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Investigating formal professional development pathways and
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“We [teachers] first require basic technical [skills] training”: Investigating formal professional development pathways and knowledge needs of teachers for technology integration

Abstract

Internationally and in Ghana, formal professional development is cited in many education policies as a focal lever for transforming pedagogy and engaging students in cognitively demanding learning processes with digital technologies. Yet, this expectation for technology integration has proven difficult to achieve for many teachers, often due to the nature of technology professional development programs, which in Ghana, have received limited research attention. In response, this qualitative study, based on interviews with 20 teachers, five education officials, and five headteachers, investigated formal technology professional development opportunities in Ghana, including teachers’ knowledge needs and preferred training subjects. Thematic analysis revealed the existence of professional learning communities, district-private partnership workshops, curriculum reform workshops, and cluster-based professional development programs. These in-service training avenues all prioritise equipping teachers with basic technical skills to use technologies as productivity tools. Teachers strongly prefer these skill sets, considering them prerequisites for supporting routine teacher-centred teaching tasks. Findings reveal that most professional development programs and teachers tend to overlook pedagogical transformation and innovation aspects of integrating technology. The study argues that technology professional development should shift from emphasising isolated technical skills training to equally prioritising pedagogical knowledge development for teachers to effectively facilitate student-centred learning and teaching with digital technologies.

Keywords: Formal professional development; knowledge needs; teachers; technology integration; technical skills; pedagogical knowledge development

1 Introduction

This article seeks to examine the nature of formal technology professional development programs, ascertain teachers' preferred training subject and knowledge needs and the pedagogical implications of these in the classroom. The rapid evolution of digital technologies and the changing demand of contemporary pedagogy reveals that pre-service training alone may not be sufficient to equip teachers with the needed competencies for effective technology use that transforms student learning in today's schools (Jones & Dexter, 2017; Trucano, 2016). In response to changing educational demands, formal professional development has become imperative to complement practicing teachers' pre-service education. Such ongoing in-service training is vital to enable classroom teachers to adeptly adapt to the rapid development of digital technologies and the evolving instructional need to leverage technology to drive pedagogical change and improve student learning outcomes, as many governments' ICT in education policies and school curricula now expect (Abedi, 2023; Xianhan et al., 2022).

The effectiveness of technology integration in education is contingent on teachers possessing the requisite skill and knowledge to purposefully use technology as a lever for pedagogical innovation (Liang, & Law, 2023). Formal professional development, operationalised in this research as "district-initiated and structured continuous preparation activities for practicing teachers" can be a significant influence on teachers' ability and knowledge acquisition to integrate technology as an integral or essential tool into the process of teaching and learning (Barton & Dexter, 2020; Bowman et al., 2022). Such formal systems of professional development programs have the potential to positively change teachers' technology integration beliefs, knowledge, and practices, leading to improvements in student

achievement (Ertmer & Ottenbreit-Leftwich, 2010; Jones & Dexter, 2017). However, research reveals that most technology professional development lags and fails to have the intended impact on teachers' preparedness (Lawless & Pellegrino, 2007; Tondeur et al., 2016; Yurtseven Avci et al., 2020). Most teachers have not yet harnessed technology to enhance meaningful student learning outcomes beyond using it primarily as a support tool for traditional teacher-centred curriculum tasks (Abedi et al., 2023; Ertmer & Ottenbreit-Leftwich, 2013). The nature and approaches to technology professional development programs, and their impact on teachers' knowledge, skills, and practices, are seen as important factors to investigate and address in order to enhance teachers' in-service preparation for more effective digital technology use in schools.

2 Teacher professional development for technology integration in Ghana

This study is linked to teacher education reform policies in Ghana, including the 2016 National Teacher Standards, 2012 Pre-Tertiary Teacher Professional Development and Management, and 2017 National Teacher Education Curriculum Framework, which require the training of teachers in pedagogy for technology use. ICT policies, such as the 2003 Ghana ICT for Accelerated Development Policy (ICT4AD) and the 2008/2015 ICT in Education Policies, also underscore the need for pedagogy-oriented teacher preparation to enable teachers to meet curriculum requirements, which advocate ICT use as a pedagogical tool to promote learner-centred pedagogy (Abedi, 2023; Ministry of Education [MoE], 2015, 2018).

Policymakers in Ghana recognise the prominence of professional development to improve teachers' pedagogy for using technology in schools to improve student learning, as evidenced by ICT in Education policies and teacher education curricula. Nonetheless, teachers' effective adoption of technology in classrooms has been challenging, mainly at the primary school level (Abedi & Ackah-Jnr, 2023; Buabeng-Andoh & Yidana, 2015; Mangesi, 2007). Based on recent literature reviews, it is claimed that the integration of technology into

Ghana's education system is still in its early stages of development (Adarkwah & Huang, 2023; Tsapali et al., 2021). Additionally, there has been little research in Ghana evaluating how teachers are prepared for technology integration despite the documentation of technology professional development as a prime education, curriculum, and ICT policy objective. Few studies examine the nature of formal professional development programs and their impact on teachers' knowledge and teaching practice. Tsapali and colleagues (2021) note the scarcity of studies on technology professional development in Ghana's research space, pointing out the need for additional research in this important area to improve practice.

