

# The Preparedness of Pre-service Science Teachers to Integrate Technology in Their Science Classrooms

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Received: February 2, 2026

Accepted: March 12, 2026

Published: March 19, 2026

doi:10.65343/erd.v2i2.70

URL: <https://doi.org/10.65343/erd.v2i2.70>

## Abstract

This study explores fourth-year science student teachers' preparedness to use technology in the classroom during their final internship in a partner school. The study used a descriptive survey design. The respondents included 120 student teachers, 8 mentors, and 8 supervisors. The student teachers were selected using a simple random sampling technique, while the mentors and supervisors were selected using a purposive sampling technique. Data was collected using questionnaires and interview schedules. The results of the study revealed that pre-service teachers were ill-prepared to integrate technology into their science classrooms. Their concerns were that they lacked the appropriate skills and competence to integrate technology specifically into the teaching and learning of science. The research, therefore, suggests the need to introduce courses that will prepare and equip pre-service science students to integrate technology and further develop their technology integration practices in their teaching.

**Keywords:** internship, technology, pre-service teachers, professional experience

## 1. Introduction

The word "technology" has significant implications in numerous domains, including education, in the twenty-first century. This is a result of the fact that most nations today employ technology as a means of knowledge transfer. After the COVID-19 pandemic, the integration of digital tools in education, particularly in science classrooms, has become more crucial than before. Students nowadays have access to a variety of digital tools in the classroom, which helps them learn due to their easy availability. With more technology in the classroom than ever before, teachers need to be competent and self-assured in their ability to successfully integrate technology into their lessons and students' learning. Research has demonstrated that a teacher's level of technology integration in the classroom is significantly influenced by their level of technological expertise (Chen, 2010). Thus, Pre-Service Science Teachers (PSST) must have opportunities in their teacher education courses to enhance their skills and teaching strategies.

Technology integration, according to Grabe and Grabe (2007), has now advanced through innovation and transformed organisations and societies, completely altering people's ways of thinking, working, and living. Schools and other educational institutions are urgently integrating ICT into the curriculum to prepare and groom students for life in "a knowledge society" (Ghavifekr, Afshari & Amla, 2012). As per the United Nations Development Programme (UNDP), information and communication technology (ICT) refers to the whole range of electronic technology and techniques employed to handle information and knowledge (Wagner, 2018). It is an indisputable fact that the pace at which ICT is developing and how it affects socio-economic activities cannot be overlooked. ICT has turned into a crucial component in creating wealth globally, having been integrated into almost all areas of commerce, government, and public life in developed nations. This integration has unquestionably revitalised all aspects of life and has had a ripple effect on education.

Educational institutions are trying to rebuild their classroom environments and instructional and educational systems in light of the success of emerging technologies in the workplace and everyday life. This is done to close the technological divide between developed and developing nations when it comes to teacher-student activities. The goal of this restructuring process is to improve learners' knowledge and understanding of particular subject areas, particularly science, as well as their capacity for meaningful learning and increased productivity in the workplace (Tomei, 2005).

Many studies have shown how crucial it is for pre-service teachers to have support in building their technology skills as well as in using a variety of teaching styles to include ICT into the curriculum (Instefjord & Munthe, 2016; Batane, & Ngwako, 2017; Niess, 2014; Lock & Redmond, 2010). However, Aslan and Zhu (2016) discovered that pre-service teachers have few opportunities to practise ICT integration and little modelling by teacher educators. Sheninger and Murray (2017) bolster the idea that traditional classroom instruction is ineffective in preparing students to function or be valuable in today's business. Furthermore, when ICT is incorporated into the delivery of courses, a study by Livingstone (2012) suggests that there is an improvement in memory retention, an increase in knowledge of the lessons taught, and an increase in self-motivation. With its ability to facilitate simpler group learning, role-playing, group discussions, and group projects, ICT integration is also beneficial in managing big class numbers (Eze, Adu & Ruramayi, 2013).

