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Examining teachers' perceptions of the impact of government of Ghana's wi-fi technology program on teaching practices: an empirical study from the senior high schools in the cape coast metropolis

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ABSTRACT

The study discusses the impact of a nationwide deployment of Wi-Fi technology in some Senior High Technical Vocational Schools (SHTVs) in Ghana, using the first four levels of Guskey's framework. A stratified sampling approach was used to select 119 teachers as participants in the study. An embedded mixed method research design was employed to collect data using a questionnaire with both close-ended and open-ended items. The findings revealed that the deployment of Wi-Fi technology impacted positively on the teachers' learning experiences and was positively perceived by the teachers in facilitating teaching and learning practices. However, the study also revealed some deficits in reliability, trust, and connectivity associated with the Wi-Fi technology, highlighting the need to explore factors that maximize the output of technological initiatives. The study identifies the school's organization and the teachers' learning experiences as two key predictors in maximizing the use of Wi-Fi technology in educational establishments. The study recommends equipping teachers with the requisite competencies in the use of Wi-Fi technologies through professional development programs, training, and the enactment of ICT curriculum-based policies in schools. These policies and support will promote and enhance the effective utility of Wi-Fi technology among teachers, enabling them to shift from traditional to more technologically inclined student-centred learning.

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Introduction

The digital divide and lack of accessible internet present significant challenges to the implementation of technology-enhanced pedagogy in educational institutions. These challenges perpetuate existing imbalances, particularly in less developed countries like Ghana. Wi-Fi technology is a potential means to bridge this gap (Smithers, 2007), offering wireless connectivity and accessibility to online resources from anywhere within an educational institution (Cobanoglu et al., 2012). This technology supports diverse pedagogical approaches and empowers students to become self-reliant learners (Carmon et al. 2015). Further, it improves the cooperation between the actors in and out of the classroom activities at school (Liang et al., 2017). Additionally, Wi-Fi technology enables instant monitoring of students' progress and intervention when necessary.

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In light of these benefits, deliberate policies are necessary to facilitate the deployment of Wi-Fi technology in educational institutions. The Government of Ghana has implemented a nationwide deployment of Wi-Fi technology in senior high/technical vocational schools (SHTVs). Out of the total number of 724 SHTVs, 663 SHTVs benefitted from the government's free Wi-Fi policy (Ghana Education Service [GES], 2022). The deployment of Wi-Fi technology in these schools aim to bridge the digital divide and facilitate online education delivery (Anouk et al., 2005; Benning & Agyei, 2016). Both teachers and students were to maximize the opportunities that came with the wifi deployment to promote academic excellence particularly within the context of SHTVs classrooms. However, the effects of implementing this technology on the process of teaching and learning have not been assessed, especially within the context of the COVID-19 pandemic. Furthermore, due to the newness of this approach and the limited existing literature on the utilization of Wi-Fi technology to enhance teaching and learning in secondary educational institutions in Ghana, it becomes essential to appraise the outcomes resulting from the application of this technology. Thus, this evaluation is necessary to determine whether the anticipated educational objectives have been met – specifically, whether this technology has been effectively employed by its users to advance teaching and learning within SHTVs classrooms. Consequently, the significance of a study aiming to elucidate the use of the Wi-Fi technology as a pedagogical tool in the Ghanaian classroom setting cannot be overstated.

The need for Wi-Fi technology in educational institutions

The word Wi-Fi, was coined from 'wireless fidelity networks' It is a technologically inclined device that aids in the wireless connection of devices to the internet (Jeon et al., 2019; Marzudi et al., 2015). This technology is designated as Local Area Network (LAN) that employs the system of IEEE 802.11 standards as means of communications. As such, the Wi-Fi technology is employed world-wide as the medium of accessing the internet (Ramirez-Vazquez et al., 2021). The technology affords cheap services to institutions of learning and other public places of interest. The use of this technology has many advantages; it is mobile and suitable to use and it provides the platform for people to get connected (Ullah et al., 2012). It is in the light of accessing limitless opportunities in relation to online resources that the prevalence of this technology is critical to school, college or university premises (Asomah et al., 2022a). To this end, teachers can leverage this technology to devise innovative ways of upgrading their pedagogical skills to the advantage of students (Agyei, 2021). Further, Wi-Fi connectivity in this study focuses on the provision of wireless access to the internet for the purposes enhancing teachers' professional practices at the SHTVs (MOE, 2009). In the educational institutions, internet has become an essential modern amenity for students and teachers. As result, its use has become indispensable in the teaching and learning processes. Current studies (Agyei, 2021; Asomah et al., 2022b; Ramirez-Vazquez et al., 2021; Ullah et al., 2012, Qazi et al., 2020) depicts high use of the Wi-Fi technology in educational and non- educational establishments (education, health, restaurants). This increase has been necessitated by the demand of such services by the people in these institutions. In particular, is the alarming rate at which students and teachers on educational campuses access the internet without recourse to their personal data. Hence, a study that purports to evaluate the impact of use of this technology to enhance teachers' professional practice at the SHTVs cannot be over-emphasised.

The study context

Recently, the Government of Ghana (GoG) has initiated a nationwide deployment of wifi technology to embark on extensive connectivity of the Wi-Fi technology to bring networks to unserved and underserved parts of the country. As part of this a total of 663 SHTVs have benefitted from the government's free Wi-Fi policy. The deployment of wifi technology provided a wireless medium through which students and teachers could access the internet, enabling them to maximize the opportunities that come with the intervention in their classroom context to promote learning. Thus, the deployment aimed at bridging the digital divide and facilitating online delivery of education in these schools.

The deployment of wifi technology was a significant step towards transforming Ghana's education system and ensuring that students and teachers had access to the resources they need to succeed and

aligns with the GoG strategic plan of transforming educational institutions (Agyei, 2013). The strong alignment of the Government of Ghana's wifi-technology program with the ICT for Accelerated Development (ICT4AD) policy is of great significance. The ICT4AD policy seeks to employ information and communication technologies (ICTs) to foster socio-economic development, particularly in rural areas. The policy underscores the necessity of infrastructure development, human capacity building, and the creation of an enabling environment for the growth of the ICT sector (ICT4AD, 2003). As a result, there has been a substantial increase in the number of computer laboratories at all levels of the educational system, including Senior High/Technical/Vocational Schools (SHTVs), since the implementation of the policy (Yidana & Addo, 2001).

With the expansion of ICT infrastructure and corresponding coverage of wifi-connectivity, the use of wifi-technology among SHTV teachers to enhance their professional practices cannot be overemphasized. Therefore, it is incumbent upon teachers to equip themselves with the necessary knowledge and skills to leverage this technology for the benefit of their students. However, the impact of wifi-technology on teaching and learning at the SHTV level has not been evaluated, even three years after the implementation of the program. This study is a follow-up evaluation aimed at measuring the impact of wifi-technology on teaching and learning in SHTVs. The study was conducted in Cape Coast, which is regarded as an educational hub in Ghana due to its abundance of well-endowed SHTVs, reflecting second cycle institutions across the country.