The present study addresses the increasing demand for further research on technology professional development in Ghana, as well as the pressing need to reform teacher preparation programs to enable effective technology integration in education. Such a study can inform the development of appropriate interventions and training strategies to support the continuing professional development of teachers, thereby enabling them to integrate technology into instruction more meaningfully. Using literature on technology professional development approaches, this research examines the perceptions of Ghana's teachers, headteachers, and education officials on formal professional development opportunities, what training teachers prefer to engage in, and their prioritised knowledge needs for effective digital technology use in schools. The study investigated the following research questions:

1. What formal opportunities for technology professional development are available for teachers in Ghana?
2. What specific content and knowledge areas do teachers prefer and need in formal professional development for technology integration?

3 Literature review

3.1 Technology professional development for teachers

Professional development is extensively recognised as the key mechanism employed by countries and education systems worldwide to enhance the knowledge and skills of practicing teachers (Popova et al., 2022). It comprises a range of activities and experiences, including the conditions that facilitate professional learning and systematic growth in individuals' professional roles. Desimone (2009) defined professional development in teacher education as processes and activities affecting practicing teachers' knowledge, beliefs, and practices, as well as student learning. Similarly, Darling-Hammond et al. (2017) conceptualised professional development as a combination of externally provided and on-the-job training activities that aim to enhance teachers' knowledge and facilitate changes in instructional practices, ultimately benefiting student learning.

Scholars such as Ertmer & Ottenbreit-Leftwich (2013), Ertmer & Ottenbreit-Leftwich (2010), and Prestridge (2017) have defined technology professional development in terms of how it changes and develops teachers' knowledge, beliefs, and teaching practices with digital technologies. These researchers argue that for teachers to effectively implement pedagogies that foster constructive learning and active student engagement with technology, it is crucial to develop their knowledge and skills while concurrently reshaping existing pedagogical beliefs and teaching practices through transformative technology professional development programs. Thus, the primary goals of technology professional development include fostering teachers' meaningful integration of technology into pedagogy and ultimately enhancing student learning outcomes (Bowman et al., 2022).

External factors such as technological tool availability and technical support are perceived to have a diminished impact and are no longer significant barriers in many countries. Instead, the literature underlines the significance of internal dispositional factors,

specifically teachers' pedagogical beliefs, knowledge, and skills, in influencing technology integration (Abedi et al., 2023; Taimalu & Luik, 2019; Tondeur et al., 2016). Teachers' knowledge, in particular, is discussed as having an impact on pedagogical beliefs and instructional practices regarding technology use (Ottenbreit-Leftwich et al., 2018; Seufert et al., 2021). Ertmer and Ottenbreit-Leftwich (2010) argue that technological change is closely linked to the development of teachers' knowledge base. This claim means that the change in teachers' knowledge is a condition for transforming teaching and learning with technology. Approaches to effective models of technology professional development and the knowledge teachers are expected to acquire is, however, a source of contention, with the debate centred on whether to prioritise training in specific technologies for regular teaching tasks (technical skills training) or the pedagogy that supports meaningful student learning with technology (pedagogy development). The ensuing section discusses these approaches to technology professional development and their impacts on classroom pedagogy and student learning.

3.2 Approaches to teacher technology professional development (skill re-tooling vs. pedagogical development models)

Many teachers are identified as requiring technology skill development (Power, 2018). Webb and Cox (2004) suggest teachers must possess knowledge, understanding, and familiarity with a variety of technological tools to effectively incorporate technology into the curriculum and cater to students' learning needs. Thus, traditionally, professional development efforts were often aimed to 're-tool' and enhance teachers' competencies in specific types of ICT tools and applications which serves to reinforce the approach to integrating technologies to supplement or augment existing curriculum practices (Daly et al., 2009; Prestridge, 2010). A study conducted by Gomez et al. (2022) reinforces the importance of teachers consistently enhancing their technological skills and knowledge through ongoing professional development opportunities. Kopcha (2010) and Angeli and Valanides (2018) posit that the

level of technical skills possessed by teachers can significantly impact their self-efficacy, confidence, and comfort in incorporating technology into teaching practices.

Professional development with techno-centric aims is becoming obsolete. Prestridge (2010) reports their inadequacy in developing teachers' pedagogical knowledge and recognising technology's transforming potential for improved student learning. It is claimed technical skills-inclined professional development alone can cause teachers to 'domesticate' the computer in regular classroom teaching practices (Bigum, 2012) missing out on the opportunities to change pedagogy and actively engage students in cognitively demanding learning tasks with digital technologies (Ertmer & Ottenbreit-Leftwich, 2013). Some researchers advocate for a renaissance approach to teacher professional development, transcending the mere teaching of technical techniques and basic handling of technology (Thurm et al., 2020) and emphasising the importance of addressing the changing landscape of education and fostering teachers' confidence in pedagogical change with digital technologies (Loveless, 2008). Willermark (2021) argues that technology professional development should aim beyond basic technical skills attainment to enhance teachers' pedagogic capacity to enrich the curriculum and transform student learning. The arguments for pedagogic-centred professional development underscore the recent shift in focus towards pedagogical innovations and the imperative of seamlessly integrating technology as an integral tool into curricula and the teaching-learning process (Liang & Law, 2023).

