
**LEARNING MATHEMATICS ONLINE: PRE-SERVICE TEACHERS'
COMPETENCES AND CHALLENGES**

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ABSTRACT: *The study sought to ascertain pre-service teachers' ICT competence they have to undertake online learning of Mathematics as well as the challenges they encountered when they participated in online learning in Akatsi College of Education. The study used descriptive survey design. A structured questionnaire was used to collect data from two hundred and twenty-three pre-service teachers who were purposively sampled for the study. The data collected was analysed using means and standard deviations. The results of the study revealed that majority of pre-service teachers had advance computer skills that helped them used the internet for online learning as well as search for information to support the lessons they were taught online. The findings of the study also revealed that majority of pre-service teachers were proficient in communicating online using Facebook, Twitter and e-mails to support their online lessons. Besides, majority of pre-service teachers indicated that they were proficient in using online tools such as Skype, Zoom, and web video for online learning. However, only 24% and 33% of pre-service teachers were proficient in designing online content using Google drives and using electronic devices to support their online learning respectively. With regard to the challenges pre-service teachers encountered when they participated in the online lessons, majority of these pre-service teachers had difficulty connecting to internet to enable them participate in their synchronous and asynchronous online lessons. With regard to challenges, majority of pre-service teachers had difficulty accessing internet to support their online learning which affected their performance in mathematics. Pre-service teachers also failed to participate in online lessons due to high cost of data. As a result, pre-service teachers resorted to staying awake up to midnight to download and upload learning materials which affected their sleep. Consequently, it was recommended that Government of Ghana partner with telecommunication companies to provide very effective broadband internet connectivity for pre-service teachers to access to enhance online learning. Stakeholders of teacher education in Ghana ought to review the Pillar of ICT in National Curriculum Framework to enable pre-service teachers to be equipped with the skills of using electronic devices to support their online learning.*

KEYWORDS: online learning, Covid-19 pandemic, ICT competence, pre-service teachers

INTRODUCTION

The government of Ghana announced the suspension of all school at pre-tertiary and tertiary levels on 15th March, 2020 as part of the efforts to stop the spread of the COVID-19 pandemic (Cromwell, 2020) with universities, polytechnics, colleges, secondary schools and the basic schools resorting to online teaching and learning (Naa, 2020). Meanwhile, Ogonnaya, Awoniyi and Matabane (2020) explained that effective engagement in online teaching and learning requires some necessary information and communication technology infrastructure (hardware and software) that most colleges and universities in developing countries might not

have. However, at many institutions of learning in Africa, some teachers and lecturers do not have enough knowledge of how to use a computer, and many might not know how to teach using online platforms and tools. According to Olesova, Yang, and Richardson (2011), lack of technology skills and inadequate background experience with online learning are constraints to online education.

As part of the teacher education reform in Ghana carried out by Transforming Teacher Education and Learning (T-TEL), T-TEL in 2015 developed a National Teacher Education Curriculum Framework (NTECF) to guide the 4-year Bachelor of Education programmes. In the framework, the information and communication technology (ICT) pillar is to equip pre-service teachers with ICT skills and competences to be able to assess the internet in searching for information and emails, use multimedia tools, use Web 2.0 mind mapping and Web Quest, use ICT tools for blended learning environment and be able to interact on the college learning management systems (Ministry of Education, 2017).

According to UNESCO (2008), ICT skills and competences refer to knowledge, skills, and ability to take advantage of ICT for the purpose of gathering, processing and presenting information in support of activities among different groups of peoples for working purposes.

Goktas, Yildirim and Yildirim (2009) also categorised teachers' ICT skills and competence into two clusters, namely basic and advanced skills. Basic skills are related to rudimentary operation of computers and the World Wide Web (www), while advanced skills extend to adopting essential operational skills in teaching.

Olayemi, Adamu, and Olayemi (2021) identified seven skills and competences needed to facilitate the integration of ICT into e-learning namely, 1) Basic computer skills (e.g. typing and editing), 2) Advanced computer skills (Internet use), 3) Managing multimedia contents skills (power point, keynote), 4) Web for education skills (Screen recording), 5) Online tools in education skills: Video chat (e.g., Skype) Web Video (e.g., YouTube), 6) Designing online contents skills (Google Drive, forums), 7) Online communication skills: Social Media (e.g. Facebook, Twitter, E-mail), 8) Use of electronic resources(e.g OPAC, database). General analysis of the responses indicated that majority of the respondents indicated high level of ICT skills and competences needed for online learning.