Conceptual framework

To evaluate the impact of this wifi-technology on teachers' professional practices at the SHTVs, the Guskey's model was adopted. This model is based on the effectiveness of professional development (PD) models and programs (Guskey, 1985, 1986, 1990, 1991, 1996, 1998, 2002, 2015) and includes five levels: Participants' Reactions (Level 1), Participants' Learning (Level 2), Organization Support and Change (Level 3), Participants' Use of New Knowledge and Skills (Level 4), and Student Learning Outcomes (Level 5).

This study adapted the first four levels of the Guskey's model to evaluate the impact of Wi-Fi technology program on teacher's professional practices in the SHTVs in the Cape Coast Metropolis, Ghana. Level 1 assessed teachers' reactions to the quality of the Wi-Fi technology, including its reliability and continuity, as they apply it to professional practices. Level 2 focused on teachers' learning experiences in enhancing their professional practices. Level 3 evaluated organizational support and change, including school policies and practices that underpin or support Wi-Fi technology use. Level 4 focused on teachers' application of Wi-Fi technology, including their use of learning experiences to facilitate teaching and learning practices.

Due to limitations in the scope of the study, it was difficult to ascertain the impact of Wi-Fi technology deployment on student learning. As such, Level 5 was excluded. This is because, the respondents in this study were teachers at SHTVs as such the collection of viable evidence to assess impact of the Wi-Fi technology on the students learning was a herculean task. The deployment of Wi-Fi technology in SHTVs in Ghana is still in its early stages, necessitating strategic planning and decision-making to advance teachers' professional practices. Therefore, the Guskey's model is a crucial tool for analysing the state of affairs and stakeholders' perceived views.

Research questions

The conduct of the study was guided by the following research questions: (1) How did the teachers perceive the influence of the Wi-Fi technology to facilitate their professional teaching practices? and (2) To what extent did the teachers' reaction, teachers' learning, school's organization and culture influence teachers' use of the Wi-Fi technology in teaching?

Research design

An Embedded mixed method research design (Creswell et al. 2003) was used in the current study. Both quantitative and qualitative data were collected in the study. The rationale was 'to obtain different but

complementary data on the same phenomenon' (Morse, 1991, p. 122) to best appreciate the phenomenon under study. Thus, for the purposes of obtaining valid and accurate conclusions about the phenomenon under investigation, quantitative results were corroborated with qualitative findings of the study (Creswell, 2014).

Sample and participants

There are 1366 teachers (male = 950, female = 416) from 11 SHTVs in the Cape Coast Metropolis. In particular, the 1366 teachers consisted of 1247 teachers (males = 862, females = 385) at the SHS and 119 teachers (males = 88, females = 31) at the Technical and Vocational Education and Training [TVET] which served as the population for the study (GES, Cape Coast Metropolitan Office, 2023). The choice of this Metropolis was considered ideal as it hosts teachers with different cultural and educational (teachers with Bachelors and Masters in education) backgrounds. The classification of the 11 schools consisted of three strata (Category A, B and C) determined by various factors including quality and quantity of infrastructure (such as school buildings, ICT labs, libraries etc.), educational resources, staffing (both the calibre and number of teachers) and academic performance as assessed by the 2019 Computerised School Selection and Placement System (CSSPS) (CSSPS, 2019). Applying the stratification method, a random number technique was utilized to select the required number of teachers from each of the strata (categorized as A, B, and C). This selection process was conducted according to a probability proportional to size (PPS) sampling approach. Thus, a total of 119 teachers were selected as the study's sample. This technique eliminated biases and afforded teachers to be selected on an equal basis. With respect to the open-ended items, responses from nine of the teachers who took part in the study were selected randomly based on stratified sampling technique. They were identified in the current study with corresponding nomenclatures as TA_1, TA_8 TA_10 (TA-Teacher from strata A with the numbers differentiating the respondents), TB_1, TB_6, TB_7 (TB-Teacher from strata B with the numbers differentiating the respondents), TC_1, TC_3, TC_13 (TC-Teacher from strata C with the numbers differentiating the respondents). This afforded us an opportunity to identify and assign statements authored by the teachers in their respective schools of categorization. Participation in the study was voluntary. Again, the participants were assured of anonymity and confidentiality in their response to the questions. Table 1 shows the distribution frequency of the participants of the study.

Instrument

A questionnaire consisting of three parts was employed in the study. In the first part, participants were asked to detail their demographic information (e.g. gender, age, department etc.). The second part of the questionnaire consisted of close-ended items relating to perceptions of teachers in relation to the deployment of the Wi-Fi technology in facilitating teaching and learning at the SHTVs. The items in this section were on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) and participants of the study were entreated to indicate their degree of agreement or disagreement to each of the statements. In this way, an interpretation of 1 = lowest score and 5 = highest score was designated as very strong negative and positive perceptions of the respondents respectively. In that continuum, a mean below and above 3 indicates negative and positive perceptions respectively for each of the individual items as generally applied across the specific domains as measured by the instrument. Finally, at the third part, the participants were asked to share their experiences by way of responding to the open-ended questions asked in relation to the deployment of the Wi-Fi technology to enhance their professional practices at the SHTVs. In ascertaining the reliability of the instrument employed in the study, Cronbach Alpha coefficients were determined in relation to the subscales corresponding to the different

Table 1. Gender distribution of the participants.

Participants	Frequency	Percent
Male	97	81.5
Female	22	18.5
Total	119	100.0

levels of the Guskey's model. In particular, Level 1-Teachers' reaction (11 items; $\alpha = .82$), Level 2-Teacher's learning (11 items; $\alpha = .83$), Level 3 – School's organization and culture (7 items; $\alpha = .71$) and Level 4 -Teacher's use of Wi-Fi technology in teaching (8 items; $\alpha = .72$) were all found to be reliable based on guidelines. With the open-ended items, Interrater reliability (Cohen's $\kappa = 0.91$) was calculated using a sample of responses from three participants by two raters. Their responses were first coded (based on the levels of Guskey's model) and then assessed. To check the content validity of the Instrument a panel of four experts including the second author of this paper reviewed and provided feedback on the relevance and comprehensiveness of the items in relation to the research objectives.