Polly and Hannafin (2010) suggest the need for a learner-centred and transformative model of technology professional development that focuses on student learning and provides an avenue for the development of teachers' knowledge for pedagogical change that meets the expectations of schooling in the digital era. To achieve more transformative outcomes in technology professional development programs, Mishra and Koehler (2006) in their famed Technological pedagogical content knowledge (TPACK) advocate integrating technical skills

with pedagogical and subject matter content knowledge development to promote constructivist teaching practices and deeper student engagement with technologies. The attention is, hence, shifting from professional development with ‘technical retooling competence’ orientations and a focus on the technology itself to those that strengthen teachers’ pedagogical knowledge and overall capacity for the constructive use of digital technologies that enhance students’ learning and preparation for the future.

4 Methodology

4.1 Study design

This research paper, adopting a qualitative research approach, is a subset of a broader research project that employed an interpretive qualitative case study methodology to investigate the holistic preparation of teachers for technology integration in Ghana. The larger study encompassed various aspects of teachers’ technology preparation, including pre-service education, formal professional development, and informal learning. The research presented in this article explores formal professional development pathways and the knowledge teachers prefer for effective educational technology use, drawing on teachers’, headteachers’ and education officials’ nuanced experiences and perceptions. The study obtained ethical approval from Griffith University’s Human Research Ethics Committee.

4.2 Instrumentation, study settings and participants

The data collection instrument employed in this research project was qualitative semi-structured interviews. Interviews are essential instruments in qualitative research for capturing detailed experiences of individuals and achieving a detailed understanding of a study phenomenon (Brinkmann & Kvale, 2018). The interviews in this study were conducted remotely through telephone and internet-based voice communication, as the researcher was not physically present in the field. An increasing number of empirical research support the

validity of telephone interviews as a viable option for gathering qualitative research data online (Tomás & Bidet, 2023). Research directly comparing telephone and face-to-face qualitative interviewing methods has determined that technology-mediated interviews produce data of similar quality and depth compared to in-person interviews (Vogl, 2013).

A purposeful sample of 30 participants, including 20 teachers, 5 headteachers, and 5 education officials, was selected for the study. These geographically dispersed participants were chosen due to their knowledge of and engagement with formal professional development activities, with the anticipation that their data would offer valuable insights for the study. The participants were drawn from two school districts—Nsawam-Adoagyiri Municipality and Fanteakwa-North District—located in Ghana’s Eastern region. The school districts were chosen primarily for accessibility and the convenience of data collection from an available participant pool, given the researcher’s inability to travel to the field owing to COVID-19-associated travel restrictions and border closures. The two districts were elected not for comparison, but rather to provide varied contexts and broader perspectives for investigating the phenomenon under study. Participants were identified and recruited through a snowball sampling strategy, a method in which the researcher collaborated with local stakeholders and intermediaries to introduce the research and initiate participant recruitment. In this method, initial participants were identified and then asked to recommend or refer other potential participants who might meet the study’s criteria. The snowballing method was instrumental in initially building trust and rapport with the participants. In addition, establishing contact with participants through texts and phone calls to schedule interview times and dates facilitated rapport prior to the actual interviews.

The research included participants from diverse backgrounds, spanning various ages, work experiences, and academic qualifications. The teachers’ age range was predominantly between 30 and 34 years, and they had varying teaching experiences ranging from 2 to 12

years. All the teachers held a Bachelor of Education degree and were professionally trained. The selected headteachers were all males, with the majority falling in the age group of 35-39, and the oldest headteacher being between 50-54 years old. Eighty percent of the headteachers had a bachelor's degree in education, with one holding a master's degree in educational leadership. Their headship experiences spanned from two to six years. All five education officials were males and held positions as Circuit supervisors, Municipal Training Officers, and Municipal ICT coordinators. Three of the officials held bachelor's degrees, while the other two had master's degrees. Their professional experience spanned from 2 to 20 years. To ensure privacy, pseudonyms are assigned to all participants. Informed consent was given by all participants prior to participation, and no identifying information was collected.

4.3 The telephone interview procedures

To start, the researcher conducted a pre-test of the interview protocols with a group of participants who possessed similar traits to those in the main study sample before conducting the actual interviews. This step aimed to determine the most effective question flow, estimate interview duration, and ensure clarity of questions. Following the pre-test, the reviewed interview questions, which included topics such as the types of formal professional development teachers receive and the knowledge and skills most preferred for technology integration, were shared with study participants in advance. With ample time to reflect on the questions and prepare answers, participants were better familiarised and prepared for the interview's scope and gave more thorough responses. Telephone calls to participants were facilitated through WhatsApp, a commonly used communication software application, installed on both the researcher's and participants' smartphones.