Most pre-service teachers today grew up in a technologically advanced environment, and they begin their teacher education programs with a variety of ICT skills. It cannot be assumed that all of them possess the necessary skills and therefore, opportunities must be given for pre-service teachers to acquire them. However, even though many pre-service teachers use technologies extensively, they are more likely to focus on social media than the potential of technologies for learning (Lei, 2009). Teachers have the potential to influence students' beliefs and values, so their ICT competencies and experiences are crucial in modifying their pedagogy to suit the needs of today's learners (Shah, 2022). Therefore, in addition to emphasising skill acquisition, courses should also focus on educational approaches that make use of ICT. The necessity of integrating ICT skills is generally acknowledged by teacher educators; yet, this is frequently realised with a single technology course that is insufficient to prepare teachers for the problems of integration (Hsu & Sharma, 2010). Courses must be created in a way that supports pedagogical development and builds skills gradually. While it is desirable for the modelling to take place within curriculum methodology resources, teacher educators frequently lack competence and confidence in their ICT skills (Kamalodeen, 2017). ICT may only be utilised for productive purposes when employed (Dykes, 2016). Additionally, a lot of the teachers might not have the requisite training and growth opportunities, and the classroom may not have sufficient access to ICT to support modelling.

Teachers have a big role in managing learning, thus they must have ICT skills so they can use the newest, most advanced educational technology to create innovative learning experiences. Buabeng-Andoh (2012) claims teachers' expectations and attitudes towards ICT integration are influenced by their personal opinions about the reasons behind adoption. One of the most crucial elements in the successful integration of ICT in the classroom is the teachers' positive attitudes about its use. They are informed as to the technological instrument to use for the teaching and learning portion by this (Gulbahar & Guven, 2008). According to Hong (2016) and Mukuna (2013), because teachers serve as gatekeepers, teachers are essential to the integration of ICT and cannot be undervalued.

To realise their vision for education, teachers can decide to employ extremely basic or sophisticated technologies. "The use of IT can provide innovative learning experiences, but in all cases a great deal depends upon the teacher to provide the context which makes this possible," as Somekh and Davis (1997) have shown. Additionally, they point out that while teachers must be proficient and self-assured users of hardware and software, this is insufficient on its own.

According to Edvard Hatlevik and Christian Arnseth (2012), teachers are the key players in implementing the ICT programme but curriculum planners hardly factor in teachers' levels of preparedness in readiness to integrate ICT into the teaching and learning process. This could have a serious negative effect on the implementation process. It is against this background that this study sought to establish the preparedness of pre-service science teachers to integrate ICT into instruction processes.

## **2. Statement of the Problem**

Students who learn in surroundings with a lot of technology perform better across the board in all subject areas, according to a review of studies on the use of technology in education. The rate at which ICTs are used in Ghanaian classrooms is still far below expectations, despite the many benefits of ICT use that have been previously documented in literature. The numerous efforts by stakeholders to invest in resources and training to integrate ICT use in its operations. The Government of Ghana has put in place many initiatives to enhance ICT integration in primary education to address equity, access and quality of education offered by schools. Such initiatives include the provision of laptop programme for teachers.

Despite all these efforts, research indicates that ICT is still not widely used in Ghanaian public basic schools (Natia & Al-hassan, 2015; Peprah, 2016; May & Abreh, 2017; Atambeogo, 2020; MoE, 2014; Yidana, 2018). These studies contend that unless teacher factors, which have a significant impact on the integration of ICT in schools, are taken into consideration, the installation of technological equipment and the establishment of ICT infrastructure in schools do not inevitably result in the acceptance and integration of ICT in schools. Since they are the ones who combine all the elements of education to create environments for teaching and learning,

teachers are essential to the integration of ICT. However, little is known about how prepared pre-service science teachers are for this task, particularly in students of Komenda College of Education, where no study has been done to determine how prepared level 400 student teachers are for using ICT in teaching and learning. In light of this, the purpose of this study was to determine how prepared pre-service science teachers in Komenda College of Education, Ghana, were to integrate ICT during their internship.

