Empowering Ghanaian Teachers: Unlocking Digital Skills and Classroom Innovation through Professional Learning Communities

Belinda Agbale & Willian Edusei-Mensah
Beijing Normal University, China

ABSTRACT

The transformative impact of digital technologies on education requires teacher candidates, as key facilitators of this transformative educational experience, to undergo a shift in their learning approaches to effectively address the unique needs of the emerging generation of learners. In response, Ghana introduced the Secondary Education Professional Development Program (SEPDP) to enhance teachers' digital competencies and support ICT integration in Senior High Schools (K-12). This study evaluates the program's impact on 17 in-service teachers from three Ghanaian K-12 schools, focusing on digital hardware and software, information and data literacy, and communication and collaboration. The study analyzed qualitative data with MAXQDA software to identify key themes. Findings revealed that the teachers identified gaps (complexities to collaboration, limited resources, conceptual adaptations) in SEPDP although it enhanced teachers' exposure to digital technologies, improved ICT integration into teaching, and fostered belief and attitude changes toward digital tools through collaborative learning in professional learning communities (PLCs). The findings also underline the importance of sustained and adaptable training programs to empower teachers and enhance ICT integration in education. These findings support the framework of teacher change and constructivist theory concerning knowledge construction and change through experience. This study highlights implications for designing effective digital PLCs, emphasizing hands-on training, collaboration, and contextually relevant content to address varying levels of teachers' digital competence. Future research should explore the long-term impact of professional development programs, integration of emerging technologies, and scalability of PLCs.

Keywords: *ICT; Teacher professional development; Digital competencies; K-12 schools; Education Technologies*

INTRODUCTION

Education in the 19th and 20th centuries was static, linear, and highly standardised, primarily aimed at preparing individuals for specific jobs and personal fulfilment (OECD, 2019). However, education in the 21st Century is becoming flexible, wide-ranging, and inclusive (Bayley, 2022). This paradigm shift is driven by the rapid advancements in technology and the evolving demands of the global economy. This paradigm shift also necessitates transforming pedagogical approaches to equip students with the skills required for the contemporary digital age (Global Education Monitoring Report Team, 2023). Moreover, the advent of the Fourth Industrial Revolution underscores the importance of digital literacy and competency. Unlike previous industrial revolutions, characterized by the mechanisation of labour and the mass production of goods, the Fourth Industrial Revolution is marked by the fusion of technologies that blur the lines between the physical, digital, and biological spheres (Schwab, 2017). This fusion requires a workforce adept at using digital tools and technologies, critical thinking, and problem-solving skills. As key agents of educational transformation, teachers play a pivotal role in shaping students' engagement in educational technologies; thus, there is a need to refine teachers' professional instructional practices (Badawy, Ali, Khan, Dashti & Katheeri, 2024).

As key facilitators of this transformative educational experience, teacher candidates must undergo a shift in their learning approaches to effectively address the unique needs of the emerging generation of learners (Martinez, 2010). Teacher Professional Development (TPD) is crucial in preparing teachers to become proficient in using technology. Research shows that effective TPD programs significantly enhance teachers' skills, knowledge, and confidence in teaching (Şahin, Sarı, & Şen, 2024; Sapkota, Gamlem & Vattøy, 2023). This study focuses on teachers' professional knowledge and performance change, emphasizing technology integration in TPD programs. TPD programs have been seen as essential to equip teachers with the necessary skills and knowledge to integrate ICT into their teaching practices (Darling-Hammond et al., 2017). The 2015 World Education Forum emphasized the need for leveraging ICT to enhance education systems. It recommended strategies such as improving teachers' ICT skills, reforming pedagogies, and developing suitable software and courseware (UNESCO, 2015).

One significant challenge is teachers' resistance to change (Pongsakdi, Kortelainen & Veermans, 2021; Reisoğlu, 2022). Many in-service teachers also exhibit reluctance to adopt new technologies due to a lack of confidence or familiarity with digital tools. This resistance often stems from deeply ingrained beliefs about teaching and learning, which are difficult to alter (Ertmer & Ottenbreit-Leftwich, 2010). The importance of teachers' digital competencies cannot be overstated, as teachers' low confidence and competence in digital skills remain a significant barrier to technology integration in pedagogical practices (Hadad, Shamir-Inbal, Blau, & Leykin, 2021; Hu, Yeh, & Chen 2023; Kim et al., 2017; Pongsakdi et al., 2021; Reisoğlu, 2022). A notable deficiency exists in teachers' confidence and competence in using digital technologies for assessment and evaluation, with many teachers relying on traditional methods due to insufficient digital training (Benali, Kaddouri & Azzimani, 2018; Brun & Hinostroza, 2014). Additionally, technophobia - anxiety or fear when dealing with technology - poses another barrier (Howard, Chan & Caputi, 2015). Many teachers enter the profession with limited digital skills and require targeted support to enhance their competencies (Koehler & Mishra, 2009). Since teaching with technology is complex and multifaceted, it must be addressed and integrated throughout teacher preparation programs (Foulger, et al., 2017).

