

5.1. Theme 1: Perceived benefits of educational technology

This theme directly addresses the first research question: "How does technology enhance the professional proficiency of secondary school teachers in Lagos?" Teachers continuously emphasized multiple advantages of educational technology in developing their professional competence and improving instructional methods.

Many teachers conveyed that technology empowered them to provide highly customized training that caters to the unique demands of each pupil. One teacher exemplified this by stating, "Utilizing interactive whiteboards and educational applications enabled me to modify my instructional approaches to accommodate the various learning types present in my classroom." Additionally, technology was perceived as an enabler of inventive teaching methodologies, as teachers integrated multimedia tools and simulations to enhance the engagement and efficacy of classes. A participant noted that virtual labs and online simulations not only increased the accessibility of complicated subjects but also stimulated curiosity and fostered critical thinking among students.

However, noticeable obstacles associated with the usage of technology were also highlighted. Insufficient training and assistance were frequently mentioned by teachers as major obstacles to effectively using the potential of technology. Many teachers expressed concerns about the absence of well-organized professional development options that could improve their technical expertise and pedagogical understanding. A teacher mentioned that although they recognized the advantages, their capacity to incorporate technology into regular courses was hindered by the absence of thorough training. Furthermore, recurrent concerns included difficulties in accessing technology and reliable internet connectivity, especially in schools situated in rural or underprivileged locations. These limitations highlight the necessity of specific interventions and continuous support to enable teachers to fully utilize the advantages of educational technology.

5.2. Theme 2: Barriers to effective technology integration

This theme addresses the third research question: "What barriers or impediments hinder the effective usage of technology in these schools?" Despite recognizing the advantages, teachers noted certain obstacles that impeded the successful incorporation of technology into their teaching methods. An overarching motif was the insufficiency of suitable instruction and specialized growth prospects customized to the requirements of teachers. Participants emphasized that generic seminars failed to address specific instructional issues or technological applications relevant to their subject areas. A teacher remarked that the training they received was mostly standardized and failed to address the specific challenges they encountered when incorporating technology into mathematics instruction. Additionally, the presence of technological infrastructure and limitations in resources presented considerable obstacles, particularly in schools with restricted budgets or obsolete equipment. Teachers voiced dissatisfaction with unstable internet connectivity, obsolete software, and an inadequate number of devices for students to use.

The study revealed resistance to change among instructors as a significant barrier. Certain teachers exhibited reluctance in embracing novel technology due to apprehensions regarding their effectiveness or possible interference with traditional instructional methods. One participant mentioned that certain coworkers experienced apprehension towards unfamiliar situations, with concerns that technology might supplant traditional teaching methods or necessitate additional time for lesson preparation. Furthermore, the presence of administrative assistance and the establishment of policy frameworks played a vital role in influencing the integration of technology. Teachers stressed the need for explicit instructions and encouraging leadership to navigate the intricacies of adopting and utilizing educational technologies. These findings emphasized the complex and varied obstacles to incorporating technology and highlighted the significance of addressing systemic difficulties to promote lasting transformation in educational methods.

5.3. Theme 3: Impact on teaching practices

This theme answers the second research question: "What are the possible advantages that technology provides for the instruction and acquisition of knowledge in secondary schools?" Technology integration significantly influenced teachers' instructional methods and classroom management practices. Teachers observed that the use of technology enabled the creation of more dynamic and interactive lessons, which increased student engagement and involvement. Teachers employed digital collaboration tools and multimedia materials to promote peer learning and cultivate collaborative problem-solving abilities among pupils. A participant observed that virtual group projects and online discussions facilitated collaboration among students beyond the physical confines of the classroom, fostering enhanced learning and critical thinking. Furthermore, technology facilitated personalized education, enabling teachers to better address the individual learning needs of diverse students. Teachers used adaptive learning platforms and personalized learning modules to offer targeted assistance and enrichment opportunities tailored to each student's development and achievement.

Nevertheless, the incorporation of technology into teaching methods also presented difficulties pertaining to the workload and time management. Teachers voiced concerns about the additional time needed to create digital materials, modify current lesson plans, and resolve technical problems during instructional delivery. Many teachers felt overwhelmed by the continuous requirement to enhance their technology competencies and incorporate novel technologies into their teaching practices. A participant stated that it was a perpetual challenge to manage the demands of incorporating technology into the curriculum while still fulfilling administrative tasks. Additionally, the transition to digital learning environments required changes in classroom dynamics and instructional practices, prompting teachers to reconsider conventional methods of lesson design and assessment. These findings emphasized the significant impact that technology could have on improving teaching methods, while also highlighting the need for thorough assistance and professional development to address any issues that might arise.