According to Naa (2020) the swift shift from the face to face to the online interaction between the teacher and learner was associated with a lot of challenges such as teachers interacting with learners online, assessment of learners online, appropriate technological device to use, access to internet connectivity, funds for data and communication between learners and teachers.

The World Bank (2020) report indicated that most students will have great challenges accessing online learning, especially those staying in rural areas, having poor internet access and are subject to other disadvantages. The report indicated that these prevailing challenges have not only reduced the chances of the effective use of online learning, but have also succeeded in frustrating the effort of students with strong passion to use the online method for general learning and academic activities. Similarly, Adarkwa (2020) also identified high cost, inadequate infrastructure, lack of ICT skills, rejection of e-learning by faculty members, and lack of accessibility to quality internet connection and electricity as challenges that could hinder pre-service teachers online learning. Queiros and de Villiers (2016) observed the start-

up cost for online learning may be expensive. To Srichanyachon (2014), instructions can be delayed as a result of poor internet connections. Also lack of constant supply of electricity and internet access in rural communities also makes it difficult to assimilate the online education process (Ivala, 2013).

Statement of the Problem

It would be recalled that in 2020, Government rolled out blended learning in Colleges of Education to address infrastructural challenges faced by colleges due to the introduction of the B.Ed program. Blended Learning System is a style of learning in which students learn via electronic and online media as well as traditional face-to-face teaching. However, the National Conference of the Principals of Colleges of Education suspended the blended Learning in Colleges of Education for the 2021/2022 academic year. This decision to abolish blended learning was due to the numerous complaints of challenges associated with the introduction of blended learning (Agboni, 2022).

Mishiwo, Danku, Ayivor and Doe (2021) assessed pre-service teachers' perception and readiness towards online learning. The results revealed that majority of the pre-service teachers have negative perceptions and were not ready for online learning. It is against this background that this study intends to investigate undergraduate pre-service teachers' ICT competencies and challenges they encountered when they participated in the online learning of the blended learning of Mathematics in Akatsi College of Education.

Purpose of the Study

With the outbreak of COVID-19 pandemic, the Ghana Tertiary Education directed all 46 Colleges of Education to adopt the blended system of teaching and learning. Blended Learning System is a style of learning in which students learn via electronic and online media as well as traditional face-to-face teaching. However, the Ministry of Education has informed the Principals of the 46 Colleges of Education to suspend the blended Learning in Colleges of Education for the 2021/2022 academic year since the online teaching and learning was associated with numerous challenges. Besides, Mishiwo, Danku, Ayivor and Doe (2021) assessed pre-service teachers' perception and readiness towards online learning and found that pre-service teachers have negative perception about online learning and therefore were not ready to participate in mathematics lessons online. Meanwhile, few empirical studies have been conducted to identify the challenges associated with the blended learning which made pre-service teachers have negative perceptions towards the blended learning in Akatsi College of Education. Therefore, the purpose of the study was to explore challenges pre-service teachers might encounter that led to the negative perceptions they have towards participating in mathematics online lessons. In addition, the purpose of the study was to ascertain if pre-service teachers have such competences to operate in such an environment heavily dependent on ICT in order to overcome their negative perceptions towards online learning of mathematics.

Significance of the Study

The findings of the study would reveal the state of pre-service teachers' ICT skills and competences as well as the challenges they encountered during their online lessons.

Research Questions

1. What ICT skills and competencies do pre-service teachers have to enable them participate in the learning of Mathematics online?
2. What challenges do pre-service teachers encounter during their online learning of Mathematics?

LITERATURE REVIEW

Using ICT to promote E-learning in Teacher Education

As part of transforming Teacher- Education and Learning, a longitudinal study was conducted from 2016 to 2017 which revealed that the Diploma in Basic Education teacher education curriculum is weighted heavily towards subject-content knowledge to the detriment of developing understanding of pedagogy and practical classroom teaching skills (Ministry of Education, 2017). In order to address the findings, the Ministry of Education developed a National Teacher Education Curriculum Framework (NTECF) through stakeholder consultations as the central vehicle for the transformation of Initial Teacher Education (ITE) in Ghana. The Teacher Education Curriculum Framework is aimed at ensuring that the pre-service teachers secure KCT through their specialism for the grades they will teach (Ministry of Education, 2017).