Although technology can be a powerful tool for a country's development, its integration into educational systems, especially in developing countries, is limited. Several barriers hinder the effective integration of ICT in TPD programs. Yue, Jong & Ng (2024) highlighted that inadequate technology content in TPD and low levels of pedagogical and technological knowledge among teachers are significant obstacles. In most developing countries, teachers extensively lack access to computers, the internet, or training in digital skills. This problem translates into a shortfall in the preparation of teachers who are equipped to impart the essential technological skills and knowledge demanded by the contemporary digital age to their students. In most Ghanaian secondary schools, the use of technology in lesson delivery is only done by teachers with background knowledge in ICT (Barfi, Amenu & Arkorful, 2020). A systematic literature review by (Soma, Nantomah & Adusei, 2021) identified teachers' inadequate knowledge of using ICT tools in teaching as one of the challenges associated with integrating ICT into education in Ghana. Another systematic review of ICT integration in secondary schools by (Kholid, Hendriyanto, Sahara, Muhaimin, Juandi, Sujadi, Kuncoro, & Adnan 2023) found challenges related to inadequate technology content in professional development, low pedagogical and technological knowledge, and resource maintenance. According to the OECD (2016), the predominant focus on hardware and connectivity has impeded the implementation of equally crucial strategies, such as enhancing teachers' ICT skills, improving professional development, reforming pedagogies, and creating suitable software and courseware.

Various initiatives have been implemented to enhance teachers' digital competencies in response to these challenges. In Ghana, the Secondary Education Professional Development Program (SEPDP) was introduced in 2018 to address the digital skills gap among teachers. This program

includes 13- and 17-week Professional Learning Community (PLC) workshops designed to help teachers plan and teach learner-centred lessons using ICT, develop 21st-century skills, and use ICT software and hardware for teaching and learning (Brun & Hinostroza, 2014; Sarpong, 2023). Teachers must leave their preparation programs with a solid understanding of using technology to support learning. Effective use of technology is not optional; it is essential from day one in the classroom (U.S. Department of Education, 2017). Therefore, this study employs a qualitative research design to explore teachers' perceptions and experiences regarding the ICT-based SEPDP in Ghanaian K-12 schools. It aims to assess the program's impact on teachers' digital competencies and identify areas for further development. This study seeks to answer the following questions:

1. How has the SEPDP impacted K-12 teachers integrating digital technologies into their teaching practices?
2. What areas of digital competence do K-12 teachers need for further development?

The findings will emphasize the need for targeted interventions and policy initiatives to bridge disparities and foster a culture of digital literacy in Ghanaian schools and developing countries. The study will contribute to the broader discourse on cultivating teachers' digital capabilities in an ever-evolving digital landscape.

LITERATURE REVIEW

Educational technologies have revolutionized teaching and learning, mainly by developing technology-enhanced learning spaces incorporating digital tools, interactive environments, and adaptive platforms. These spaces are shaped by various learning paradigms, such as e-learning (Clark & Mayer, 2016), mobile learning or m-learning (Traxler, 2007), ubiquitous learning (Mohd Tahir et al., 2018), and smart learning (Adu & Poo, 2014; Bower, 2019)). As educational institutions progressively embrace technology-enhanced learning, the importance of teachers' digital competence development is heightened. The transformations brought about by digital technologies highlight the urgency of systemic support in building teachers' digital competencies, ultimately ensuring students are prepared for the demands of a technology-driven society (Koehler & Mishra, 2009).

Developing Teachers' Digital Competencies

Research indicates that well-designed TPD programs can significantly enhance teachers' digital competencies and ability to integrate technology into their teaching practices (Şahin et al., 2024; Sapkota et al., 2023). Teachers' digital competencies, encompassing a range of skills, knowledge, and attitudes related to using digital tools and technologies, play crucial roles in successfully integrating technology into education (Çebi et al., 2022). As Mcgarr & Mcdonagh, (2019) highlighted, possessing technical competencies is valuable, but the ability to critically navigate and leverage digital content across various platforms and devices holds greater significance. This study defines digital competencies as the integrated and functional use of digital knowledge, skills, and attitudes (Aesaert, van Nijlen, Vanderlinde, & van Braak, 2014).

Digital literacy is defined as accessing, managing, understanding, integrating, communicating, evaluating, and creating information safely and appropriately through digital technologies (Law et al., 2018). Different modalities could be employed to develop teachers' digital competencies such as personal learning, school-based learning, government-facilitated programs, and informal learning each contributing uniquely to teachers' professional growth, often complementing traditional TPD. Personal learning plays a significant role, where teachers engage in self-directed

learning through online courses, webinars, and professional learning networks (PLNs). These networks enable teachers to connect with peers, share resources, and collaborate on best practices, providing valuable support for staying current with technological advancements (Vescio et al., 2008). School-based learning also fosters the development of digital competencies through collaborative professional development methods. Peer coaching and mentoring offer hands-on support from experienced teachers, building confidence and competence in using digital technologies (Tondeur, van Braak, Sang, Voogt, Fisser, & Ottenbreit-Leftwich, 2012). Government-facilitated professional development further supports the development of digital competencies through structured programs, workshops, certification courses, and funding for technology integration in schools. Government initiatives often include policies that promote technology use in education and provide the necessary infrastructure and resources (European Commission, 2019). Teachers' Professional Development (TPD) seeks to cause attitudinal and procedural changes in professional teachers (Guskey, 2002). TPD involves continuous learning and training that teachers undergo to enhance their knowledge, skills, and instructional practices. This study advocates professional development programs that support teachers in integrating technology effectively into their teaching practices. In developing teachers' digital competencies, motivation and technology acceptance are critical factors influencing the TPACK development of teachers (Max et al., 2023). Van den Beemt & Diepstraten, (2016) also emphasized the importance of informal learning, social environments, and personal trajectories in shaping teachers' ICT use and pedagogical beliefs, advocating for TPD programs to incorporate informal learning approaches and foster ICT-rich social environments.