Data collection and analysis

Questionnaires were administered to teachers who took part in the study at their respective schools. This was aimed at determining and reporting how things look like with respect to established theories or assumptions on the phenomenon under study without manipulating the environment in which the teaching staff within the SHTVs found themselves (Cohen et al., 2017). In this study, the quantitative data were analysed using descriptive analysis and regression analysis test. In ascertaining the standard assumptions of multiple regression, an initial analysis of the data was performed. Tabachnick and Fidell (2013) argued that a sample size of 119 was suitable for the conduct of multiple regression. Further, a scatter plot analysis of the study's data was ranged in the region of -3.3 to 3.3 which Pallant (2016) considered as convenient. Thus, the outliers registered in the study were not significant as the standardised residuals conformed to this region. In employing the Collinearity diagnostics in relation to the Variance Inflation Factor (VIF) and Tolerance, school's organization and culture (Tolerance = 0.337, VIF = 2.966) and participants learning culture (Tolerance = 0.337, VIF = 2.966) comprised coefficients of the variables. Pallant, (2016) asserts that Tolerance coefficients higher than 0.10 and VIF coefficients less than 10 as registered depicts the possibility of no multicollinearity in the data. Quantitative content analysis was employed in relation to open-ended items. The analysis was premised on the generation and coding of themes anchored on the responses from the respondents (Miles & Huberman, 1994).

Results

In employing the Guskey's framework, the four levels of the Wi-Fi technology use to influence a shift in pedagogy at the SHTVs were analysed. Levels 1 and 2 were used to respond to issues in relation to the teachers' reaction (impressions) and learning experience, level 3 prioritized SHTVs conditions and policies that support the deployment of the Wi-Fi technology while level 4 focused on the use of the Wi-Fi technology in the classroom context.

Teachers' reaction

The first level of the Guskey's framework was used to solicit teachers' assessments on the reaction to Wi-Fi technology program. As such, the teachers' general impressions on the quality (planning, usefulness, helpfulness, reliability, trust, connectivity, confidence, comfortability) and the extent to which the Wi-Fi technology met their expectations were explored. Table 2 shows mean scores of teachers' views on the quality and expectations of the Wi-Fi technology.

The data from the close-ended items of the questionnaire as presented in the Table 2 revealed that the respondents were generally impressed with the practical value of Wi-Fi technology in enhancing their professional practices at school. As a result, they gave a high rating (Mean = 4.01 SD = 1.04) to the question of whether 'the deployment of Wi-Fi technology was useful in facilitating teaching at the school'. This sentiment was echoed by TC_3, who found that the technology made it easier to access the internet, download teaching and learning materials, and conduct research online, creating an environment that was conducive to teaching and learning. TA_1 also commented that the deployment of Wi-Fi technology had sped up access to information and teaching and learning at the school. The respondents also agreed that it was worth the time to use the technology to facilitate teaching at the school, with a high score of (Mean = 3.54 SD = 1.05). Further, evidence from the open-ended items showed that TB_1 supported this

Table 2. Teachers' views on the deployment of the Wi-Fi technology ($N = 119$).

Items	Mean	Std. Deviation
It was comfortable with the experiences of the Wi-Fi technology in facilitating teaching at the school.	3.42	1.31
It was worth the time using the Wi-Fi technology to facilitate teaching at the school	3.54	1.25
The deployment of Wi-Fi technology was essential in facilitating teaching at the school	4.01	1.04
The deployment of the Wi-Fi technology was well planned to enhance effective teaching and learning at the school.	3.25	1.33
The incorporation of the Wi-Fi technology was resourceful in enhancing professional practices at the school	3.47	1.27
The deployment of the Wi-Fi technology was helpful in facilitating teaching at the school	3.44	1.29
The deployment of the Wi-Fi technology was useful in facilitating teaching at the school	3.42	1.31
The deployment of the Wi-Fi technology increased the efficiency in carrying out professional practice at the school	3.41	1.35
There is confidence in the services provided by the Wi-Fi technology at the school	2.95	1.31
There is trust in the services provided by the Wi-Fi technology at the school	2.76	1.27
It is easy to connect to the internet using the Wi-Fi technology at the school	2.88	1.33
Overall	3.32	1.28

Note: 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree.

by stating that the availability of Wi-Fi in the school enabled teachers to access online content materials that would have been difficult to access elsewhere. Other comments reported were as follows:

TC_3"*It helps me access the internet easily, download teaching and learning materials and do more research online. Thereby creating easy environment for teaching and learning*"

TA_1"*The deployment of the Wi-Fi technology has fastened access to information and teaching and learning at my school*"

TB_1"*the availability of the Wi-Fi in the school really enables me and I'm sure most teachers here to access contents of our respective teaching subjects online which without the Wi-Fi, would have been hectic on some of us. Most especially, in cases where you do not have sufficient bundle*"

However, there were some reservations among some teachers regarding the comfortability (Mean = 3.42 SD = 1.31), planning (Mean = 3.24 SD = 1.33), resourcefulness (Mean = 3.47 SD = 1.27), usefulness (Mean = 3.42 SD = 1.31), and efficiency (Mean = 3.41 SD = 1.35) of the Wi-Fi technology in facilitating their professional practices at the SHTVs. TB_7 argued that the Wi-Fi system at the school was only accessible in certain points or places and houses that were quite distant from the school and thereby reducing the connectivity levels. TA_10 also suggested that the deployment of the technology had not made much of an impact. The following were in relation to some specific responses of the teachers:

TB_7"*Wi-Fi system at my school is accessible at certain points or places in the school and houses and it's quite distant from the school. As such, we scarcely get any connectivity*"

TA_10"*the deployment of the Wi-Fi technology has not been effective as expected. Hence, not much impact has been made in relation to my approach to teaching*"

Despite these concerns, the respondents lost confidence (Mean = 2.95 SD = 1.31) and trust (Mean = 2.76 SD = 1.27) as a result of their inability to connect (Mean = 2.88 SD = 1.33) to the internet using the Wi-Fi technology in support of teaching and learning. TA_8 added that the deployment of the technology was a good initiative aimed at facilitating effective teaching and learning, but it was neither effective nor operational at their school. Similarly, TB_6 observed that the use of Wi-Fi technology had not improved their teaching experience in any way. Overall, TC_13 summarized that the connectivity was generally intermittent, limited to a small area within the school, and mostly slow and frustrating. Their specific comments were observed as:

TA_8"*the deployment of the Wi-Fi technology in the school is a very good agenda aimed at facilitating effective teaching and learning but its neither effective nor operational in my school*"

TB_6 "*the use of the Wi-Fi technology has not in any way helped my teaching experience in my school*"

TC_13"*the internet is limited to small area within the school. It is mostly slow and frustrating to say the least*"

Despite these issues, the overall mean (Mean = 3.32 SD = 1.28) suggests that the teachers viewed the deployment of such technology to facilitate teaching and learning as positive, even though they were not particularly impressed with the quality of the services rendered.

Teacher's learning

Level 2 of the framework provides for the learning experience of teachers in accessing the Wi-Fi technology. The results from the study depicts teachers' positive disposition towards the impact of the deployment of the Wi-Fi technology. Table 3 displays mean scores of teachers in relation to the learning experience gained as result of the deployment of Wi-Fi technology at their schools.