The NTECF is made up of four integrated pillars: Subject and Curriculum Knowledge (which includes subject matter knowledge and curriculum studies), Literacy Studies in Ghanaian Languages and English, Pedagogic Knowledge, and Supported Teaching in School. Under pillar 3 of the NTECF, (Ministry of Education, 2017) pre-service teachers are required to:

- use of ICT productivity tools to search for information on the internet;
- integrating ICT into lesson planning with the use of multimedia tools, using ICT-based and multimedia tools;
- use ICT-based subject-specific Pedagogical Skills like conceptual learning, organisation of ideas, and tele- collaboration with specific learning tools such as Web 2.0 mind mapping and Web Quest;
- use ICT for Pedagogical Transformation that enables and manages deeper learning through blended learning environment with autonomous professional learning skills.

Meanwhile, Iddrisu, Samsoni, and Mueni (2020) observed that several factors, such as poor internet connections, inadequate infrastructures, low levels of ICT knowledge (technical know-how), teacher unpreparedness, and weak content development negatively impact the adoption of online learning in Ghana. According to Aboagye (2020) only few tutors and lecturers in Ghana are confident and prepared to teach online, while the majority of them prefer face –to-face training.

Moreover, Larbi-Apau, Sampong and Kwofie (2020) in their study of barriers to online learning adoption in higher education found that existing physical structures in higher education systems in Ghana are not designed to support emerging educational technologies. Many of the systems are constrained by Information and Communication Technology (ICT) infrastructure such as poor network security, inadequate wireless technologies and low-speed

internet bandwidths. It also included ineffective infrastructure management to ensure contributions of technology as a means to improving learner learning. In contrast to developed countries where a team of experts are usually engaged to design and develop online courses and instructions, many institutions in Ghana require academic faculty to design and develop their own digital course content. Thus, investigating whether pre-service teachers are equipped with the pre-requisite ICT skills and competences to participate in online learning and challenges encountered during online learning sessions could help stakeholders of the initial teacher education to review the ICT curriculum.

Pre-service Teachers' ICT Competencies

ICT competencies are being taken into consideration in the educational standards that various countries have developed in the form of profiles such as NETS (National Educational Technology Standards) (NETS, 2007) for students in the United States of America, the official certificate in computing and the Internet (B2i) in France, and the incorporation of ICTs in the National Curriculum in England (Aypay, 2010). Ghana also formulated ICT in Educational Policy.

According to Kopaiboon, Reungtrakul and Wangwonick (2014), ICT competency refers to the ability resulting from an individual's knowledge, skills, characteristics and attitudes to carry out work to achieve success. From UNESCO (2008), ICT Competency refers to knowledge, skills and ability to take advantage of ICT for the purpose of gathering, processing and presenting information in support of activities among different groups of peoples for working purposes. NICS (2010) and Albirini (2006) also see ICT competence as knowledge, skills and ability to take advantage of ICT for gathering, processing and presenting the information. Kopaiboon et al. (2014), also stated that individuals who are regarded as ICT competent or having ICT Competency must be able to:

- reproduce necessary documents
- find out solutions to problems
- choose proper ICT tools for problem-solving and effective work
- collect and share information in an ethical way
- process data, and
- possess fundamental ICT knowledge as well as use ICT tools

To better understand the extent of readiness of the students towards online learning, their ICT skills and competencies, Olayemi, Adamu, & Olayemi (2021) and other researchers investigated students' ICT competences. The results revealed that majority of respondents have high ICT competencies needed for online learning. In terms of basic computer skills, 76 (51.4%) claimed to be 'proficient' and 46 (31.1%) indicated that they are very proficient. Also, 21 (14.2%) and 5 (3.4%) of the respondents fell into the category of 'fairly proficient' and 'not proficient' respectively in basic computer skills. Similarly, Ismail, Bakar and Wafa (2020) found that many students lacked basic information technology (IT) skills and experience needed to be able to support themselves using technology for online settings.