Innovative approaches to professional development have emerged as essential strategies for enhancing teaching practices and instructional effectiveness. Training should be participatory and collaborative, fostering an environment where teachers can co-create learning experiences and develop digital and pedagogical skills (Bendtsen, Forsman, & Björklund, 2022; Kaminskienė, Järvelä, & Lehtinen 2022). In this vein, Chaipidech et al. (2021) emphasized the importance of personalized learning systems in fostering teacher growth in digital pedagogy. Similarly, Ma et al. (2023) demonstrated the effectiveness of knowledge maps and collaborative learning strategies in online TPD. Their findings illustrate the effectiveness of both strategies in enhancing teachers' learning performance. Hennessy et al. (2022) also advocated for a prevalent focus on technology skills among teachers and indicate a need for greater emphasis on instructional strategies tailored to students' needs.

Effective TPD programs often involve collaborative participation, where teachers work together to explore and implement new teaching methods, fostering a supportive community of practice (Garet, Porter, Desimone, Birman, & Yoon 2001). These collaborative approaches have been found to significantly enhance teachers' instructional practices and their ability to adapt to new educational challenges.

Professional Learning Communities (PLCs)

PLCs have gained significant popularity among teachers in facilitating collaborative learning. DuFour & Reeves (2016) asserted that PLCs are organized cooperatives of teachers that collaboratively engage in examining and enhancing their instructional methodologies, thus facilitating a systematic framework for ongoing professional development. This method has been particularly pertinent in tackling issues posed by swiftly advancing technology in education since there is an increased necessity for integrating digital literacy into instructional practices. PLCs offer teachers collaborative growth opportunities to enhance their technical skills and pedagogical methods for effectively integrating technology into their teaching practices (Lave & Wenger, 1991). These communities guarantee that teachers are equipped to develop student-centred methodologies that improve engagement, cater to different student requirements, and conform to the objectives of a technology-infused educational framework (Tondeur et al., 2012). Teachers may

exchange best practices, address shared difficulties through professional learning networks, and cultivate a positive attitude toward integrating digital resources in their classrooms (Desimone & Garet, 2015). In addition to technical abilities, the professional learning community emphasizes the pedagogical values teachers must foster in students: critical thinking, teamwork, and self-regulated learning (Scherer et al., 2019). Researchers assert that this collaborative framework will enable teachers to acquire new skills and pedagogical approaches, especially in domains necessitating significant transformation, such as incorporating digital technology (Liu et al., 2024).

PLCs offer this supportive atmosphere where teachers enhance their digital competencies through collaborative learning and mutual assistance. Studies indicate that PLC participation enables teachers to exchange effective practices, explore new technology, and offer feedback on various strategies (Liu et al., 2024). It also encompasses the recursive aspect of digital skill development within the profession through PLC activities.

The Context of Ghana

In Ghana, incorporating digital technology into education has encountered numerous infrastructure obstacles, insufficient resource accessibility, and deficiencies in teacher preparation (Sarpong, 2023). Recent studies indicate that PLCs may serve as a potential solution to these obstacles. El-Serafy et al. (2022) discovered that PLCs in Ghanaian schools foster a culture of collaboration and mutual support among teachers, facilitating the sharing of resources and solutions to shared technology constraints in their institutions. Furthermore, the qualitative perspective offers profound insights into teachers' experiences participating in PLCs. Arkorful et al. (2021) conducted a study involving high school teachers in Ghana. Their findings indicated that participation in PLCs improved these teachers' capacity to use information and communication technology (ICT) in their instructional methods. Teachers indicated enhanced confidence, heightened understanding of accessible technologies, and improved problem-solving abilities about technology utilization.

Despite its potential, Ghana's PLCs face several obstacles. Studies demonstrate that insufficient time, lack of leadership support, and budget constraints hinder successful PLC participation (Carr, 2024). Cultural factors, such as hierarchical structures in educational institutions, may impede the promotion of open collaboration and peer feedback. Researchers have provided several ideas to address these difficulties, including support from leadership, capacity building, and infrastructure development (Dampson, 2021).

Related Theories: The Framework of Teacher Change and Constructivist Theory

The Framework of Teacher Change and Constructivist Theory both emphasize the dynamic and experiential nature of learning, making them highly relevant to understanding how teachers develop their digital competencies. These theoretical frameworks are beneficial when analyzing the processes through which teachers acquire new knowledge and adapt their practices, especially in the context of professional development programs (PDPs) and PLCs.

The Framework of Teacher Change

The Framework of Teacher Change proposed by Guskey (2002) offers a comprehensive framework for understanding how teachers change their beliefs and practices over time because of professional development. Guskey's model emphasized the importance of focusing on student outcomes as a primary driver of teacher change. Teacher change is not a linear or one-time event, but a complex and ongoing process influenced by internal and external factors (Fullan, 2007). According to Guskey (2002), effective professional development programs result in observable improvements in student learning, leading to changes in teachers' attitudes and beliefs about their practices. This model consists of several stages that teachers progress through as they engage in professional development: changes in student outcomes, teacher practice, and teacher beliefs.

Guskey's model suggests that teacher change begins when teachers see improvements in student outcomes after implementing new strategies or technologies introduced during professional development programs. These positive results then motivate teachers to modify their teaching practices further, leading to changes in their beliefs about the effectiveness of their approaches. This cycle continues as teachers refine their practices based on ongoing feedback and reflection. The model acknowledges the importance of support structures, such as coaching and peer collaboration, in helping teachers sustain these changes over time (Guskey, 2002).