The results from Table 3 indicate that the teachers had gained a moderate amount of learning experience through the use of the Wi-Fi technology in the various schools. Comparable tendencies were detected in the teachers' ability to access the internet (Mean = 3.23) using smart phones, tablets to connect (Mean = 3.55) to the Wi-Fi technology at designated hotspot, classrooms, teachers' bungalows (Mean = 3.26) to enhance their professional practice. In corroborating the above observations, some of the comments attributed to the teachers were reported on the open-ended items as:

TC_3 *"in using the Wi-Fi technology, I have learnt how to incorporate e- learning and obtained adequate information online which eventually aided my teaching and learning at the school"*

TB_1 *"learning became more fun as students and teachers saw how the various subjects being taught relate to the outside world" I have learnt how to use my smart phones and laptops to connect to Wi-Fi in order to search for information"*

TA_8 *"I use my laptop to access the internet, post teaching materials and other animations to facilitate my teaching courtesy the school's Wi- Fi"*

Again, the teachers developed the skills (Mean = 3.40) of using their computers, laptops, smart phones to access the internet (Mean = 3.26) in power point presentations, animations and images (Mean = 3.13) in devising innovative ways of teaching (Mean = 3.24) as a result of the uninterrupted internet services (Mean = 3.08) provided by the Wi-Fi technology. These were some of the comments of the teachers:

TC_1 *"using power-point presentations, online videos and resources such as images and PDF through the Wi-Fi in the school has greatly improved the learning experiences of students as well as our teaching experiences"*

TA_10 *"I'm now conversant with the use of power points slides and images to motivate and draw student's attention during online instructional delivery "*

TB_1 *"in using the Wi-Fi, I'm able to download large volumes of resources within a shorter period"*

TC_3 *"the deployment of the Wi-Fi technology in my school, helped me to watch and download tutorial videos to aid my students. Thus, creating enabling environment for teaching and learning".*

Nonetheless, they expressed their inability to monitor students' participation, provide access control and security to facilitate teaching and learning using the Wi-Fi technology at their schools (Mean = 2.80). In particular, some teachers highlighted the following as responses to some of the open-ended items:

Table 3. Teacher's learning experiences (N = 119).

Items	Mean	Std. Deviation
I have learnt to access the internet to facilitate my teaching using the Wi-Fi technology at the school	3.23	1.28
I have learnt the skill of using the Wi-Fi technology to facilitate my teaching at the school	3.40	1.16
I have learnt to use the computer, laptops, smart phones to access the internet to facilitate my teaching using the Wi-Fi technology at the school	3.52	1.30
I have learnt to access the internet using the Wi-Fi technology at designated hotspot, classrooms, teachers' bungalows etc. at the school	3.26	1.24
I have learnt to use the smart phones, tablets etc. to connect to the Wi-Fi technology at the school	3.55	1.27
I have learnt to post teaching materials (tutorials, notes, videos) to facilitate my teaching using the Wi-Fi technology at the school	3.04	1.33
I have learnt to incorporate interactivity in my lessons to facilitate my teaching and learning using the Wi-Fi technology at the school	3.10	1.25
I have learnt to use power-point slides, animations and images to facilitate my teaching using the Wi-Fi technology at the school	3.13	1.34
I have learnt to use the Wi-Fi technology to provide reliable/uninterrupted internet services to enhance my professional practices at the school	3.08	1.34
I have learnt innovative ways of facilitating my teaching using the Wi-Fi technology at the school	3.24	1.25
I have learnt to monitor my students' participation, provide access control and security to facilitate my teaching using the Wi-Fi technology at the school	2.80	1.25
Overall	3.22	1.28

Note: 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree.

TB_6 *“as result of the restricted use of the Wi-Fi on campus, I’m unable to keep up to date records of my students who participate during lessons”*

TA_1 *“it’s a bit complex and unable to control students during online delivery”*

TA_10 *“it is difficult clamping down on students who use the Wi-Fi during instructions to access other materials other than what is being taught”*

TB_7 *“using the Wi-Fi technology wasn’t easy at the beginning, especially limiting my student’s ability to manipulate and surf the web exclusively on academic materials”*

The overall mean score ($M = 3.22$ $SD = 1.31$) of the experiences acquired by respondents were positive and an indication that the deployment of Wi-Fi technology impacted positively on the teachers’ learning experiences based on their use of the technology during teaching and learning.

School’s organization and culture

In order to explore conditions, policies and practices that underpin or support the deployment of the Wi-Fi technology to enhance teachers’ pedagogy at their school, the survey provided for teachers to respond on three issues: the support/policies offered by the school to facilitate the online delivery of education; whether there was a change in pedagogy as a result of the deployment of the technology and whether technology has been successful in supporting the online delivery of education. [Table 4](#) demonstrates the results as reported by the teachers.

Regarding the provision of support and policies through professional development programmes, training, and seminars aimed at equipping teachers to facilitate online education, the teachers provided mixed responses. For example, their responses (Mean = 3.02) varied in relation to the provision of clear-cut policies use to support Wi-Fi technology in delivering online education. These variations on the use of Wi-Fi technology to enhance the professional practices of teachers were also observed in the teachers’ comments from the open-ended items. For example, some teachers reported that Wi-Fi was being used only at the ICT lab while others claimed it was accessible at specific locations in the school. To this end, some highlighted that:

TA_8, *“there is Wi-Fi in the school but it is being used at the ICT lab leaving the other subject areas”*

TC_10 *“the Wi-Fi is accessed at some locations at the school, unless you go there”*

Similar observations showed lack of pre-requisite training on the use of the Wi-Fi technology to facilitate professional practices (Mean= 3.14). Some of their comments are as follows:

TA_1 *“currently, the school has an active Wi-Fi connection. But frankly, I’m unable to use it to help my students owing to the lack of training in the school”*

TB_1 *“if only such technology came with the ICT personnel to train us to integrate it into our existing methods of teaching”*

TC_13 *“there is zero training from the school since the installation of the wi-fi technology to help my teaching skills”*

Table 4. Teacher’s views on policies and support by the school ($N = 119$).

Items	Mean	Std. Deviation
The school’s support (professional development programmes) is helpful in aiding a change in my mode of teaching (online delivery of education)	2.95	1.33
There are policies at my school to support the deployment of the Wi-Fi technology to facilitate the online delivery of education	3.02	1.32
The school provides professional support (training) to teachers on the use of the Wi-Fi technology to facilitate online delivery of education	3.14	1.34
The school ensures that teachers are motivated to use the Wi-Fi technology to aid them in teaching (online delivery of education)	3.28	1.28
The provision of readily available resources by the school supports online delivery of education.	2.86	1.33
The deployment of the Wi-Fi technology is successful in supporting online delivery of education at the school	3.19	1.38
The satisfaction with the use of the Wi-Fi technology supports online delivery of education at the school	2.98	1.41
Overall	3.32	1.28

Note: 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree.