### 3. Methodology

The research used a descriptive survey design. This study focused on Level 400 pre-service teachers who are studying to be basic school (Early grade, Primary and Junior High School) teachers during their seventh semester, where they undertook a 12-week internship in a basic school. The target population included all the student teachers offering science, supervisors/tutors from the college and mentors (classroom teachers) in all the partner schools where the student teachers were practising. The study sampled 120 student teachers, 8 mentors and 8 supervisors (tutors) using a simple random technique and purposive sampling technique, respectively. The total sample size for the study was therefore 136 respondents.

The study employed self-administered questionnaires, observational methods, and interview schedules as data collection techniques. Analyses of the data were descriptive. The statistical software package known as the Statistical Package for Social Science (SPSS) made data analysis easier. To address the study questions, descriptive statistics were utilised in the analysis of qualitative data, with frequencies and proportions being used to understand respondents' preparedness in integrating ICT in instruction in public basic schools.

It was realised that pre-service science teachers' tales about their preparedness would be distinct and that their stories about their proficiency might be conveyed through interviews since they have differing degrees of ICT confidence and ability. Six pre-service science teachers who taught science lessons during their internship were purposefully sampled and interviewed using an interpretive methodology to add more nuance and depth to their sense of readiness.

### 4. Results and Discussion

The study sought to establish the level of pre-service science teachers' preparedness in integrating ICT in teaching science at the basic school level.

As seen in Table 1, the most popular ICT products among respondents were Calculators 90 (75.0%) followed by mobile phones 83 (69.2%), laptop computers 65 (54.2%), photocopied materials 56 (46.7%), pen drives 53 (44.2%), projectors 33 (27.5%) and desktop computers 18 (15.0%). This demonstrates that, in comparison to other ICT tools like mobile phones, laptops, photocopied materials, and online video materials, calculators are used extensively in science classrooms, but desktop computers are used the least.

Table 1. ICT Products Mostly Used in Teaching Science

ICT Product	Frequency	Percentage (%)
Mobile phones	83	69.2
Laptop computers	65	54.2
Desktop computers	18	15.0
Projector	33	27.5
Calculators	90	75.0
Pen drives	53	44.2
Online videos	25	20.8
Photocopied material(s), e.g. charts and photos	56	46.7

#### 4.1 ICT Literacy in Science Classroom

The study sought to establish whether the respondents were ICT literate in science. The findings indicated that the majority (98 out of 120) of the respondents were ICT literate, whereas a minority (22 out of 120) did not have any formal training aside from what they learned in college. The high number of respondents who are ICT literate is attributed to the curriculum of the college course, which requires ICT skills in the use of equipment such as computers and laptops, among others.

The study's results revealed that while some of the pre-service science teachers (42.5%) learned ICT skills through official training, most teachers (45.8%) learned ICT skills out of personal interest. This acquisition, however, was not predicated on the fact that the curriculum calls for this kind of training. The results also revealed that a sizable portion of pre-service teachers (11.7%) learnt ICT skills via collaborating with their peers. This is illustrated in Figure 1.