In developing teachers' digital competencies, Guskey's model emphasizes the role of student-centred outcomes in motivating teachers to adopt new technologies. Teachers are more likely to embrace digital tools when they see how they enhance student engagement, learning outcomes, and digital literacy. Therefore, professional development programs focused on ICT integration must provide evidence of how digital technologies can positively impact teaching and learning. This aligns with studies such as those by Ertmer (2005) and Gil-Flores et al. (2024) who emphasize the need for teachers to experience firsthand the benefits of ICT in their teaching to shift their pedagogical beliefs and practices.

PLCs play a vital role in facilitating teacher attitude change by fostering collaboration, reflective practice, and evidence-based dialogue. According to Guskey's (2002) Framework of Teacher Change, observable improvements in student outcomes motivate teachers to modify their practices and beliefs. PLCs align with this process by providing a collaborative environment where teachers analyze student data, share strategies, and receive continuous feedback, reinforcing the connection between new practices and positive results. Through peer support, mentoring, and shared experiences, PLCs challenge existing beliefs and encourage the adoption of innovative approaches, including digital tools (Stoll et al., 2006; van den Beemt & Diepstraten, 2016). This collective learning environment sustains long-term attitude change by linking improved teaching practices with enhanced student performance.

Constructivist Theory

Constructivist theory, which originated from the works of Piaget (1964) and Vygotsky(1978), posits that knowledge is constructed through social interaction and personal experiences rather than being transmitted passively from teacher to student. In the context of teacher professional development, this theory emphasizes the importance of active learning, reflection, and creating new meaning based on personal and social experiences. According to this perspective, teachers are not passive recipients of information but active participants in constructing their knowledge.

Vygotsky (1978) introduced the Zone of Proximal Development (ZPD) which is particularly relevant to teacher learning. It suggests that teachers can best develop new competencies when guided by more knowledgeable peers or mentors within their zone of potential growth. This social aspect of learning is central to PLCs, where teachers collaborate with colleagues to share ideas, solve problems, and refine their practices. Studies have shown that teachers in collaborative settings can better integrate ICT into their classrooms because they learn from one another and engage in shared problem-solving (Tondeur et al., 2016).

With regard to digital competencies, the constructivist approach is efficient. As teachers encounter new digital tools and pedagogical methods, their learning process is enhanced when they engage with these tools in authentic, hands-on contexts and reflect on their experiences. A study by Puentedura (2013) emphasized the importance of teachers' active engagement in using digital technologies to develop their technical skills and pedagogical strategies. Furthermore, the idea of social constructivism, which stresses collaborative learning through shared experiences, supports the integration of digital tools into teaching by creating opportunities for teachers to experiment with new technologies in a safe and supportive environment.

Synthesis of Teacher Change and Constructivist Theory in Digital Competency Development

When applied to the development of K-12 teachers' digital competencies, both the Framework of Teacher Change and Constructivist Theory offer a robust framework for understanding teachers' challenges and opportunities in integrating digital tools into their teaching practices. The Framework of Teacher Change emphasizes that digital competencies are developed over time through a process that includes learning, experimenting, reflecting, and adapting. PLCs can play a critical role in this process by providing teachers with the collaborative environment necessary for experimentation and reflection. Constructivist Theory, on the other hand, underscores the importance of teachers' active involvement in their learning processes. Teachers do not simply receive digital skills; they construct them through practical experiences, peer interactions, and ongoing reflection. This aligns with the findings of Tondeur et al. (2017), who concluded that teachers who engage in collaborative and reflective practices can better integrate ICT into their teaching. Both theoretical models highlight the importance of experiential learning and social interaction in teacher development. For digital competencies, the emphasis on collaborative learning, hands-on practice, and sustained support aligns with the goals of digital professional learning communities, which provide teachers with the resources and guidance needed to navigate the complexities of ICT integration.

Conceptual Model

According to Rimini & Spiezia (2016), integrating ICT into education is crucial for preparing students for future challenges. Notwithstanding, UNESCO (2023) observed that the prevailing pedagogical approaches continue to mirror 20th-century standards, rendering students ill-prepared for the demands of the contemporary digital age. Such a misalignment significantly challenges cultivating skills essential for the Fourth Industrial Revolution. The framework of teacher changes by Guskey (2002) asserted that high-quality professional development could bring about change in the classroom practices of teachers, their attitudes and beliefs. The social constructivist theory also underpins the notion of PLCs, asserting that social interaction and collective experience fundamentally shape learning as a collaborative process (Vygotsky, 1978). DuFour & Reeves (2016) described the essential attributes of effective PLCs as a collective set of values and vision, a collaborative culture, an emphasis on student learning, reflective discussion, and shared accountability. Each fosters an environment conducive to professional advancement and the evolution of innovative teaching methods. Studies in several educational contexts have demonstrated that PLCs significantly enhance teachers' digital proficiency. Koehler et al. (2013) showed that PLCs facilitated the enhancement of Technological Pedagogical Content Knowledge (TPACK), enabling teachers to incorporate digital resources into their practices more effectively.