Some teachers reported that their schools were supportive in providing materials to aid their instructional delivery, organizing workshops and seminars to equip staff with the necessary skills to use Wi-Fi technology to access the internet and teach. Here are some of their comments:

TC_1 *"my school provides me with some materials to support my instructional delivery"*

TB_6 *"my school has been extremely supportive in getting teachers to utilise the Wi-Fi technology to support our teaching online."*

TA_10 *"my school hopes to transform the usual face-to -face interaction into a more interactive teaching approach facilitated by the Wi-Fi technology"*

TB_7 *"series of workshop and seminars have been organised to equip the staff with necessary skills in using the Wi-Fi to access the internet to teach".*

However, others stated that even though Wi-Fi technology was deployed in their schools, teachers were hardly provided with readily available resources to support online education (Mean = 2.86). This lack of support was affirmed by the statement of some teachers, who reported that their schools had not provided any training on the use of Wi-Fi technology to help improve their teaching skills. To this end, it could be suggested that the lack of internal policies and support for Wi-Fi technology use as a means of instruction in schools could be indicative of it not being a considered option. The teachers' responses also indicated that there had not been any shift in pedagogy as a result of the deployment of Wi-Fi technology at their schools (Mean = 2.95). This lack of change in pedagogy could be attributed to the negative perception in which teachers perceived the use of Wi-Fi technology in their schools to support online education (Mean = 2.98). Some specific comments reflected this finding:

TB_1 *"there have been no programmes to enhance our capacity to incorporate the Wi-Fi technology in the classroom context to facilitate teaching and learning in my school"*

TA_1 *"the school has really not been supportive because many a time the Wi-Fi service has not been available and no training for teachers"*

TC_13 *"probably a deliberate decision by school administration to reinforce this initiative to guide our mode of teaching will enhance teachers' educational practices"*

The teachers' responses were neutral concerning the success of Wi-Fi technology in supporting online education (Mean = 3.19), suggesting that teachers may feel alienated and lack the competency to conduct lessons anchored on the use of Wi-Fi technology in their schools. Overall, teachers perceived the support received from their schools as positive (Mean = 3.32 SD = 1.28) despite some isolated difficulties encountered in accessing the internet to facilitate their professional practices via the Wi-Fi technology deployed at their schools.

Teacher's use of Wi-Fi technology in teaching

This level of the Guskey's framework was used to explore the applicability of the Wi-Fi technology in the classroom context in milieu of the teachers' reactions, learning experiences and the support/policies received from the SHVTs. Evidence of the mean scores on application of Wi-Fi technology is presented in [Table 5](#)

The findings revealed that teachers in the SHTVs are yet to master the use of the Wi-Fi technology to improve their professional practices, as evidenced by the results presented in [Table 5](#). This was reflected in moderate ratings by the teachers in the way they are able to use or transfer their learning in the classroom: accessing the internet (Mean = 3.32), using multimedia tools such as PowerPoint slides, animations, and images to engage students (Mean = 3.19), creating interactive lessons (Mean = 3.21), and utilizing various devices such as smartphones, tablets, and computers to connect to Wi-Fi (Mean = 3.18) to facilitate online education delivery. Moreover, the deployment of Wi-Fi technology has encouraged teachers to utilize innovative approaches to teaching (Mean = 3.12). Here are some responses by TB_7, TA_ 10, TC_ 3, and TA_ 1 that highlight the various ways in which Wi-Fi technology has been used to enhance teaching and learning.

Table 5. Use of Wi-Fi technology in the classroom context ($N = 119$).

Item	Mean	Std. Deviation
I use the Wi-Fi technology as means of accessing the internet to facilitate my teaching during online delivery of education	3.32	1.33
I apply my learning experience in the use of the Wi-Fi technology to facilitate my teaching during the online delivery of education	3.32	1.28
I use innovative ideas to facilitate my teaching during teaching (online delivery of education) as a result of the deployment of Wi-Fi technology at the school	3.12	1.35
I use the Wi-Fi technology to post teaching materials (tutorials, notes, videos) to facilitate my teaching during online delivery of education	2.98	1.22
I use power point slides, animation and images to capture students' attention in lessons during online delivery of education as a result of the deployment of the Wi-Fi technology.	3.19	3.05
I make lessons interactive to facilitate my teaching during online delivery of education at the school	3.21	1.33
I monitor, provide access control and security to students to facilitate teaching and learning during online delivery of education using the w-fi technology at the school.	2.87	1.30
I use smart phones, tablets, computers etc. to connect to the Wi-Fi to facilitate teaching during online delivery of education.	3.18	1.39
Overall	3.32	1.28

Note: 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree.

TB_7 "I do search for information needed to do demonstrations, explanation of concepts and display of diagrams to the students"

TA_10 "I download PDFs, images and videos concerning the topics to be taught and play/show it to the students in class"

TC_3 "I am able to stream lessons especially, video tutorials which really enhances the teaching and learning"

TA_1 "I use the Wi-Fi to search questions and also learn topics I don't understand online to achieve different ways of ways/methods of teaching to the understanding of the students"

However, some teachers reported difficulty in monitoring, providing access control and security to students (Mean = 2.87), as well as posting teaching materials (tutorials, notes, videos) to facilitate online teaching (Mean = 2.98). In affirming this assertion, some of the teachers remarked that:

TB_1 "I rely on my colleagues to use the Wi-Fi to access materials online to aid my teaching"

TA_8 "I use the services of the ICT teachers in sourcing online content specific educational materials to prepare my lessons"

TC_13 "It is difficult to single handily facilitate online instructions that involve using images, videos etc at the school"

The results suggest that the use of Wi-Fi technology in the classroom is moderate. It is inferred that teachers rely on their prior knowledge, rather than their ability to manipulate complex sets of interrelationships of factors, to facilitate their professional practices using Wi-Fi technology. Therefore, other contributory factors must be implemented to augment the absolute use of Wi-Fi technology in teaching. This inference could explain teachers' inability to use Wi-Fi technology in its entirety at the SHTVs. Overall, the mean scores for teacher reaction (Mean = 3.32 SD = 1.28), learning experience (Mean = 3.22 SD = 1.28), school organization and culture (Mean = 3.32 SD = 1.28), and the application of Wi-Fi technology as a tool to enhance teaching and learning practices at the SHTVs (Mean = 3.32 SD = 1.28) suggest that teachers have a moderately positive disposition towards the use of this technology.

The final research question investigated the factors (level 1- teacher reaction, level 2- teacher learning, and level 3- school organization and culture) that aid teachers in using Wi-Fi technology in the classroom context. The study employed standard regression to measure the impact of these factors on Wi-Fi technology use in the classroom context. This was done first for each of the independent factors. The aim was to determine whether the contributions of teachers' responses, teachers' learning or acquisition of knowledge, and the school's organization and culture independently could predict the integration of Wi-Fi technology into teaching at SHTVs. From the analysis, teachers' reaction ($p = 0.580$) was found as not significant in predicting the teachers' use of the Wi-Fi technology to teach at the schools while teachers' learning and the school's organization and culture were both significant. Consequently, the impact of teachers' learning, and school's organization and culture were explored by conducting further analyses to improve the regression model. Table 6 accounts for the estimated Coefficients of the predictors (teachers' learning, and school's organization and culture)

Table 6. Estimated Coefficients of predictors (teachers' learning, and school's organization and culture) ($N = 119$).