5.4. Theme 4: Professional growth and learning opportunities

This theme also relates to the first research question: "How does technology enhance the professional proficiency of secondary school teachers in Lagos?" Teachers recognized multiple opportunities for professional development and cooperation enabled by educational technology. They emphasized the significance of online networks and digital platforms for sharing information, interacting with colleagues, and accessing professional growth opportunities. Many teachers engaged in virtual seminars, webinars, and online courses to augment their technological aptitude and pedagogical expertise. A participant expressed those virtual conferences, and online forums had expanded their network and introduced them to cutting-edge teaching methods employed by teachers globally. Additionally, technology allowed for ongoing feedback and self-reflection on teaching methods, fostering a culture of constant growth and development among teachers. Teachers employed digital assessment technologies and data analytics to oversee student progress, detect areas of learning deficiency, and adapt teaching approaches accordingly.

Nevertheless, there were apparent obstacles to professional growth facilitated by technology. Teachers voiced concerns over the quality and applicability of online resources and professional development opportunities. Many teachers felt overwhelmed by the large amount of material available online and faced

difficulties in determining reliable sources and efficient teaching methods. A participant mentioned that discovering high-quality information and significant professional development opportunities on the internet could be intimidating. There is a requirement for carefully selected platforms that provide customized assistance for instructors. Furthermore, inequalities in the availability of technology and digital literacy skills among teachers raised questions about fairness, especially in schools serving underprivileged areas. These findings emphasized the need for equitable access to professional development opportunities and specific assistance to enable teachers to fully utilize technology for their professional advancement.

5.5. Theme 5: Recommendations for improvement

This theme synthesizes the insights from the first three research questions, providing actionable steps to enhance technology integration and professional development. Participants made several recommendations to improve the successful integration of educational technology and support the professional development of teachers. Teachers stressed the importance of customized and continuous professional development programs that correspond to their instructional requirements and technical skills. They supported the implementation of interactive workshops, peer mentoring programs, and cooperative learning communities that prioritize the practical use of educational technology. A participant proposed the necessity for seminars that offer practical methodologies and firsthand exposure to technology tools pertinent to their respective subject domains.

Moreover, stakeholders emphasized the significance of allocating funds towards technological infrastructure and resources to guarantee fair and consistent access to reliable connections in all educational environments. Teachers demanded additional funding to acquire modern devices, software licenses, and technical assistance to address current inequalities and facilitate smooth incorporation of technology in classrooms. A participant emphasized the importance of enhancing technology infrastructure. In order to effectively utilize digital technologies in teaching, it is imperative to have dependable internet connectivity and up-to-date equipment.

Additionally, teachers emphasized the importance of having supportive leadership and well-defined policy frameworks to cultivate a culture of innovation and collaboration in implementing educational technology. Teachers supported the need for clear instructions from administrators, proper resource distribution, and policy initiatives that prioritize professional growth and the long-term incorporation of technology. A participant stressed the importance of leadership support, noting the need for principals and district administrators to actively promote the use of technology in education and provide the essential tools and assistance to teachers. These proposals highlighted the need for a comprehensive approach to overcome obstacles, enhance professional growth, and maximize the effectiveness of educational technology in improving teaching and learning outcomes.

6. Discussion

The study results indicate that technology has a significant influence on enhancing the professional development of secondary school teachers in Lagos, aligning with global trends in educational technology adoption. Teachers in Lagos reported that technology improves their teaching approaches and increases their effectiveness in delivering courses (Lawless and Pellegrino, 2007). These findings are particularly relevant

given the rapid advancements in educational technology and the increasing emphasis on digital literacy in the 21st century (Cuban, 2001; Selwyn, 2011).

However, significant barriers hinder the effective integration of technology into teaching approaches. The primary obstacles, as highlighted in previous research, include inadequate training and a lack of professional development opportunities tailored to specific instructional challenges and relevant technological applications (Ertmer et al., 2012; Inan and Lowther, 2010). The lack of tailored training programs that effectively address specific instructional challenges and relevant technological applications in different subject areas remains a serious issue.

Infrastructural issues, such as unreliable internet access and obsolete equipment, also pose significant challenges. These findings correspond with the conclusions of Bebell and O'Dwyer (2010), who highlighted the importance of technological infrastructure in determining the effectiveness of technology integration in educational institutions. Frequently, educational institutions in Lagos encounter the obstacle of inadequate resources, impeding teachers' ability to effectively utilize technology. Limited resources often impede educational progress in many impoverished countries (Trucano, 2005).

Resistance to change among teachers was acknowledged as a significant barrier. This hesitancy typically arises from concerns about the efficacy of technology and potential disruptions to conventional teaching approaches (Keengwe et al., 2008). Fullan (2013) argues that successfully implementing technological innovations requires more than just technical ability; it also requires a shift in instructors' attitudes and beliefs about technology. Overcoming these challenges is essential for fostering a culture that prioritizes innovation and diversity.