On interview days, participants were called at pre-scheduled times when they were expected to be at home. The stability of participants' Internet connections was confirmed in advance to determine the best locations for the interviews to prevent any unforeseen

network problems that might undermine the quality and flow of the interviews. The interviews were conducted in a friendly, relaxed, and unbiased manner to encourage open and candid responses. Extreme probing or follow-up questions were avoided to avoid influencing responses. When participants had trouble understanding a question, the researcher repeated or rephrased it and provided examples to help them understand. Each interview lasted about 50 minutes. With participants' consent, the interviews were recorded digitally and transcribed.

4.4 Data analysis

The data collected from the interviews with the participants was familiarised and analysed using thematic analysis, following the procedures outlined by Braun et al. (2019). The dataset was thematically analysed by recurrent coding and classifying similar concepts and words to identify dominant themes that were relevant to the research question. Through this reflective analytic procedure, categories of codes were extracted to generate overarching themes and findings pertaining to the formal professional development pathways for technology integration in Ghana. The emergent final themes were subsequently examined and discussed within the context of technical and pedagogical knowledge and approaches to technology professional development. This analysis provided a deeper insight into the type of training typically provided by professional development programs to teachers and the knowledge teachers prefer to attain from such programs for effective technology integration.

5 Findings

5.1 Formal technology professional development for teachers

This section presents findings on four key professional development programs that support teachers in their ongoing learning for technology integration.

5.1.1 School-based professional learning communities

The majority of participants, comprising fourteen teachers, three headteachers, and four education officials, identified professional learning communities (PLCs) in schools as key professional development programs for teachers to learn about using educational technologies. Participants regarded PLCs as a platform for peer-to-peer learning, where teachers from the same school convene regularly to exchange knowledge, ideas, and experiences related to academic and instructional matters. PLCs offer teachers opportunities for collaborative learning, enabling them to learn and benefit from the expertise of their more experienced colleagues regarded as ‘experts’ in using technology. “PLCs offer a platform for teachers who are well versed in ICT to train others to use technology to supplement instruction”, a Ghanaian Language (Twi) subject teacher stated. An education official, also indicated PLCs allow teachers to collaborate and share knowledge about how to use technology to supplement classroom teaching tasks, particularly lesson delivery.

There has been an introduction of a new standards-based curriculum that has a mandatory Professional Learning Community session as part of the school timetable. Teachers in schools meet and share problems encountered in the classroom and ideas on how to improve their lesson delivery with technology.
(Education officer 1)

While collaborative learning opportunities in PLCs were recognised as valuable for teachers to learn from peers, PLCs were specifically designed and introduced with the primary goal of preparing teachers for the use of educational technology. A primary school teacher stated, “ICT lessons are given during PLCs, but they are not solely for technology integration.” A Headteacher agreed with the primary school teacher that PLCs exist not only for preparing teachers for technology use but also for general teacher professional development. “We do organise school-based meetings [PLCs] for teachers to learn, but it is not solely based on learning how to integrate technologies...it includes other subject areas”. Despite the limited

focus and degree of technology integration training offered, some teachers reported PLCs are helpful in supporting training for the use of technology in the classroom.

My school organises professional learning communities where teachers [...] study and share ideas about teaching challenges. Some ICT lessons on how to teach and integrate it into other teaching [subjects] are taught... My ICT integration abilities have improved [because] of the little tuition [training] I received from other teachers who are given a chance to lead on how to integrate ICT [during] professional learning communities. (Primary 2 school teacher)

The small number of teachers who often participate, and the collaborative nature of PLCs, make it desirable for teachers to learn from peers to enhance self-efficacy in using technology to support teaching tasks. Contrarily, some participants expressed scepticism regarding the effectiveness of PLCs as learning platforms for training in technology use, arguing the amount of technology training provided within PLCs is often limited compared to the broader range of general educational topics discussed. A headteacher opined that technology integration topics often receive little attention during PLCs.

PLC was implemented not a while ago in schools. It was only recently started with the introduction of the new pre-tertiary curriculum. Topics about ICT [integration] have only been raised once or twice, which is not enough for teachers to learn about it. (Headteacher 2)

5.1.2 District-private partnership formal workshops

The findings revealed that formal professional development programs, facilitated through collaborations between private organisations and district education departments, provide opportunities for teachers to acquire knowledge about technology integration, particularly in districts with limited possibilities for continuing professional development. Despite restrictions in accessing these workshops, fifteen participants, including education officials, headteachers, and teachers, acknowledged these programs as effective avenues for preparing teachers to use educational technology. In contrast to other district-led programs, which tend to be more general in scope, participants highlighted the focused nature of private-public workshops in delivering targeted technology training to teachers

An education official noted the importance of non-governmental organisations in assisting teachers with technology training. He stated, “The district education does not usually provide direct support for teachers’ ICT professional development...however, it is the NGOs who often help organise it for teachers in the district” (Education Officer 3). Another education official revealed that through a partnership between his district and a private university, teachers in the district receive annual professional development in the use of technology in the classroom. He stated, “Our district currently collaborates with a university, which provides ICT training to teachers...they [university] help us to organise ICT workshops once a year” (Education Officer 4).