Variable	R	R-Square	F(Sig)	Standardised Coefficients	T	Sig
Impact of teachers' learning	.785	.616	187.583 (.000 ^a)	.785	13.696	.000 ^a
Impact school's organization and culture	.823	.677	245.386 (.000 ^a)	.823	15.665	.000 ^a
Impact of teachers' learning, and school's organization and culture	.846	.716	146.403 (.000 ^a)	0.341 (L) 0.546 (O)	6.406 4.895	.000 ^a .000 ^a

Note: ^a $p < 0.05$; L = Teachers' Learning, O = School's Organization and Culture.

Similarly, analysis from Table 6 reports of the R-Square in relation to teachers' learning as 0.616. Thus, teachers' learning as an independent variable in the model accounts for an approximate 62% of the variations in the Wi-Fi technology use by the teachers. This was affirmed by the p -value ($p < 0.001$), an indication of the teachers' learning as a significant predictor in the Wi-Fi technology use by the teachers at the schools. In addition, the model shows that, school's organization and culture accounts for an approximately 68% of the variations in the Wi-Fi technology use in teaching. The p -value ($p < 0.001$) gives an indication of school's organization and culture as a significant predictor in the model. The collective impact of the teachers' learning and school's organization and culture from the model (R-Square = 0.716) shows that, an approximately 72% accounted for the predictability of using Wi-Fi technology to teach at the SHTVs. The surge in the use of the Wi-Fi technology to teach at the SHTVs is contingent on the combination of teachers' learning and school's organization and culture. Further, the model posits the F- test conducted as significant [F (2, 116) = 146.403, $p < 0.001$]. In a nutshell, in producing the regression model for the study, the independent variables' standardised coefficients were computed resulting in the overall effect as shown:

$$\begin{aligned} \text{Teacher's Use of Wi - Fi Technology in teaching} &= 0.546 \text{ School's Organization and Culture} \\ &+ 0.341 \text{ Teacher's Learning.} \end{aligned}$$

The model suggests that, teachers' learning preceded by school's organization and culture best predict the teachers use of the Wi-Fi technology to teach. Hence, it is fair to speculate that in deploying the Wi-Fi technology in educational establishment such as the SHTVs, the School's Organization and Culture and Teacher's Learning ought to be prioritised in order to get teachers to incorporate it in their teaching. To this end, equipping teachers with the pre-requisite competencies (teachers' learning) in a conducive environment (teachers' learning preceded by school's organization and culture) to incorporate Wi-Fi technology in their lessons is implied in the current study. Some teachers articulated their views on a number of issues (combination of factors) that influence their use of the Wi-Fi technology in teaching. For instance, TA_10 argued that:

It is difficult to use the Wi-Fi technology to access the internet to facilitate teaching in the absence of professional developments programmes and training (support/policies) from the school and certainly, not when I'm ill-equipped in terms of the technical know-how in incorporating the technology in my teaching. I think a blend of these two areas will make my work easier and faster.

It could be deduced from the remark that, the school's organization and culture as well the teacher's learning are deemed critical in the teachers' use of the Wi-Fi technology in the classroom context ostensibly to support their pedagogy. Similarly, in support of this assertion, TB_7 contended that, "with the active support of the school in terms of in-service training, seminars and appropriate framework (time table), I can incorporate this technology in my lessons in class" Also, TC_3 acknowledged as effective, the issues of school's organization and culture as well as competency (teacher's learning) as the effective way of seeing to the teacher's use of the Wi-Fi technology to enhance their professional practice at the school. He stated that:

My personal competencies in ICT use and the opportunity afforded me by way of support from my school were contributory factors in integrating the Wi-Fi technology into my lessons (online delivery of education) in my school.

The findings from both qualitative and quantitative data, were complementary. The study highlights that, the teachers' learning and the school's organization and culture best predicted Wi-Fi technology

use in teaching. Altogether the findings exposed that the teachers' learning and school's organization and culture significantly predicted Wi-Fi technology use in teaching, teachers' reaction was not significant predictor in the use of the Wi-Fi technology to access the internet to facilitate teaching at the schools. Among the four levels of the Guskey's model explored in this study, teachers' learning preceded by the school's organization and culture best-predicted Wi-Fi technology use in teaching. Finally, the teachers' learning and school's organization and culture accounted for only 71.6% of the variations in the use of Wi-Fi technology to teach, which presupposes the existence of other factors of influence in the use of the Wi-Fi technology in teaching.

Discussion of results

This study aimed to assess the effectiveness of the Government of Ghana (GoG) initiative in introducing Wi-Fi technology to enhance connectivity in selected SHTVs. The deployment of this Wi-Fi technology established a wireless medium in the schools, enabling students and teachers to access the internet. The primary goal was to address the digital divide and support the online delivery of education. The present study endeavours to examine the influence of this Wi-Fi technology on the professional practices of teachers in the SHTVs, three years after the program's implementation. The study assessed the impact of the program at four levels of Guskey's framework: the teachers' reaction in relation to the quality (planning, usefulness, helpfulness, reliability, trust, connectivity, confidence, comfortability) of the Wi-Fi technology, the teachers' learning experience, the school's organization and culture and the use of the Wi-Fi technology to facilitate teachers' professional practices.

In relation to the findings of first level of the Guskey's model, this study's results indicate that while teachers were moderately impressed with the calibre of services provided, they held a favourable outlook regarding the implementation of such technology to enhance their professional activities. This finding aligns with the studies of (Asomah et al., 2022a; Balanskat et al., 2006) which report of participants positive perception towards technological adoption in educational settings. The authors argued that user's disposition towards technology is a complex process that is influenced by many other factors. In particular, Asomah et al., (2022a) outlined the improvement in the pedagogical activities of educators as a result of their positive disposition towards the implementation of a teaching technology in Ghanaian universities.

The data further showed from the second level of Guskey's model that, the learning experiences acquired by teachers were moderately perceived as positive an indication that the deployment of wi-fi technology impacted positively on the teachers' learning experiences. This outcome also aligns with studies of Benning and Agyei (2016), Agyei (2021). For instance, Agyei (2021) sought to evaluate the impact of the ICT- instructional professional development programme in relation to the quality and the extent of the teachers' transfer of the programme's ideas from capacity building to classroom instructional practices. The outcomes of Agyei's research align closely with those of the present study, as both investigations indicate that teachers generally expressed satisfaction with content and processes involved in their learning experiences.