In a comparable study, Cotter (2019) discovered that teachers involved in PLCs expressed enhanced confidence and proficiency in using ICT tools for instructional objectives. Studies suggest that when teachers are exposed to digital technologies and gain meaningful experience with ICT, they are more likely to incorporate these tools into their teaching practices (Ertmer et al., 2013; Howard et al., 2015; Koehler & Mishra, 2009). Teachers becoming familiar with digital resources can better align these tools with educational goals, improving teaching and learning outcomes (Ghomi & Redecker, 2019). Moreover, ICT experience encourages teachers to engage in reflective practice (Ferdig & Roehler, 2004; Gašević, Dawson, & Siemens, 2015; Tripp & Rich, 2011). This reflective process promotes continuous improvement, enabling teachers to adapt and refine their practices (Sang et al., 2010). This adaptability is essential in developing economic contexts as teachers may need to creatively navigate resource limitations while utilizing digital tools to enhance learning. As teachers develop excellent proficiency in ICT, they become more confident in integrating these tools into their pedagogy, which ultimately benefits student learning. These lend support to this study's conceptual framework, which suggests that teachers' technology exposure

made rich through PLC can contribute significantly to their technology use and enhance digital competence among teachers.
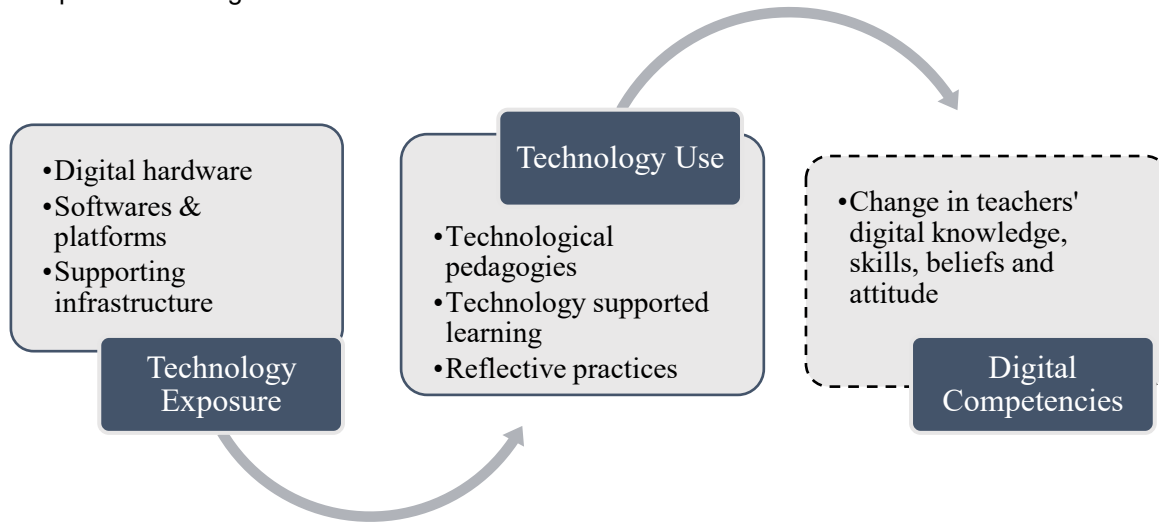
Figure 1: Exposure and Pedagogical Technology Integration Interactions

METHODOLOGY

Context and Participants

In 2018, Ghana introduced the Secondary Education Professional Development Program aimed at equipping teachers with ICT skills to foster the development of 21st-century skills in the classroom. This study focuses on in-service teachers who graduated from a non-ICT-rich curriculum before 2018 and participated in a 13-to-17-week PLC workshop. The workshops aimed to improve teaching quality and relevance through experiential sharing and strategies incorporating ICT and 21st-century skills.

The study involves three senior high schools in the Volta Region of Ghana. Seventeen teachers from these schools who participated in the PLC workshops were selected for structured interviews. These teachers taught STEAM-related subjects (Science, Technology, Arts, and Mathematics) and had three to eight years of teaching experience. They were actively involved in the workshops, which took place from August to October 2023 and January to May 2024.

The participants, selected randomly from three public senior high schools, were professional teachers in service. Among them, 65% were male, and 35% were female. 6% were above 50 years old, 35% were between 41 and 50, and 59% were between 31 and 40. Regarding experience, 24%, 12%, 24%, 18%,18% and 4% had 8, 7, 6, 5, 4 and 3 years respectively, of teaching experience. In terms of subjects, 17%, 24%, 24% and 35% taught (Arts, Mathematics, Science, and ICT), respectively.

Instrument and data collection

The study employed a qualitative approach. Structured interview questions were administered to understand teachers' digital competencies and their application in lesson planning, teaching, and learning. Interviews were conducted through phone calls to participants. The interviews were audio-

recorded with participants' consent and later transcribed for analysis. The questions were based on the Global Framework of Reference on Digital Literacy Skills developed by UNESCO in 2018. The questions addressed teachers' ability to use digital hardware and software, information and data literacy, and communication and collaboration in digital literacy competence areas as proposed by Law et al., (2018).

Data processing and analysis

The interview data was examined using thematic analysis, which follows a methodical six-phase procedure described by Braun & Clarke (2006). The first step in becoming acquainted with the data was to immerse oneself in the interview transcripts, which allowed for a thorough comprehension of their substance. Initial codes were then produced by locating and labelling data segments relevant to the study's goals. Finding recurring patterns and significant linkages in the coded data was the third step in the theme search process. The defining and naming step, in which each subject was precisely labelled to capture its essence and significance, came after these themes were examined to ensure they were coherent and pertinent. Ultimately, the results were combined into a cohesive narrative report supported with interview-based illustrative evidence. The study used MAXQDA software for thematic analysis. Interview transcripts were imported into MAXQDA for coding and analysis. Informed consent was obtained from all participants, and confidentiality and anonymity were ensured. Preliminary findings were validated with participants to ensure accuracy and alignment in interpretation. The data in Table 1 below summarizes the codes and themes developed.