Despite the importance of district-private collaborative programs in supporting teachers’ technology preparation, some participants indicated these workshops occur less frequently than other district-initiated professional development programs, such as school-based PLCs. Most district-private workshops, according to participants, are also limited to a few teachers, particularly those who teach ICT as a curriculum subject. The mathematics teacher and the Ghanaian Language teacher, both of whom did not teach ICT, stated that they had yet to participate in district-private workshops because such programs are typically not available to general subject teachers.

There is no [training] support for teachers [to integrate technology] except for a private company that organised one for ICT teachers years ago. It was organised for only a few selected ICT [subject] teachers who were given laptops after the training. (Mathematics teacher 1)

Although NGOs collaborate with the Ghana Education Service to organise workshops for teachers, ICT integration is rarely featured... In the case of ICT training, it has been reserved for only ICT [subject] teachers. (Ghanaian Language (Twi) teacher)

An ICT subject teacher resented the limited nature of district-private ICT workshops, suggesting such programs should be “organised for all teachers”. Many participants,

nevertheless, agreed that district-private workshops are more beneficial because they offer hands-on training and authentic experiences with technology tools. Additionally, teachers are on occasion given laptops to practice with during and after such workshops, which encourages ongoing learning and technology use in classrooms. Two ICT subject teachers remarked that these benefits make district-private workshops more preferred to learn about technology use than other district-initiated programs.

Private-district workshops are well-organised and practically-oriented than district-organised workshops. Certificates are given, and the most important aspect is they can provide a laptop for every teacher who attends to practice during the training. (ICT subject teacher 5)

With NGO workshops, we have the opportunity to practice what is being taught. They give us laptops to use for practice and to teach our students with. Topics taught are already on the laptops in the form of video tutorials, making it possible for us to learn effectively during training and on our own at home once the workshop is completed. (ICT subject teacher 2)

5.1.3 Curriculum-based reform workshops

Nine participants, including two education officials, a headteacher, and six teachers, reported that district-by-district in-service workshops that accompany curriculum reforms enable teachers to receive technology integration training. These workshops often aim to train teachers on new curriculum introductions and innovative teaching approaches. Unlike district-private workshops that usually target ICT teachers, curriculum reform workshops are organised and mandated for all teachers across subject areas. A year two teacher shared her experience with technology training as part of a curriculum reform workshop for all teachers.

We [teachers] learned about ICT during a district-organised training on a new standard-based curriculum for pre-tertiary [Basic] schools, where all teachers in the district were trained on various aspects of the new curriculum... It [the workshop] was for all teachers and subject areas, including ICT [in education]. (Primary 2 school teacher)

A mathematics teacher had a similar experience with a curriculum reform workshop in which he learned about using technology in the classroom as part of other subjects.

When the curriculum was changed, teachers received nationwide in-service training on the content and using ICT to teach together with other subjects. It was an activity-based training, which aided easy retention. The whole training was practical, and that added to its effectiveness. (Mathematics teacher 1)

A Social Studies teacher explained that technology training during curriculum reform workshops assists teachers in learning how to use specific technology tools to support teaching activities and deliver instruction. She posited many teachers now teach and present lessons with their mobile phones as support after attending a recent reform workshop.

Teachers recently went for a workshop when the curriculum was introduced. It was during this one-week workshop that we were taught to use technologies as teaching and learning materials. They taught us how to teach with our phones and laptops because ICT is now a major part of the new basic education curriculum. The workshop has helped as most teachers now improvise by using their phones to enhance lesson delivery. (Social Studies teacher)

The excerpts from the Social Studies teacher suggest curriculum reform workshops offer avenues for new teaching methods and technological tools to be introduced to teachers to aid instructional delivery in the classroom. A headteacher concurred that technology training is an important component of district curriculum reform workshops for teachers to support instructional delivery with technologies, though this is not their primary purpose, as they are intended for general professional development activities.

Yes, they [teachers] occasionally attend curriculum reform workshops organised by the district, though these workshops are not specifically organised for ICT integration. They are general training and professional development activities that cover a wide range of subjects and topics at the basic school level. (Headteacher 3)

5.1.4 Cluster-based formal professional development

Cluster-based professional development organised in zones, according to three education officials, a teacher, and a headteacher, provides openings for teachers to learn about using technology to support teaching practices. Participants described these formal programs as general district-wide training programs whereby teachers from various school zones gather,

based on the class level they teach to prepare on general educational issues and share ideas about new developments in the classroom, including using technology in teaching. These programs are held yearly around the country on a determined day known as ‘Professional Development Day’. Students do not attend school on this day as it is designated for teachers to be present at workshops in clusters in their respective school districts.

With the introduction of the new curriculum, a PD Day was instituted, during which teachers meet in clusters (groups of 5 or 6 schools) to share ideas. Students do not attend school on PD days. The challenges that teachers face in their respective schools are discussed during this one-day workshop, and it includes technology use in the classroom. What some teachers excel at is shared so that others can learn and benefit from it. (Education Officer 4)

Cluster-based professional development programs, like school-based PLCs, are not specifically designed and organised to prepare teachers to integrate technology. A headteacher revealed that learning about technology is instead part of general training topics and subjects aimed at improving teachers’ overall teaching practices in schools.