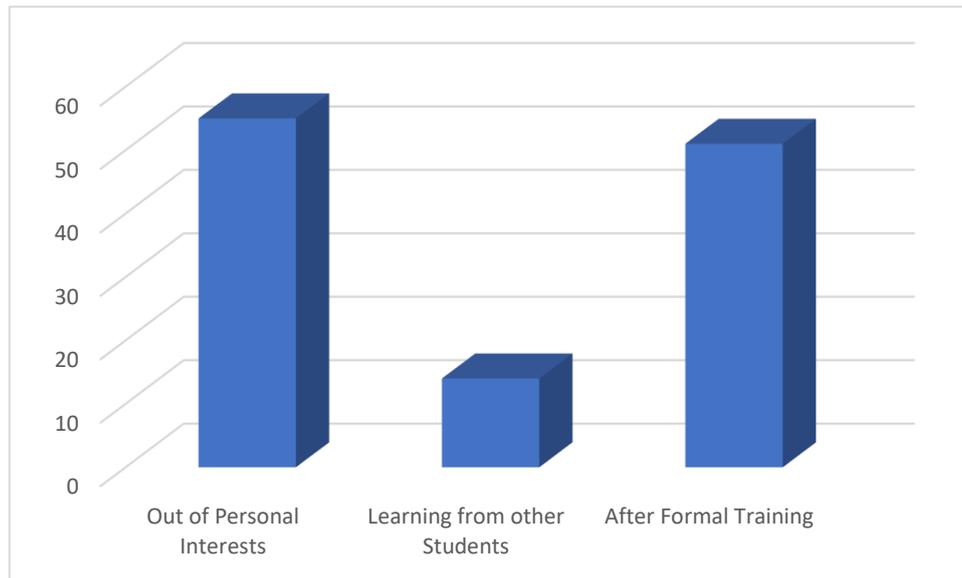


Figure 1. Means of Acquiring ICT Skills for Teaching Science

This finding showed that pre-service teachers do not go through training on how to integrate ICT into instruction when they are in colleges of education. Instead, they receive basic computer knowledge of certain software packages and how to operate computers, as indicated by the six students who were interviewed. This concurs with Agyei (2021) findings that most ICT training in Ghana is tied down to technology literacy as a result primary and secondary school teachers in Ghana do not have sufficient knowledge and skills on how to integrate ICT into the curriculum.

The data from the survey gave the pre-service teachers under examination some prior knowledge of ICT integration. Many questions focused on the pre-service teachers' opinions about the value of ICT for teaching, their confidence in using it, the benefit of using it for learning for their future students, and their confidence in helping their students use it for learning. The table below provides the overall mean, which was calculated by summing the replies to each of those categories.

Table 2. Survey Data

Category	Mean	Standard Deviation
Preparedness in using ICT for teaching	2.16	.907
Level of Competence in the use of hardware and software	2.30	.734
Confidence that they can facilitate their learners' use of ICT for learning	1.59	.929

As Table 2 shows, pre-service teachers usually thought that their preparedness levels in using ICT tools for teaching were lower than the perceived levels of competence in the use of hardware and software. This indicates that the average confidence level was lower than their perceived utility. The figures also show that every pre-service teacher gave ICT a rating of three or lower. In general, pre-service teachers acknowledged that they lacked preparedness or confidence in their capacity to incorporate ICT in their science classroom.

#### 4.2 Perceived Preparedness in Using ICT

The survey data and the pre-service teachers interviewed showed a similar pattern, with the interviewees offering more specific information. While four pre-service teachers indicated that their knowledge of ICT was restricted to simple word-processing operations, two interviewees expressed confidence in their abilities. The following comment demonstrates that those who were highly skilled also indicated that they were at ease utilising new technologies: *"I have taught myself a lot about a range of different ICTs...I have no problem with something I haven't used before"*. One student reported that she felt less confident in her abilities to utilise ICT for the first time in the classroom, despite her high level of confidence in using it for academic and personal purposes. Another student believed that he knew where to turn for assistance if he could not learn a new technology on his own. There was general agreement that students felt less confident when using ICT applications in educational settings.

The supervisors from the college reported that the students lack some basic skills in integrating ICT well during their lessons. They observed that when fixing ICT tools whilst teaching was problematic for most of the students although some were able to fix it perfectly. Also, one other supervisor remarked that some audiovisuals the students used in delivering their lesson could have been edited to suit the lesson and reduce the time spent on the lesson. As a result, the student could not finish their lesson on time. Another supervisor recommended more courses that are geared towards the specific ways of integrating ICT tools for specific subject areas rather than the core ICT course if the student teachers are expected to be competent in delivering ICT-rich lessons.

The mentors interviewed also observed a substantial knowledge on the use of ICT tools by the student teachers who worked under them. They said some of the mentees came with their laptops and smartphones that they used during their lesson delivery. They however said that the students lack the ability to set up the ICT tools so they always fall on them to assist. This indicates that the pre-service teachers had low levels of ICT experience and they felt unable to use ICT in pedagogically sound ways.