Table 1: Codes and themes from interview data

RQ	Axial codes	Open codes	Sub-open codes	Nodes	Examples
The SEPDP impact on integrating digital technologies into teaching practices	Digital Competencies	Proficiency	Digital technologies	6	"I am good in using most of the digital technologies" (Am)
			AIs	3	"Of late I use my phone mostly and Meta AI which helps me a lot" (K)
		Practice	Digital Content Creation	5	"I downloaded a course on drama for the students to watch it's video on a laptop" (E)
	Professional Development	Teaching Methods/Delivery	Enhanced Teaching Strategies	4	"It has made my lessons more practical, and I am able to help the students simulate lessons. It has enhanced the concentration of students during teaching and learning" (S)
			Easy Lesson Delivery	8	"It has made teaching easy and efficient for me" (Ob)
		Significance	Improve research skill	4	"It has helped improved my research skills. I can create original contents for my lessons and made my lesson preparation easy" (Op)
			Integration of ICT skills	8	"Showing videos and presentation of teaching materials" (An)
			Minimal Impact	4	"There is not much difference since all that is taught during

					the training are things I already do in my lesson delivery" (Ob) "The impact is very minimal since the training was superficial" (Me)
			Positive Sentiment	7	"Super" (Ab)
Areas of digital competence needed for further development	Technology use	Communication and Collaboration	Collaboration and peer support	5	"Intensive training should be given to teachers in ICT and there should be a constant support system" (K)
			Communication with other bodies	2	"More workshops should be organized for teachers and other stakeholders of education" (Am) "I use mNotify to send messages to parents on progress and setbacks after teaching their wards" (Am)
		Engagement in/outside classroom	Student-led technology use	4	"I give my students assignments to research online. Compare and contrast the differences between arteries and veins" (Ko)
			Mixed skill level	3	"I engage my students with the syllabus Ghana app to practice grammar" (An)
			Limited interaction	4	"I am an intermediate user of digital tools and a novice in AI use"
		Training on hand-on practice	Uneven competence	11	"I am ok using my phone but hardly use AI" (Sa)
			Application in teaching	7	"The limited use of digital tools during the training made it ineffective" (Tu)
			Using multimedia for teaching	4	"Before I teach, I go online to research on the topic and pick the relevant materials to add to what I have" (K)

Source: Study data (2024)

RESULTS

The themes developed from the interview, assessing how the SEPDP has influenced teachers' integration of digital technologies into teaching are discussed below. Based on Braun and Clarke's six-phase paradigm, the themes were categorized into: digital competencies (Proficiency and practice); professional development (teaching methods and significance); and technology use (engagement and training); thus providing a holistic view of the impacts of the SEPDP. In regard to digital competencies, participants presented varying degrees of proficiency, highlighting the variations in skill levels.

Teachers skilled in fundamental digital tools had difficulties engaging in advanced technologies such as artificial intelligence and multimedia content creation. This observation corresponds with previous research (Çebi et al., 2022), emphasizing the necessity for extensive digital training. Teachers identified gaps in the SEPDP, notably the inadequate focus on collaboration and student-led initiatives. These findings highlight the imperative of tailoring professional development programs to meet local needs, as Scherer et al. (2019) suggested.

Many participants reported improvement in lesson delivery, with student engagement and more learner-centred approaches. However, limited access to digital tools and uneven training quality hindered broader application. The feedback offers insight into participants' perspectives on digital competencies, professional development through PLCs and areas for improvement. Pseudonyms have been used to protect the anonymity of participants.

Impact of SEPDP on Integrating Digital Technologies into Teaching Practices

The study showed varying degrees of impact of the SEPDP on teachers' integration of digital technologies into their teaching practices. Most participants acknowledged the necessity of professional development for enhancing digital competencies, with varying viewpoints. Many participants acknowledged the SEPDP's contribution to improving research competencies and facilitating lesson planning. Oppong (Op) remarked, *"It has improved my research skills and made lesson preparation easier"*. In contrast, other individuals, including Obed (Ob), noted that *"there is not much difference,"* as the training content was regarded as redundant or superficial. The findings on the impact of the program and teachers' further competency needs are outlined in the following themes:

Proficiency in Digital Technology Tools

A considerable proportion of individuals expressed confidence in their ability to utilize digital tools, such as computers and smartphones. For example, Ama (Am) said, "*I am good at using most of the digital technologies*" However, proficiency with advanced tools such as AI was limited. Kofi (K) noted, "*Of late I use my phone mostly and Meta AI which helps me a lot*".

Digital Content Creation

From the responses, teachers reported minimal involvement in the creation of digital content for lessons. Ekua (E) said, *"I downloaded a course on drama for the students to watch its video on a laptop"*. Ekua also presented an example of downloading a course video for student accessibility, illustrating that certain participants were endeavoring to leverage multimedia resources despite limitations in resources and skills.

Practical Application in the Classroom

Many participants emphasized improvements in teaching methods stemming from the SEPDP. For example, Sarah (S) reflected, *"It has made my lessons more practical and enhanced student concentration."* Conversely, some respondents, such as Mensah (Me), reported slight effects, asserting that "*the training was superficial*."