Furthermore, evidence from the third level of Guskey's framework illustrates a perceived favourable influence regarding the assistance provided by schools, despite occasional challenges encountered in accessing the school's internet through the deployed Wi-Fi technology. Comparable observations were documented in the findings of Yidana and Addo (2001), who contended that despite the supportive and positive impact of technology within the educational institution, teachers faced certain shortcomings related to reliability, trust, and connectivity in technology utilization, similar to the current study's discoveries. Additionally, the results at the third level of Guskey's model in this research affirm a range of studies that emphasize the presence of accompanying problems with the adoption of technology. For instance, (Agyei, 2013; Chuttur, 2009) asserted that enhancing connectivity levels is crucial, as deficient access can hinder effective teaching and learning processes.

Finally, at the fourth level of the Guskey's model, the study showed that teachers' use of the wi-fi technology was inclined more to how they employed their prior knowledge of ICT in enhancing their professional practices via the Wi-Fi technology deployed at the school. The results of the current study however, do not seem to align with the finding of Agyei, (2012) who contended that, reliable internet

connectivity allows teachers to shift from the traditional pedagogy to a more technologically inclined students' ownership-type of learning. The teachers in this study were not

However, a notable disparity emerges between the outcomes of the current study and the findings put forth by Agyei (2012). The divergence centers on the role of reliable internet connectivity in catalyzing a shift from conventional pedagogical methods towards a more technology-driven, student-centric learning environment. Agyei's contention emphasizes the transformative potential of robust connectivity, enabling teachers to embrace a pedagogical shift towards fostering student ownership of learning through technological integration

Again, among the four levels of the Guskey's model explored in this study, the teachers' learning preceded by school's organization and culture best-predicted Wi-Fi technology usage in teaching at the SHTVs. Additionally, the teachers' learning and school's organization and culture accounted for only 71.6% of the variations in use of the wi-fi technology to teach, which presupposes the existence of other factors of influence in the use of this technology to teach. The findings, align with the studies of Sherry and Gibson (2002) who argued that technological, individual, organizational, and institutional factors should be considered when examining technology adoption in educational systems. Thus, in the deployment of any technology for adoption in the context of any educational establishment, there is the need for thorough exploration of factors that minimizes or maximizes the output of that initiative. Clearly, this study establishes the factors of the school's organization and the teachers' learning experiences as two best predictors in maximizing the use of Wi-Fi technology in an educational establishment particularly at the SHTVs level.

The qualitative data reported in the study showed that, teachers still resort to traditional means of pedagogy as result of irregularities associated with access to the internet via the Wi-Fi technology to facilitate teaching and learning deployed in the school. This finding affirms with the study of Agyei, (2013) in his analysis of technology integration in teacher education in Ghana where he held that teachers still resort to the traditional pedagogy. Moreover, Fishman and Krajcik (2003) elucidated in their study that, the bedrock of systemic reforms in relation to educational goals is to align such reforms across elements of school systems (such as administration and management, curriculum and instruction, assessment and policy).

In using the first four levels of Guskey's framework, the current study evaluates the impact of the Wi-Fi technology deployed and operationalized nation-wide in all the SHTVs in Ghana. The fundamental goal of this initiative by the Government of Ghana was to promote teaching and learning practices via online especially at the SHTVs.

Consequently, we contend that teachers are equipped with the requisite competencies in the use of Wi-Fi technologies through professional development programmes, training and enactment of ICT curriculum-based policies in the SHTVs. This will promote and enhance effective utility of the Wi-Fi technology among the teachers.

It is therefore important that schools prioritize providing robust technical support to address challenges related to Wi-Fi access. Initiatives could include regular maintenance of network infrastructure, timely troubleshooting, and offering guidance to teachers on resolving connectivity issues.

Conclusions and implications

The findings of the current study revealed that teachers' learning and school's organization and culture were crucial in the deployment of Wi-Fi technology in teaching. Teachers observed that irrespective of their impression of the technology's quality, without the fundamental policies and support (professional development programmes and training) from schools as well teachers' learning experiences (competencies), the integration of the Wi-Fi technology to facilitate teaching and learning practices via online will be a challenge at the SHTVs.

Acknowledging the pivotal role of school organization and culture and recognizing its significance in overcoming the challenges encountered in the successful deployment of Wi-Fi technology for online teaching, the authors highlight the importance of a holistic approach to technology integration, involving not only the quality of the technology itself but also the support and policies provided by schools. We postulate that, Educational institutions should formulate clear policies and provide the necessary

support structures, including professional development programs, to facilitate the seamless integration of Wi-Fi technology into teaching practices. In instances where ICT infrastructure exist, it is important that schools prioritize providing robust technical support to address challenges related to Wi-Fi access. Initiatives could include regular maintenance of network infrastructure, timely troubleshooting, and offering guidance to teachers on resolving connectivity issues.

Further, the study also highlights the importance of teachers' competencies to technology integration, we recommend that Educational institutions should prioritize comprehensive training programs and continuous professional development opportunities for teachers to enhance their competencies in technology integration. This investment can contribute significantly to the effective utilization of Wi-Fi technology in online teaching and learning.

Limitations and further research

The sample for the conduct of the study was limited to only teachers from public SHTVs in the Cape Coast Metropolis. This invariably affect the research findings hence, can't be generalized over all SHTVs. The study discovered that teachers' learning and the school's organization and culture accounted for 71.2% of the variance in using Wi-Fi technology in teaching. In the light of this, the authors recommend that, further research be conducted to explore other factors that explains 28.8% of technology use in teaching aimed at removing the bottlenecks in integrating the Wi-Fi technology to teach.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

Data supporting this study are not publicly available due to the anonymity and confidentiality of the respondents. Please contact the-research-correspondents @ asomahsrcprez@gmail.com.