They organise cluster-based meetings once a year for teachers to meet and learn, but it is not solely focused on training them [teachers] on how to integrate technologies in classrooms. Other general subjects and topics are covered as well. (Headteacher 1)

A year four primary school teacher, like the headteacher, stated that cluster-based professional development assists teachers in learning to use technology, although this is not its sole focus. She posited, “It is not particularly about ICT integration”. Instead, during such workshops, “teachers are trained in general classroom subject areas where they face difficulties”.

5.2 Perceived impact of technology professional development opportunities

This segment presents findings on the perceived effectiveness of formal professional development programs in providing teachers with opportunities to learn technology use.

5.2.1 Professional development enhances technical skills, awareness, and confidence

Participants acknowledged available formal professional development programs for their effectiveness in developing teachers' technical skills and boosting their confidence in using educational technologies to support teaching tasks. These programs were also seen as effective in increasing teachers' awareness and introducing them to new teaching methods, including the use of technology. An ICT subject teacher's experience with a technology professional development program left a strong impression on him, as it furnished him with new ideas, knowledge, and skills to integrate technology.

The in-service training, I received had a positive impact on my integration competencies as the program met my needs in ICT. It has provided me with additional knowledge and new ideas, and different ways of teaching with ICT. (ICT subject teacher 1)

Other teachers likewise recognised the impact of formal professional development on their ability to effectively use specific technological tools in teaching. A math teacher discussed his participation in a district-sponsored workshop that equipped him with the skills to use simple technologies such as mobile phones to enhance his teaching and lesson presentations.

The professional development I had impacted me positively. It has helped me to teach effectively and made students more comfortable with my teaching methods. The impact I would say is positive on my current competencies because it has helped me in the way I deliver lessons using simple ICT tools like the mobile phone and computer. (Mathematics teacher 2)

Participating in formal professional development has proven to be a confidence booster for some teachers to use technology in instruction. A primary six teacher expressed how these workshops have helped demystify the complexities associated with technology integration, ultimately simplifying the process, and increasing his confidence.

It [district-initiated professional development] has given me the confidence to teach with ICT tools with ease and has made the complexity of ICT to be simple. It has increased my level of competency in teaching with ICT and enlightened me more on ICT use. (Primary 6 school teacher)

The primary six teacher added that his participation in district-led professional development has enabled him to enrich his lesson note preparation with Internet-based learning materials, thereby enhancing the quality of his teaching and lesson delivery.

It [district-initiated training] has taught me many things I did not know. It has improved my teaching. With the help of ICT, I can go to certain websites to research and generate the learning notes, pictures, and other materials that I want to give to my kids [students], which has helped me improve my teaching and lesson delivery. (Primary 6 school teacher)

The data presented shows that certain professional development programs have been successful in raising teachers' awareness of the potential benefits of employing new pedagogical tools to support their teaching. Participants in these programs reported heightened awareness of technology integration and the value of using specific technological tools in instructional practices. An education official cited an example in which teachers, who had previously identified a lack of computers as a deterrent to integrating technology, became more receptive and oriented toward using technologies such as mobile phones to support instruction after participating in certain professional development programs.

Upon visiting teachers in classrooms after such [formal professional development] activities, I noticed that some had changed their old ways [methods] of teaching. A teacher, who had always complained about the lack of ICT resources to support teaching, was using his mobile phone to teach, which was really amazing. Teachers learn that in the absence of a laptop and Wi-Fi or router, they can [still] use mobile phones to support teaching. (Education Officer 1)

These findings exemplify how formal professional development can broaden teachers' perspectives, help them overcome obstacles, and foster a mindset that focuses on leveraging available resources to integrate technology. Existing professional development pathways play a crucial role in shifting teachers' orientations and showcasing alternative teaching ways, enabling them to be aware and driven towards supporting teaching activities with technology. Teachers acquire technical skills in ICT and develop the confidence to prepare and deliver lessons using the limited technological tools and resources available to them in schools.

5.3 Technology professional development approaches and needs of teachers

This division concludes with a presentation of the professional development, skills, and knowledge preferences and needs of teachers for technology integration.

5.3.1 Knowledge of technological tools and software (mastery of technical skills)

Most participants, involving two education officials, four headteachers, and ten teachers, expressed the need for technology professional development that equips teachers with proficiency in specific technological tools, programs, and software to support classroom instruction. Teachers' lack of knowledge and experience with technologies such as projectors and PowerPoint was cited as the primary reason for their need for technical skills-oriented professional development. A headteacher highlighted the essentialness of such technical skills, noting most teachers struggle with technology integration in these areas. "Knowledge of these two [projector and PowerPoint training] are the most critical needs my teachers require to integrate technology in the school." He added, "Once teachers are trained in the use of a variety of technological tools, they will be able to use them to assist their lesson delivery and presentations." (Headteacher 1). Another headteacher assented, stating, "With sufficient technological skills training, teachers would know computer programs and tools, and may be able to select those that can support technology integration" (Headteacher 3).