The SEPDP has significantly altered teaching methodologies for several participants. Teachers acknowledged that the study enhanced their capacity to access, assess, and incorporate digital tools into their teaching practices. Oppong (Op) shared, *"It has improved my research skills. I can create original content for my lessons and make lesson preparation easier"*. Similarly, Ansah (An) stated, *"Showing videos and presentations of teaching materials has made my lessons more engaging."* Participants reported that the program has not only enhanced their digital literacy but has also empowered them to facilitate the adoption of more learner-centred practices, hence fostering greater student engagement and participation. This shows the program's capacity to bridge the digital divide in Ghanaian classrooms by equipping teachers with essential 21st-century skills.

Areas of Digital Competence Needing Further Development

Although the SEPDP addressed fundamental digital competencies, the analysis revealed areas that need further enhancement.

Communication and Collaboration

Teachers emphasized the need for professional learning communities in utilizing digital tools for peer collaboration and stakeholder engagement. Ama (Am) suggested, *"More workshops should be organized for teachers and stakeholders."* Kofi (K) also added, *"Intensive training should be given to teachers in ICT, and there should be a constant support system".*

Student-Led Technology Use

Teachers promoted students' active involvement with digital tools for research. Kojo (Ko) remarked, "*I give my students assignments to research online. Compare and contrast the differences between arteries and veins*". At the same time, Ansah (An) shared "*I engage my students with the syllabus Ghana app to practice grammar*". However, this method was not uniformly used throughout several classrooms, indicating differing proficiency levels.

Inadequate Hands-On Training

Participants frequently mentioned inconsistencies in competence resulting from insufficient practical, experiential training sessions. Turkson (Tu) stated, *"The limited use of digital tools during the training made it ineffective."* Participants advocated for ongoing, rigorous teaching that incorporates practical demonstrations. Ansah (An) suggested, "*Digital tools should be available to enhance training*." Also, they advocated for PLCs with Kofi (K) stating, "*There should be a constant support system".*

DISCUSSION OF FINDINGS

The Impact of SEPDP on Integrating Digital Technologies into Teaching Practices

The results support earlier studies highlighting the importance of professional development in improving digital literacy (Desimone et al., 2015; van den Beemt & Diepstraten, 2016)). The findings indicate that the SEPDP has positively influenced digital competencies among participants, albeit with varied levels of impact. Some participants demonstrated high proficiency in digital technologies, aligning with existing studies (Darling-Hammond et al., 2017; Ertmer & Ottenbreit-Leftwich, 2010; Ramirez-Montoya et al., 2017). It further aligns with the results by Ghomi & Redecker (2019), who emphasized the importance of developing teachers' technical proficiency to foster effective digital teaching practices. Similarly, the use of digital content creation skills by participants support Ferrari, Punie & Redecker (2012), who noted that digital competence encompasses technical skills and the ability to create and manage digital content. As the expressions exemplifies, participants' use of multimedia and online resources to enhance lesson delivery aligns with Koehler & Mishra (2009) emphasis on integrating digital tools into pedagogy. Similarly, use of tools like mNotify to communicate with parents demonstrates the application of technology for broader educational engagement, reflecting the findings of Jenkins, Clinton, Purushotma, Robison & Weigel (2006) on participatory culture in digital literacy.
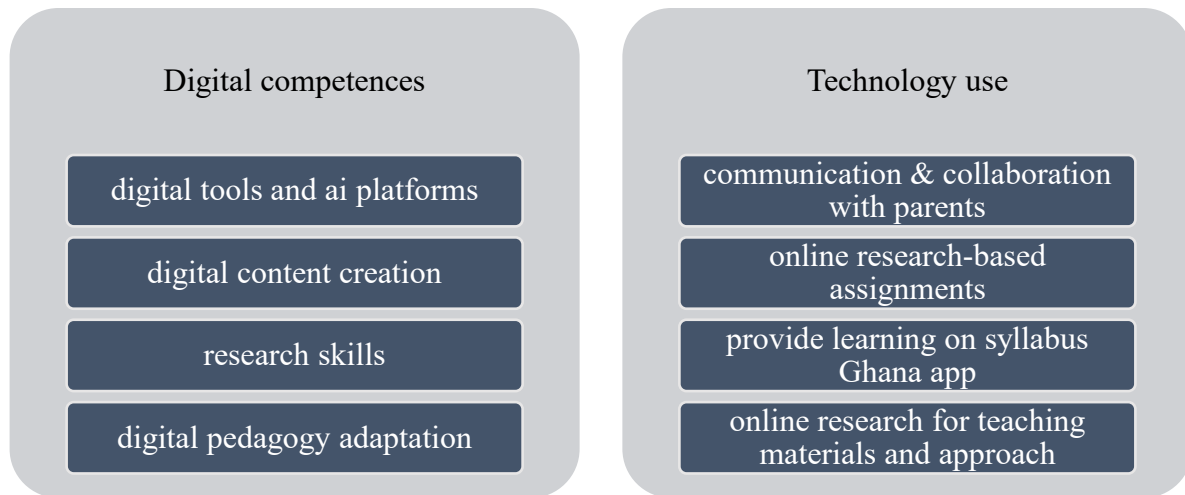
Figure 2: The Impact of SEPDP on Integrating Digital Technologies into Teaching Practices