The study also highlighted the positive impact of technology on teaching methods. Teachers observed that the utilization of technology enhanced the liveliness and interactivity of lessons, increasing student engagement and participation. Hattie's (2009) study offers proof that technology, when used well, may significantly enhance the quality of both teaching and learning. Interactive whiteboards, digital collaboration tools, and multimedia materials were identified as particularly beneficial in improving class engagement and effectiveness (Schmid et al., 2009).

Moreover, the utilization of technology has facilitated the integration of personalized education, augmenting teachers' capacity to effectively cater to the distinct learning needs of pupils. These findings align with Tomlinson's (2001) conclusions, arguing that personalized instruction is crucial for effectively addressing the varied skills and learning preferences of children. Adaptive learning platforms and personalized learning modules have been highlighted for their effectiveness in providing targeted support and opportunities for enrichment.

However, it is important to acknowledge the augmented workload and challenges in time management that accompany the use of technology. Teachers expressed concerns regarding the time required to develop digital content and adapt existing lesson plans, in accordance with Bauer and Kenton (2005). Teachers encounter a significant challenge in balancing the incorporation of technology into the classroom with fulfilling administrative responsibilities.

The study emphasizes the importance of using educational technologies to promote professional growth and collaboration. Online forums and digital platforms were considered significant resources for sharing best practices and accessing professional development opportunities (Dede et al., 2009). Participating in virtual

workshops and online courses has broadened teachers' networks and exposed them to innovative teaching techniques from many nations (Voogt et al., 2013).

To ensure equitable and unbiased access to professional development opportunities, addressing disparities in instructors' digital literacy skills is crucial. Technology availability and professional growth, particularly in schools serving poor areas, were highlighted as significant challenges (Warschauer, 2004). Ensuring that all teachers have access to high-quality materials and training is essential for promoting fairness in education.

The study's findings suggest that supportive leadership and clearly defined policy frameworks are crucial for fostering an atmosphere that encourages innovation and collaboration in the implementation of educational technology. Anderson and Dexter (2005) argue that leadership plays a vital role in guiding and assisting teachers as they navigate the complexities of integrating technology. Clear instructions and flexible policies are crucial for efficiently handling challenges and maximizing the benefits of educational technology.

Overall, technology has the potential to significantly enhance teachers' professional development and improve instructional methodologies. However, addressing barriers to its efficient integration is imperative. Ample professional development opportunities, abundant resources, supportive leadership, and clearly defined policy frameworks are crucial to fully maximize the advantages of educational technology. This study contributes to the growing body of literature on educational technology integration and provides valuable insights for policymakers and teachers facing similar circumstances.

7. Implications of the study

The findings of this study have substantial ramifications for integrating technology into secondary education, particularly in Lagos, and potentially in similar contexts worldwide. The study highlights the essential requirement for professional development in efficiently utilising educational technologies. According to Darling-Hammond et al. (2017), continuous professional development is essential for instructors to stay up-to-date with the latest technological advancements and teaching methods. It is crucial for schools and educational planners to prioritise the implementation of comprehensive and tailored continuous training courses that cater to the specific needs of teachers in various subject areas. Furthermore, the analysis highlights the need for substantial investment in IT infrastructure. This aligns with the findings of Olaniran (2016), who emphasises that adequate infrastructure is essential for the effective integration of technology in educational institutions. An important hindrance in Lagos is the inadequacy of resources, such as reliable internet connectivity and state-of-the-art equipment. In order to address these infrastructure challenges, it is crucial for government institutions, private sector partners, and international donors to collaborate in a coordinated manner. This collaboration is essential to guarantee that schools have the necessary resources to promote digital learning.

Another significant outcome is the necessity to foster supportive leadership inside schools. Leadership plays a vital role in fostering a culture that embraces and promotes technological innovation (Anderson and Dexter, 2005). School administrators should adopt a proactive position in promoting digital programmes, providing teachers with the necessary support and tools, and cultivating an environment that encourages innovation and collaboration. This study suggests that leadership training programmes should incorporate courses on technology management and integration to equip school leaders with the essential skills to effectively guide their institutions through digital transformations. The report also emphasises the necessity

of addressing the attitudinal barriers that teachers face when it comes to using technology. Keengwe et al. (2008) provided evidence that teachers' beliefs and attitudes significantly influenced their readiness to integrate technology into their teaching, highlighting the widespread issue of resistance to change. Professional development programmes should include components that especially focus on mindset reform, showcase the benefits of technology, and provide teachers with practical opportunity to improve their skill in using new technologies.