Many teachers agreed with the headteachers that professional development should focus on technical skills because they are prerequisites for effective technology integration. The two primary school teachers' excerpts below best demonstrate teachers' need for technical skills-based professional development, which many teachers consider essential for learning basic technologies for lesson preparation and presentation.

I prefer training in computer hardware and software that I can use to teach. Knowledge of websites and software will assist us [teachers] in researching and downloading a variety of teaching materials for lesson preparation... (Primary 6 school teacher)

We [teachers] first require basic technical [skills] training. I need to understand everything there is to know about Microsoft Excel, spreadsheets, and using a projector for PowerPoint presentations. Anything about [the use of] ICT resources should be taught first. (Primary 2 school teacher)

An ICT subject beginning teacher stated that knowing how to use specific technological tools is crucial, especially for female teachers, who often face challenges in teaching with technology.

ICT training must focus on ICT tools and how to use them. The majority of teachers are not familiar with ICT tools and even how to manipulate [use] them. They, particularly my female colleagues, find it difficult to teach [with ICT] as a result of this. (ICT subject teacher 6)

The excerpts given show teachers, for starters, demand professional development that focuses on providing them with technical skills in ICT. Teachers express a preference for initially acquiring technical skills to build confidence and comfort with technological tools. They believe that mastering technical skills is a necessary prerequisite before effectively integrating technology into pedagogy to enhance teaching and learning. Teachers see professional development with a technical ‘retooling’ focus as a panacea for technology use.

5.3.2 Knowledge of pedagogy (Pedagogical knowledge development)

A relatively smaller number of participants; three education officials, one headteacher, and seven teachers, expressed a desire and advocated an approach to professional development that gives precedence to developing teachers’ pedagogical understanding and knowledge of how to use technology to transform teaching and enhance student learning. An education official indicated what is currently needed the most is “regular provision of in-service training opportunities that equip all teachers with the methodology of integrating technology into teaching.” (Education Officer 3). Another official compared the training and knowledge teachers require foremost, concluding that “looking at the competencies teachers need to integrate technology, how to support teaching with technology is the real problem and need.” (Education Officer 1). Many education officials, as shown in the excerpt below, believe that

pedagogical knowledge development should be the primary goal of professional development because many teachers are already familiar with basic technology tools.

An ideal ICT professional development course is one that will give [train] teachers the pedagogy of using ICT tools to teach.... Teachers are already aware of the use of ICT, so they need pedagogical training in how these tools can actually be used to facilitate teaching and learning activities... When they are taught how to use ICT tools to teach, I believe they will be able to integrate ICT with the resources they have at their disposal. (Education Officer 4)

In comparison, a small number of teachers conveyed the need for professional development that expands teachers' knowledge of the pedagogy that supports effective educational technology use. A year 5 school teacher, one of the few teachers who indicated a preference for this knowledge, argued that pedagogical-based training is required for teachers to advance their use of technology to improve teaching, claiming that simply learning technical skills in ICT is insufficient for more effective technology integration.

I prefer the pedagogical aspect because it will improve teaching delivery...we [teachers] will get in-depth knowledge of how to teach with technology [...] effectively. I believe the pedagogical aspect is very important in improving our instructional delivery...just teaching us how to use computers is not good or enough for us. (Primary 5 school teacher)

This smaller group of participants recognises the significance of meaningfully integrating technology and advocates an approach to professional development that goes beyond basic technical skills training in ICT and focuses on teachers to help them understand the pedagogy that promotes the effective use of technology to transform instruction and student learning.

6 Discussion

Four professional development programs were identified as informative platforms through which the Ghana Education Service, local district education directorates, and on occasion, private entities provide training to teachers to integrate technology. School-based PLCs were perceived as the most frequently organised formal professional development program while

district-private workshops and private entities were acknowledged as playing the most crucial role in preparing teachers to use educational technology. The latter finding echoes the research of Kozma (2008) and Haßler et al. (2015), which suggests that private entities play central roles in providing training for teachers in developing nations to support technology integration. This is often due to funding constraints that hinder the implementation of district-led professional development programs in such countries. All formal technology training programs found were perceived by participants as being critical corridors for teachers to become aware of, oriented towards, and motivated to confidently integrate technology at a basic level in the classroom.

The main research questions in this study included the availability and characteristics of current technology professional development opportunities for teachers. From the findings, there were only a limited number of formal training programs specifically designed and oriented toward preparing teachers for technology integration. Most training programs identified are generic, with a primary focus on general teacher preparation and continuing education covering a variety of topics, including the use of educational technologies. The content of these programs seems to centre on preparing teachers to use specific technological tools for the creation and delivery of instructional content, which many teachers find highly beneficial. Teachers perceived that acquiring such technical skills increased their awareness, confidence, and reorientation toward using basic technologies to support classroom instruction. These findings, which point out the predominantly technical skills approach in most programs, contrast with current arguments advocating for a shift away from the mere mastery of technical skills for productivity. Instead, there is a growing prominence on pedagogical knowledge development that enables pedagogical change and heightens students' engagement with technologies for deeper learning outcomes (Ertmer & Ottenbreit-Leftwich, 2013; Thurm & Barzel, 2020; Willermark, 2021). This transition is supported by the current

need for pedagogical innovation (Liang & Law, 2023) and the claim that when teachers receive professional development that prioritises technical skills, they may become stuck using technology to supplement traditional practices without a change in pedagogy, resulting in low cognitive learning outcomes (Daly et al., 2009; Prestridge, 2010).