Concerning advanced computer skills, Olayemi, Adamu, & Olayemi (2021) reported that a large number of the respondents, 75 (50.7%) were very proficient. Also, 41 (27.7%) indicated

they were very proficient while 28 (18.9%) and 4 (2.7%) fell into the category of 'fairly proficient' and 'not proficient' respectively. Having the skills of managing multimedia content had a large number of the respondents, 71 (48.0%) being proficient while 46 (31.1%) were fairly proficient in those skills. At the extreme are respondents 22 (14.9%) and 9 (6.1%) who indicated very proficient and not proficient respectively. Managing web content for educational activities recorded 31 (20.9%) which indicated that they are 'very proficient' while 15 (10.1%) said they were not proficient. However, majority of the respondents 68 (45.9%) were proficient while 32 (21.6%) were 'fairly proficient'. With regard to the required skills for the effective use of online learning tools, 42 (28.4%) of the respondents are very proficient, 68 (45.9%) were 'proficient', 32 (21.6%) were 'fairly proficient' while 6 (4.1%) are not proficient.

Whether pre-service teachers have online content skills, 23 (15.5%) were very proficient, 57 (38.5%) proficient, 46 (31.1%) fairly proficient and 22 (14.9%) not proficient. Online communication skills had majority of the respondents 72 (48.6%) being very proficient, 66 (44.6%) proficient, 7 (4.7%) fairly proficient, and 3 (2.0%) not proficient. The responses for use of e-resources indicated that 32 (21.6%) were very proficient, this was followed by 63 (42.6%) who indicated to be proficient, 37 (25.0%) fairly proficient and 16 (10.8%) not proficient.

General analysis of the responses indicated that a large number of the respondents have some good measure of the relevant skills and competencies needed for the smooth and effective use of online learning platforms. The result also shows clearly that majority of the students claimed to be proficient with the use of online learning.

Challenges with Online learning

With regard to challenges, Olayemi, Adamu, and Olayemi (2021) and Dube (2020). Investigated the challenges undergraduate students encountered in their online learning because of Covid-19 pandemic. The researchers identified the following perceived challenges which hindered online learning: high cost of data 118(90.4%), poor internet services 89(60.1%), erratic power supply 89(60.1%), inaccessibility to online library resources 60(40.5%), limited access to computer 52(35.1%), and inadequate knowledge of online platforms/tools 39 (26.4%).

Meanwhile, Ogonnaya, Awoniyi, and Matabane (2020) also reported that the high cost of data posed a challenge to students' participation in online lessons. Atta-Obenga and Dadzie (2020), Baylon & Antwi-Boasiako (2016) also observed that due to the high cost of internet bundles, made it difficult for many students to access online platform to participate in online lessons. Similarly, Mishiwo, Danku, Ayivor and Doe (2021) evaluated pre-service teachers' perception and readiness towards online learning. The study was descriptive in nature. The results of the study revealed that majority of pre-service teachers have knowledge in the use of the internet. Besides, majority of the pre-service teachers also have knowledge in the use of electronic devices for online learning. Adarkwa (2020) used a semi-structured interview to explore the perceptions of university students, teacher trainees, and nursing trainees on online learning in Ghana and how to successfully integrate ICT in education to improve online learning for students. In all, 15 of the students were randomly selected to form the sample for the study. The interview results revealed the following results:

Students' outcomes

Only few of the students believed students' outcomes in the online learning would be better than the traditional approach. Many believed that the difficulty with internet access and network challenges resulted in a negative effect on their outcomes. The student reported that their outcome of online learning as compared to the traditional approach was very sad and heart-breaking. The students added that in the course of taking their quiz online system jammed.

Communication

Some of the students indicated that sometimes communication between teacher and students was not possible because the e-learning system could go off for a while before it starts functioning. Thus, intercommunication between lecturers and students was very poor. It was also reported that when they were in the middle of lessons the network could go off.

Cost

One of the major challenges encountered by almost all of the participants was the financial commitments they made to ensure they actively took part in the online lessons. According to the students, the online method of learning was expensive than the traditional face-to face approach. Also, Ogbonnaya, et al. (2020) reported that university students in Ghana complained that the cost of data hindered their participation in online lessons. Thus, 34% of the students found the cost of data as a challenge to access the internet to enable them engage effectively in online lessons.