Reference

- Agyei, D. D. (2012). *Preparation of pre-service teachers in Ghana to integrate information and communication technology in teaching mathematics* (University of Twente). Retrieved from (Unpublished doctoral dissertation https://ris.utwente.nl/ws/files/6_062204/thesis_D_Agyei.pdf).
- Agyei, D. D. (2013). Analysis of technology integration in teacher education in Ghana. *Journal of Global Initiatives: Policy, Pedagogy, Perspective*, 8(1), 69–86.
- Agyei, D. D. (2021). Integrating ICT into schools in Sub-Saharan Africa: From teachers' capacity building to classroom implementation. *Education and Information Technologies*, 26(1), 125–144. <https://doi.org/10.1007/s10639-020-10253-w>
- Anouk, J., Bart, C., & Nyaga, M. (2005). Integrating ICT in teacher training: Reflections on practice and policy implications: Case of KTTC. <http://www.idrc.ca/en/ev-93060.html>
- Asomah, R. K., Assamah, G., Commey-Mintah, P., & Boateng, F. O. (2022a). The use of social-media and IT application tools for teaching in Ghanaian universities: Case of University of Cape Coast, Ghana. *European Journal of Education and Pedagogy*, 3(5), 24–31. <https://doi.org/10.24018/ejedu.2022.3.5.425>
- Asomah, R. K., Agyei, D. D., & Assamah, G. (2022b). A SWOT analysis of e-learning integration in University of Cape Coast. *European Journal of Education and Pedagogy*, 3(4), 1–8. <https://doi.org/10.24018/ejedu.2022.3.4.373>
- Balanskat, A., Blamire, R., & Kefalla, S. (2006). The ICT impact report. *European Schoolnet*, 1, 1–71.
- Benning, I., & Agyei, D. D. (2016). Effect of using spreadsheet in teaching quadratic functions on the performance of senior high school students.
- Cape Coast Metropolitan Education Office. (2023). Ghana Education Service, Directorate of Human Resource. Cape Coast Metropolis, Ghana.
- Carmon, Y., Shamai, S., & Weissman, T. (2015). Comparison of the achievable rates in OFDM and single carrier modulation with IID inputs. *IEEE Transactions on Information Theory*, 61(4), 1795–1818.
- Cobanoglu, C., Bilgihan, A., Nusair, K. K., & Berezina, K. (2012). The impact of Wi-Fi service in restaurants on customers' likelihood of return to a restaurant. *Journal of Foodservice Business Research*, 15(3), 285–299. <https://doi.org/10.1080/15378020.2012.706194>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education*. Routledge.
- Creswell, J. W. (2014). *Research design, qualitative, quantitative, mixed method approaches* (4th ed.). SAGE Publication Inc.
- Creswell, J. W., Plano Clark, V. L., Gutmann, M., & Hanson, W. (Eds.). (2003). *Advanced mixed methods research designs*. SAGE.
- Chuttur, M. Y. (2009). Overview of the technology acceptance model: Origins, developments and future directions. Indiana university, USA. *Working Papers on Information Systems*, 9(37).
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). Routledge.
- Computerized School Selection and Placement System [CSSPS]. (2019). *Ghana Education Service SHS Selection register*. Retrieved from <https://ghstudents.com/wp-content/uploads/2019/06/GES-SHS-selection-REGISTER-2019.pdf>.
- Fishman, B., & Krajcik, J. S. (2003). What does it mean to create sustainable science curriculum innovation? *Science Education*, 87(4), 564–573. <https://doi.org/10.1002/sce.10088>
- Ghana Education Service [GES]. (2020). Teaching syllabus: Senior high school, Curriculum Research and Development Division [CDD]. Accra, Ghana: Ghana Publishing Company.
- Guskey, T. R. (1985). *Implementing mastery learning*. Wadsworth.
- Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational Researcher*, 15(5), 5–12. <https://doi.org/10.2307/1174780>
- Guskey, T. R. (1990). Cooperative mastery learning strategies. *The Elementary School Journal*, 91(1), 33–42. <https://doi.org/10.1086/461636>
- Guskey, T. R. (1991). Enhancing the effectiveness of professional development programs. *Journal of Educational and Psychological Consultation*, 2(3), 239–247. https://doi.org/10.1207/s1532768xjepc0203_3
- Guskey, T. R. (1998). The age of our accountability. *Journal of Staff Development*, 19(4), 1–9.
- Guskey, T. R. (2002). Does it make a difference? Evaluating professional development. *Educational Leadership*, 59(6), 45–51.
- Guskey, T. R. (2015). *On your mark: Challenging the conventions of grading and reporting*. Solution Tree.
- Ict4ad, G. (2003). Ghana ICT for Accelerated Development (ICT4AD) Policy. *Assessed October, 1* 2010.
- Jeon, J., Yoo, M., & Christodoulidou, N. (2019). The impact of Wi-Fi service on millennial diners. *Journal of Hospitality and Tourism Technology*, 10(3), 383–400. <https://doi.org/10.1108/JHTT-11-2017-0133>
- Liang, C., Schimel, J. P., & Jastrow, J. D. (2017). The importance of anabolism in microbial control over soil carbon storage. *Nature microbiology*, 2(8), 1–6.
- Marzudi, W. N. N. W., Abidin, Z. Z., Muji, S. Z. M., Ma, Y., & Abd-Alhameed, R. A. (2015). Minimization of mutual coupling using neutralization line technique for 2.4 GHz wireless applications. *International Journal of Innovation in the Digital Economy*, 6(3), 1–15. <https://doi.org/10.4018/ijide.2015070101>

- Ministry of Education [MoE]. (2009). *Report on e-readiness assessment of second cycle institutions in Ghana*. ICT in Education Programmes Unit, Ministry of Education.
- Miles, M. B., & Huberman, A. M. (1994). *An expanded source book: Qualitative data analysis* (2nd ed.). Sage Publications.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research*, 40(2), 120–123.
- Norris, P., & Inglehart, R. (2013). Digital divide. In *Handbook on the digital creative economy* (pp. 90–102). Edward Elgar Publishing.
- Pallant, J. (2016). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. (6th edition). McGraw Hill Education.
- Qazi, A., Naseer, K., Qazi, J., Al-Salman, H., Naseem, U., Yang, S., Hardaker, G., & Gumaie, A. (2020). Conventional to online education during COVID-19 pandemic: Do develop and underdeveloped nations cope alike. *Children and Youth Services Review*, 119, 105582. <https://doi.org/10.1016/j.chilyouth.2020.105582>
- Ramirez-Vazquez, R., Gonzalez-Rubio, J., Escobar, I., Suarez Rodriguez, C. D. P., & Arribas, E. (2021). Personal exposure assessment to Wi-Fi radiofrequency electromagnetic fields in Mexican microenvironments. *International Journal of Environmental Research and Public Health*, 18(4), 1857. <https://doi.org/10.3390/ijerph18041857>
- Sherry, L., & Gibson, D. (2002). The path to teacher leadership in educational technology. *Contemporary Issues in Technology and Teacher Education*, 2(2), 178–203.
- Smithers, R. (2007). McDonald's to offer free Wi-Fi in restaurants. *The Guardian*.
- Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2013). *Using multivariate statistics* (Vol. 6, pp. 497–516). Boston, MA: Pearson.
- Yidana, I., & Asiedu-Addo, S. K. (2001). The use of information technology in teacher education. *Mathematics Connection*, 2(1), 30–33.
- Yidana, M. B., & Asare, P. Y. (2021). Preservice teachers' behavioural, emotional and cognitive engagement efficacy. *International Journal of Education and Research*, 9(3), 233–248.
- Ullah, S., Higgins, H., Braem, B., Latre, B., Blondia, C., Moerman, I., Saleem, S., Rahman, Z., & Kwak, K. S. (2012). A comprehensive survey of wireless body area networks: On PHY, MAC, and network layers solutions. *Journal of Medical Systems*, 36(3), 1065–1094. <https://doi.org/10.1007/s10916-010-9571-3>