The second research question delved into teachers' preferences regarding the types of professional development they seek, along with their specific knowledge needs for effective technology integration. The data revealed teachers desire training programs that outfit them with technical skills and knowledge pertaining to particular technology tools and software as a crucial first step for technology integration. Before seeking knowledge to support pedagogical change, most teachers believe they must first master technical skills to increase their use of technology to supplement regular teaching practices. The argument for technical skills training is based on the premise that teachers must first acquire familiarity with the technology itself before they can effectively integrate it into their teaching practices. This key finding is consistent with Angeli and Valanides' (2018) and Kopcha's (2010) claims that teachers' perceptions of their technical skill mastery can significantly impact their self-efficacy, confidence, and comfort levels in incorporating technology into teaching practices. Teachers believe that for effective technology use in instruction, they must possess technical knowledge and be well-acquainted with various technological tools. This observation aligns with Power's (2018) argument that many teachers require technology skill development.

Professional development programs with techno-centric aims may be considered redundant and less effective for enabling teachers to constructively integrate digital technologies as cognitive tools in instruction and achieve meaningful student learning outcomes (Ertmer & Ottenbreit-Leftwich, 2013; Prestridge, 2010). However, based on the study findings, it becomes evident that these training approaches are perceived as a

precondition for effective educational technology use and are preferred by most teachers in Ghana, especially those who may still be in the early stages of technology adoption. While techno-centric training programs might not be deemed the most optimal, the findings indicate they serve as a stepping-stone for many teachers to become familiar with digital technologies. This familiarity can lay the foundation and potentially foster a gradual change toward more meaningful technology integration in the future. Overall, the study findings reveal a gap between teachers' preferences and their predominant preparation in acquiring technical skills for productivity, as opposed to Ghana's ICT policy and teacher education policy primacies that teachers should receive pedagogy-centred technology professional development to facilitate a shift from teacher-centred to student-centred teaching and learning in schools.

7 Conclusion and implication

This paper has aimed to explore the nature of formal technology professional development programs, the knowledge and skills sought by teachers, and the resulting impact on pedagogy within classrooms in Ghana. The discussion of the findings foregrounds that both formal professional development programs and teachers' training and knowledge needs intersect and are inclined toward attaining basic technical skills. Teachers place significant value on technical skills, as they perceive it to be fundamental in improving their use of technology as a productivity tool to complement regular teaching practices. An overarching belief is that technical proficiency is a prerequisite and exerts a significant influence on teachers' use of technology. This belief influences and reinforces teachers' utmost preference for technology professional development that prioritises the enhancement of technical skills and knowledge in ICT. However, teachers require more than isolated technical skill training, as such training may not always facilitate pedagogical innovation and transformation. Instead, what should take precedence for more effective technology integration is an approach to professional

development that equally nurtures transformative changes in teachers' pedagogical beliefs, knowledge, skills, and teaching practices in the classroom.

The study findings hold substantial implications, highlighting the necessity of shifting the focus of teachers, training facilitators, and teacher educators towards the enhancement of teachers' pedagogical skills and knowledge. This shift is essential in moving from the prevalent teacher-centric approach to a student-centric instructional method, aligning with the mandates of Ghana's curricula and education policies, which underscore the significance of pedagogical training and the constructive use of technology to enhance learning outcomes. Hence, rather than solely focusing on developing technical expertise, it is recommended that technology professional development programs should emphasise the integration of teachers' technical skills with the development of their pedagogical knowledge. This approach coheres with the principles of TPACK, which is considered an effective framework for guiding the preparation of teachers in understanding pedagogical strategies that could enable transformative technology integration and promote new ways of student learning. Whereas pedagogical knowledge change is crucial, it may not be sufficient on its own to ensure a transformation in classroom instruction. It is equally imperative to provide additional support for teachers, including adequate access to technology resources and mentoring to effectively translate pedagogical knowledge changes into teaching practices.

The study had two limitations. First, it relied on self-reported data on technology professional development programs and the knowledge teachers seek to attain. The reliance on self-expressed perspectives has the potential to introduce biases into the findings. Future research could involve direct observations of actual training programs and teaching practices. This approach could offer a more precise understanding and firsthand insight into how existing formal professional development initiatives are preparing teachers for technology integration in Ghana. Secondly, the findings were based on 30 participants from two districts

within a single region, which could potentially limit their generalisability to teachers across Ghana. Future research could be broadened to cover a more extensive and diverse participant pool, including teachers, headteachers, and education officials from various school districts and regions to enhance the generalisability of the findings. An important future extension of this research would be to look into context-specific training practices that could possibly help teachers acquire pedagogical knowledge in technology professional development in Ghana.

Declaration of Competing Interest

The author declares no potential conflict of interest.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

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