Another vital concern is guaranteeing equitable access to technology and opportunity for professional advancement. The study uncovers disparities in the adoption of technology across schools situated in different socio-economic areas, which corresponds with the findings of Warschauer (2004). To address this problem effectively, it is crucial to implement regulations that ensure fair access to high-quality professional development and technological resources for all teachers, regardless of their location or their schools' economic circumstances. This can help to reduce the gap between those who have access to digital technology and those who do not and promote equal opportunities in education. Moreover, the findings suggest that integrating technology into instructional approaches might significantly enhance student engagement and academic performance. This is consistent with Hattie's (2009) study, which shows that technology can improve learning by promoting interactivity and engagement. Therefore, it is recommended to encourage teachers to explore and incorporate many digital tools and platforms that can facilitate interactive learning and cater to a broad spectrum of learning preferences. It is advisable to encourage the use of interactive whiteboards, instructional software, and online collaborative tools in order to improve the educational experience.

The study also emphasises the ability of technology to enable differentiated education, which is crucial in meeting the needs of diverse students. Tomlinson (2001) asserts that differentiated instruction allows teachers to tailor their teaching methods to address the unique requirements of individual students, leading to improved learning outcomes. Adaptive learning systems, a form of educational technology, provide customised learning experiences that accommodate the unique abilities and constraints of students. This enhances the convenience for teachers to implement diverse instructional methods. The study suggests that educational policies should be modified to enable the integration of technology into teaching and learning. Policymakers need to establish clear norms and frameworks that define the expected standards for the use of technology in educational institutions. They should also designate budgetary resources for technical assets and implement measures of accountability to ensure the effective utilisation of technology. These policies should include systems for ongoing review and research to continuously assess the impact of technology on education and make necessary adjustments.

Ultimately, the study underscores the need of advocating for a collaborative approach to integrating technology. The cooperation between teachers, school administrators, policymakers, and other stakeholders is crucial for developing and implementing initiatives that encourage the effective use of technology in education. This collaborative endeavour can foster the formation of a shared vision and ensure that all stakeholders are aligned with their goals and efforts. Fullan (2013) argues that the effective execution of educational innovations necessitates the cooperation of all parties involved. Conclusively, this study highlights the importance of implementing comprehensive strategies to address the various challenges and opportunities associated with integrating technology into education. In order to enhance educational outcomes for students, educational stakeholders can improve the efficacy of technology in teaching and learning by giving priority to

professional development, allocating resources to infrastructure, cultivating supportive leadership, addressing barriers related to attitudes, ensuring fairness, and fostering collaboration.

8. Conclusion

This study highlights the crucial role of technology in the professional development of secondary school teachers in Lagos. Educational technology significantly enhances instructors' professional skills and offers substantial opportunities for improving teaching and learning. However, the optimal utilization of technology is hindered by challenges such as inadequate infrastructure and attitudinal barriers. To address these issues, educational authorities in Lagos should take immediate and specific actions. First, implementing comprehensive professional development programs tailored to teachers' specific needs will equip them with the necessary skills to effectively integrate technology into their teaching practices. Second, improving technological infrastructure, including reliable internet access and up-to-date equipment, is essential for ensuring that all teachers can utilize digital tools effectively. Additionally, fostering supportive leadership that promotes a positive attitude towards technology adoption is crucial. Educational leaders should provide clear guidelines, adequate resources, and continuous support to encourage teachers to embrace innovative teaching methods. Ensuring equal access to resources, particularly in underprivileged areas, is vital for promoting equity in education. The findings underscore the need for a collaborative approach to integrating technology into education. Policymakers, teachers, and other relevant stakeholders must work together to overcome the identified barriers and maximize the benefits of educational technology. By adopting these strategies, educational authorities can align teachers' self-perceptions with their classroom practices, leading to improved educational outcomes and a more effective education system in Lagos.

9. Limitations of the study and future research

While this study provides valuable insights into the role of technology in the professional development of secondary school teachers in Lagos, several limitations may affect the generalizability of its findings. Firstly, the use of purposive sampling, although effective for targeting relevant participants, may introduce selection bias, as it focused on schools with existing access to educational technology. This may exclude schools and teachers who face more significant barriers to technological integration, thus limiting the study's ability to represent the full spectrum of challenges within the education system. Additionally, the sample size, while sufficient for qualitative analysis, may not capture the diverse experiences and perspectives of all secondary school teachers in Lagos, thereby affecting the breadth of the study's conclusions.

Future research should aim to address these limitations by employing more inclusive sampling methods and expanding the participant pool to include a wider range of schools, particularly those with limited access to technology. Longitudinal studies could provide deeper insights into the long-term effects of technology integration on professional development and teaching practices. Furthermore, comparative studies between different regions or countries could help to contextualize the findings within broader educational trends and challenges. Investigating the impact of specific technological tools and professional development programs on teaching outcomes would also provide more targeted recommendations for policymakers and educators. By

exploring these areas, future research can build on the current study's findings and contribute to a more comprehensive understanding of educational technology's role in teacher development.

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