Areas of Digital Competence Needing Further Development

The mixed skill levels among participants highlight a need for differentiated training approaches, consistent with those who stressed accommodating diverse teacher competencies. While participants' positive sentiment shighlights the SEPDP's motivational impact, the superficial nature of some training sessions, as noted by some participants, points to limitations in program design. This finding resonates with Laurillard (2012), who criticized generic training programs for failing to address contextual needs. The literature suggests that professional development must go beyond technical knowledge, focusing instead on practical, real-world applications that empower teachers to integrate technology effectively (Koehler & Mishra, 2009). Participants expressions of limited application of digital tools reflects Laurillard (2012), who noted that insufficient hands-on training during professional development often hampers technology integration. Minimal impacts reported by participants further reveal challenges in the depth and practicality of the training, reflecting Laurillard (2012), who argued that superficial training often results in limited pedagogical change. The research identifies shortcomings in the SEPDP, including insufficient practical implementation and resource limitations, inadequate practical training, and resource shortages, illustrating worldwide challenges in ICT integration (Benali et al., 2018). These findings call for more tailored, practical and intensive professional development initiatives, consistent with Koehler & Mishra (2009), who stressed the significance of context-specific training in the TPACK framework.

The uneven competence levels reported by participants highlight disparities in training outcomes. Ferrari et al., (2012) pointed out that targeted interventions addressing specific skill deficits are necessary to ensure equitable competence development. These findings align with the participants' recommendations for more workshops and intensive ICT training to bridge skill gaps effectively. The findings highlight gaps in communication and collaboration, echoing Ghomi & Redecker (2019), who identified collaboration as a critical competence in the digital age. The participants call for intensive training and constant peer support aligns with the need for sustainable professional learning communities, as Hattie (2012) suggested, where collaborative practices enhance collective teacher efficacy.
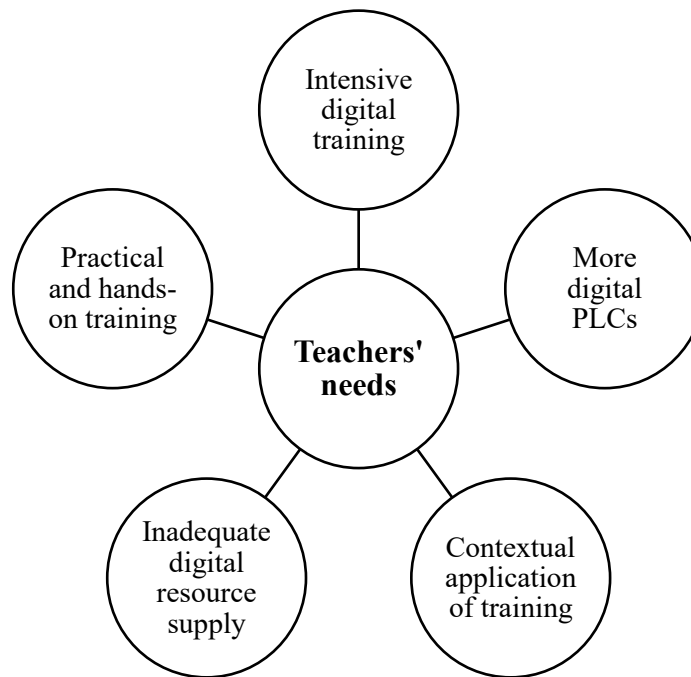
Figure 3: Teachers' Digital Competence Needs

THEORETICAL AND PRACTICAL IMPLICATIONS OF THE STUDY

This study offers significant theoretical and practical implications, particularly in supporting the Theory of Change and Constructivist Theory. The Theory of Change, which emphasizes the role of inputs, activities, and outcomes in transforming systems, is evident in the positive changes observed in teachers' digital competencies and teaching practices through the SEPDP. The improvements in teachers' skills are seen as outcomes of strategic interventions such as customized training programs, peer collaboration, and hands-on experiences. The study emphasizes the importance of designing training programs that cater to the diverse competence levels of teachers, thereby providing a foundation for sustainable professional development. From a constructivist perspective, which theorizes that learning is an active, social process of constructing knowledge, the findings highlight the value of collaborative learning environments within PLCs. Teachers' experiences, interactions with peers, and engagement with digital tools enabled them to co-construct knowledge in authentic contexts. This aligns with the idea that teachers build their competencies through experience, reflection, and social interaction, reinforcing the need for experiential, contextually relevant learning environments.

The study emphasizes that effective digital PLCs should include hands-on training, practical application of digital tools in teaching, and ongoing support systems, such as mentorship and follow-up workshops. These elements ensure that teachers continue to develop and retain the competencies needed to integrate ICT into their teaching. Additionally, PLCs should be designed with an understanding of the local context, ensuring that training programs are relatable and meet the specific needs of teachers in Ghana and similar developing regions. The integration of emerging technologies like AI into these communities also prepares teachers for future educational advancements, ensuring that they remain adaptable and forward-thinking in a rapidly evolving digital landscape.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This study's reliance on self-reported data limits the generalizability of its findings. Additionally, the research only examined the immediate effects of the SEPDP, leaving the long-term impacts on teaching practices and student outcomes unexplored. Future research should focus on longitudinal studies to assess the sustained effects of PLC programs and conduct comparative analyses across various regions and educational systems. Exploring the role of emerging technologies like AI and augmented reality in teaching practices is also essential. Investigating how improved teacher digital competencies influence student engagement, learning, and digital literacy development represents another crucial area. Finally, research should examine the scalability of PLCs to reach a broader audience, particularly in under-resourced settings, to ensure wider access to effective professional development initiatives.

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