Online platform

Students persistently lamented about the breakdown of the online platform. According to the students, sometimes when they logged in and started quiz, the site could just jam. Ismail, Bakar and Wafa (2020) reported that students had difficult catching up with the online learning session and rather preferred face-to-face teaching. Students also indicated that lecturers failed to give them instant feedback and immediate response to their questions during online learning. Besides, respondents also got worried because they could not understand learning content conducted via online platform well. They also complained of having difficulties holding group discussion on the online platforms.

Internet connectivity

Adarkwa (2020) found accessing of good internet was one of the major challenges students mentioned. Most of the students indicated that they logged in at midnight since it was free to access online learning site and download and upload materials. They indicated that even though it was effective as compared to the normal day hours, it affected their sleep. Similarly, Ogbonnaya, Awoniyi, and Matabane (2020) revealed that most of the respondents in their study (105 to 71%), encountered challenges in learning online that were related to internet connectivity. Thus, internet connectivity challenges ranged from a slow internet network connection to a complete internet failure. Ismail, Bakar and Wafa (2020) investigated online challenges of Malaysian higher institutions and found that even though students have access to computers, their challenge was heavily pointed to the poor internet connection they experienced in their areas

Electricity

There were mixed views on the availability of electricity for the online learning. Some believed lack of electric power affected their learning while others were okay with it. With the availability of power, Information and Communication Technology (ICT) devices performed their functions optimally. Olayemi, Adamu, and Olayemi (2021), reported that majority of the respondents, 65 (43.9%) overwhelmingly disagreed with the availability of regular power supply needed for their online learning. Ogbonnaya, et al. (2020) reported that pre-service teachers complained of erratic power supply as a challenge for their online learning. Arthur-Nyarko and Kariuki (2019) also found unreliable supply of electricity in Ghana as a major factor affecting online learning in the country.

METHODOLOGY

Research Design

The study employed a descriptive survey research design. This type of design would assist to describe the characteristics that exist in the population but not to determine the cause-and-effect relationship. The justification for the use of the design was that it provided detailed description of pre-service teachers ICT skills and competencies as part of quality teaching and learning in Colleges of Education in Ghana.

Population, Sample and Sampling Procedure

The population for the study comprised three hundred and seventy-five (375) level 400 pre-service teachers of Akatsi College of Education who are pursuing Bachelor of Education in Junior High School option. Two hundred and twenty-three (223) level 400 pre-service teachers were purposively selected because they had successfully taken part in online learning of mathematics for the 2020/2021 academic year and therefore possessed the unique characteristics needed to serve as respondents for the study.

Instrument

A structured questionnaire was used for data collection. The questionnaire was adopted from (Olayemi, Adamu, & Olayemi (2021). The questionnaire was divided into two parts. The first part of the questions assessed pre-service teachers' ICT skills and competencies they needed to support their online learning. Respondents were asked to indicate their level of agreement on their proficiency on a four Likert scale format (1 = not proficient, 2 = fairly proficient, 3 = proficient, 4 = very proficient). On the scale of 1 to 4, 2.5 being the median, when the mean is above 2.5, it implies the perception exists, but when the mean is below 2.5 the perception does not exist.

The second part of the questions assessed the respondents' challenges they encountered while participating in online lessons based on 4-Likert scale format. Respondents were asked to indicate their level of agreement on perception about their readiness and perception on a four-scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4= strongly agree). On the scale of 1 to 4, 2.5 being the median, when the mean is above 2.5, it implies the perception exists, but when the mean is below 2.5, the perception does not exist.

Data Collection Procedure

Permission was sought from the authorities of Akatsi College of Education having explained the purpose of the study. The researchers visited each class and explained the purpose of the study to pre-service teachers as well assured them about the confidentiality of the information they would provide. In all, 223 questionnaires were distributed. Pre-service teachers spent 45 minutes to complete the questionnaire. All questionnaires were collected for analysis.

Data Analysis

Data was analysed using frequencies, percentages, means and standard deviations. The frequencies were converted into percentages.

RESULTS AND DISCUSSIONS

Research Question 1: What ICT skills and competencies do pre-service teachers have to participate in the learning of Mathematics online?