The pre-service teachers asserted that their college supervisors and mentor teachers played a significant role in their use of ICT in the classroom. Their mentor's confidence and competence with ICT determined whether ICT integration was a positive or negative experience. The following comments reflect some of their experiences: *"My mentor was a specialist in ICT so we had more access to ICTs than most other teachers"*; *"My mentor teacher didn't help with ICTs...but I guess technology wasn't her strong point"*; *"On my pracs if I haven't seen the teacher using ICTs, I won't use it."* According to Albion and Redmond, (2008), mentor teachers who are "confident, competent, and consistent users of ICTs" should be paired with pre-service teachers in order to promote the successful integration of ICT. The mentor educator must be able to give illustrations of excellent practices. A number of pre-service teachers believed that their school-based placement had not helped them advance their ICT skills. *"Most teachers I saw didn't really incorporate ICT into their teaching in any real meaningful way"*.

The pre-service teachers were cautious about experimenting with technology they were unfamiliar with for fear of making a mistake, since the school-based placement served as both a learning opportunity and a formal assessment. Pre-service teachers' use of innovative technological approaches in the classroom was not perceived as supportive. Integration into the classroom was further hampered by time and access restrictions. A number of pre-service teachers specifically expressed their concern about replicating the planned lesson when the technology did not work.

#### 4.3 ICT Experiences at the College Level

Pre-service teachers expressed varied views on how well their college experiences helped them develop their ICT abilities, and this was strongly linked to their confidence levels and the courses they took. After completing the ICT core course, all pre-service teachers felt that their previously acquired skills were strengthened; nonetheless, the course did not help them build pedagogically sound methods for ICT integration in science lessons. According to one criticism, the course was too early in the student's program because they hadn't had time to learn about the use of ICT in the classroom. Instead of emphasising skill development, Albion and Redmond (2008) advise that an ICT course targets pedagogical usage.

Pre-service teachers requested more examples of "best practices" from their tutors and mentors outside of the core ICT course. However, this would need the tutors and mentors to be proficient users. Their assessments of the tutors' and mentors' capacity to offer practical illustrations of sound teaching techniques were not entirely consistent.

### 5. Conclusion

The study offers evidence to support the claim that science pre-service teachers are significantly impacted by pre-service science teachers' readiness and preparedness to ICT tools in their lessons. The results demonstrate

that pre-service science teachers can improve their information and ICT skills and knowledge while teaching science because of the school culture and continuous support for ICT integration in teaching of science.

The results of the study show that utilising information and communication technologies to enhance pre-service science teachers' integration will have a good effect on biology education. Because schools have the potential to be learning environments for teachers as well, if the school culture is changed to support this, as stated by Desimone (2009), pre-service science teachers gain experiences to learn how to integrate ICT as effectively as possible. The study's conclusions make it clear that pre-service science teachers need continual assistance since ICT integration in science lessons allows them to advance their knowledge and abilities.

Also, the pre-service science teachers acknowledged the value of ICT in teaching, but asserted that they lacked the ability to put it into practice. This study confirmed the value of a school-based experience, finding that current and future ICT use in the classroom is significantly influenced by the assistance of a qualified mentor. The pre-service teachers stated that their readiness to integrate ICT into their lessons was not significantly impacted by their college-based experiences. This emphasises how important it is to have excellent cases of ICT integration in college courses.

## 6. Recommendations

From the study's conclusions, it is recommended that there should be ongoing support for pre-service science teachers so that they utilize their skills on ICT integration in the teaching process. Additionally, the course structure of pre-service teachers should be designed to include courses that can fully equip them in integrating ICT tools in their science lesson. Placement of pre-service teachers should take into consideration the ICT background of mentors if the colleges want their pre-service teachers make good use of ICT tools. Also, follow-up is necessary to ensure that pre-service teachers are effectively utilising ICT resources and applying their newly acquired knowledge and abilities.

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