Table 4.1: Pre-service teachers’ ICT competence for Online learning

ICT Skills and Competences	%*	M	SD
Basic computer skills (e.g. typing and editing)	89	3.30	1.159
Advanced computer skills (internet use)	57	2.51	0.667
Managing multimedia content skills (power point)	48	2.26	1.029
Using web for educational skills (screen recording)	36	2.09	1.030
Using online learning tools (Video chats)	66	2.69	1.171
Designing online content skills (Google drive)	24	1.89	1.068
Online communication skills Facebook, email)	75	3.03	1.033
Using electronic resources (database)	33	2.03	0.975

Note. %*, Percentage of pre-service teachers who are either ‘proficient’ or “very proficient’ in ICT skills during online learning

Table 4.1 showed that majority of pre-service teachers, 89% have basic computer skills which supported them to type and edit their contents to support their online learning (mean = 3.30, SD = 0.667). The finding is consistent with the finding of the study conducted by Olayemi, et al. (2021) which reported that students are very proficient in typing and editing their contents online.

The findings of the study revealed that majority, 75% of pre-service teachers are proficient in communicating online using Facebook, twitter and e-mail (mean = 3.03, SD = 1.033). Our findings of our study are consistent with the study conducted by Olayemi, et al. (2021) which reported that majority of student being proficient using communication skills.

With regard to the skills for using online tools for educational activities required for effective participation in online learning, 66% of pre-service teachers indicated that they are proficient in using online tools such as Skype, Zoom, web video for online learning. The findings of our study is in line with the results of the study of Olayemi, et al. (2021) which reported that majority of the students were proficient in the use of online tools for online learning.

However, only 24% of pre-service teachers were proficient in designing online contents. The finding is inconsistent with the findings of Olayemi, et al. (2021) which reported that majority of students in their study are proficient in designing online content using Google drives. Besides, only 33% of pre-service teachers have the skill of using electronic devices to support their online learning which is not in line with the study of Mishiwo, Danku, Ayivor and Doe (2021) which indicated that majority of pre-service teachers have knowledge in using electronic devices.

Research Question 2: What challenges do pre-service teachers encounter during online learning?

Table 4.2: Pre-service teachers Perceived Challenges which hinder their Online learning

Challenges	%*	M	SD
E-learning platform supported learning	20	1.81	0.735
High cost of data affected my performance	64	3.23	0.711
Poor internet connectivity	90	3.28	0.727
Accessible College online library	85	3.25	0.704
Electricity supply is stable	34	2.33	0.531

Note. %*, Percentage of pre-service teachers who either ‘agreed’ or “strongly agreed’ their perceptions towards online learning

Table 4.2 revealed that majority of pre-service teachers, 90% agreed that due to poor internet services they had difficulty connecting to the internet in order to participate in the online mathematics lessons ($M = 3.28$, $SD = 0.727$). The finding is consistent the study of Narh, Boateng, Afful-Dadzie and Owusu (2019), Adarkwa (2020), Ogbonnaya, et al. (2020) and Ismail, Bakar and Wafa (2020) which reported that pre-service teachers have challenge connecting internet to support them in order to participate in online lesson. Most of the students explained that they logged in at midnight since it was free to access online learning site and download and upload materials. They indicated that even though it was effective as compared to the normal day hours, it affected their sleep.

With regard to accessing of online library materials to support them in learning mathematics, majority of pre-service teachers, 84% agreed that the College has no link with online libraries. Therefore, it was difficult accessing online library materials. In line with our finding is the study of Adarkwa (2020) which indicated student had difficulty accessibility online library resources.

Also, 64% of pre-service teachers agreed that high cost of data affected their performance in online learning of mathematics ($M = 3.23$, $SD = 0.711$). The finding is in line with that of Ogbonnaya, Awoniyi, and Matabane (2020) and Olayemi, Adamu, and Olayemi, (2021) which indicated that high cost of data for online learning was a challenge that affected students’ participation in online lessons. Also Atta-Obenga and Dadzie (2020), Baylon & Antwi-Boasiako (2016) and Mahama (2016) reported that the cost of internet made it unaffordable to many students.

Whether e-learning platform promoted learning of mathematics, only 20 of pre-service teachers agreed that during their online lessons the e-learning platform was stable ($M=1.81$, $SD=.735$). This finding is not in line with the study of Olayemi, et al. (2021) and Adarkwa (2020) which reported that some communication between teacher and students was not possible because the e-learning system could go off for a while before it starts functioning. Thus, intercommunication between lecturers and students was very poor. The finding is not consistent with that of Ismail, Bakar and Wafa (2020) which reported that students had it difficult to catch up with the online learning session. Students also indicated that lecturers did not give them instant feedback and immediate response during learning.

CONCLUSIONS

The evidence available from the findings of this study provided the basis for a number of conclusions to be made. For successful adoption and effective use of any tool or technology, measuring the level of competence of the users towards its effective application and use becomes imperative. As far as pre-service teachers' information, communication and technology skills and competences are concerned, majority of pre-service teachers, have advance computer skills that help them to use the internet for online learning as well as search for information to support the lessons they are taught online. The findings of the study revealed that majority of pre-service teachers are proficient in communicating online using Facebook, twitter and e-mails to support their online lessons. With regard to the skills for using online tools for educational activities required for effective use of online learning, majority of pre-service teachers indicated that they are proficient in using online tools such as Skype, Zoom, web video for online learning. However, only 24% and 33% of pre-service teachers were proficient in designing online content using Google drives and using electronic devices to support their online learning respectively.

Concerning challenges pre-service teachers encountered, it was revealed that majority of pre-service teachers, agreed that they have difficulty connecting internet to enable them participate in their synchronous and asynchronous online lessons. Concerning their performance, majority of pre-service teachers agreed that the difficulty they encountered assessing internet to support their online learning affected their performance in mathematics. Also, the high cost of data for online learning was found to be a challenge to the students' online learning. Pre-service teachers explained that they resort to staying awake up to midnight to download and upload learning materials which affected the sleep.

Implications for Research

The Ghana Ministry of Education suspended the use of online teaching approach in the 46 Colleges of Education in Ghana for the 2021/2022 academic year with the complain that it was associated with challenges. However, Ghana Tertiary Education Commission wrote to all Colleges of Education to reduce the risk of Covid-19 infection by deploying blended approach. In addition, due to the insufficient infrastructure in the Colleges of Education, the Conference of Principal of Colleges of Education prepared for the 2021/2022 Academic Calendar in such a way that, except level 100 undergraduate pre-service teachers, levels 200, 300 and 400 undergraduate pre-service teachers cannot complete their academic year at a sitting. As result, tutors in the Colleges of Education in Ghana will continue use deploy online teaching and learning. However, with the challenges pre-service teachers encountered when they

participated in previous online teaching and learning coupled with the lack of some ICT competences, the transition to online teaching and learning, teacher education should be rethought through and restructured. In order to further improve online teaching and learning, Colleges of Education could secure robust learning management systems that allow both tutors and pre-service teachers to work both online and offline to improve the stability of online platforms and reduce the amount of money pre-service teachers spend on internet bundles.

The study also sought to keep stakeholders abreast of the challenges regarding poor internet connectivity and high cost data for the Principals of Colleges of Education (PRINCOF) to make frantic efforts and partner with telecommunication companies such as Vodafon which have a programme for tertiary institutions for tutors and students in the same college to use an internet packet at a very low cost to enhance students' participation in online teaching and learning. The Government of Ghana also need to bridge the infrastructure gap by completing the ongoing projects to accommodate students to enable them take part in face-to-face lessons in order to reduce the use of online teaching and learning in the Colleges of Education in Ghana. The study was also aimed at helping stakeholders of teacher education in Ghana to review the Pillar on ICT in National Curriculum Framework to equip pre-service teachers with basic and advanced computer skills to enable them use electronic devices to support students in their online teaching and learning of Mathematics.

Meanwhile, the findings of our study revealed that pre-service teachers who participated in the online lessons during the previous two semesters pre-service were not proficient in designing online content using Google drives and using electronic devices to support their online lessons. Pre-service teachers also encountered challenges ranging from poor internet connectivity to high cost of data. Therefore, our study sought to inform the Ghana Tertiary Commission of Ghana of the Ministry of Education and other stakeholders about the lack of particular ICT competences among pre-service teachers so that frantic efforts would be made to equip pre-service teachers with requisite ICT competences to enable them participate in the online Mathematics lessons. The study also sought to keep stakeholders abreast of the challenges regarding poor internet connectivity and high cost data for the Government of Ghana bridge the infrastructure gap by completing the ongoing projects to accommodate students to enable them take part in face-to-face lessons in the Colleges of Education in Ghana. The study was also aimed at helping stakeholders of teacher education in Ghana to review the Pillar on ICT in National Curriculum Framework to enable pre-service teachers to be trained in using electronic devices to support their online learning of Mathematics.

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