International Journal of Engineering Science and Applied Mathematics
Volume.13, Number 11; November-2022;
ISSN: 2836-9521| Impact Factor: 5.78
https://zapjournals.com/Journals/index.php/ijesam
Published By: Zendo Academic Publishing

AN INVESTIGATION INTO LECTURERS' USE OF ICT TOOLS FOR TEACHING IN COLLEGES OF EDUCATION IN GHANA

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Article Info

Keywords: Keywords:
information and the integration of information and communication technology (ICT) communication technology,

Abstract

ICT tools in teaching and learning (T&L) processes has significantly tools, teaching and learning, transformed the global educational system. However, despite the efforts Colleges of Education, Ghana of governments worldwide to promote the use of advanced technologies in education, many teachers still struggle to effectively utilize available ICT tools. This issue is particularly prevalent in Colleges of Education (CoEs) in Ghana, where the full integration of ICT tools into T&L has not been achieved as anticipated. Consequently, this study aimed to investigate the adoption and utilization of ICT tools by Ghanaian lecturers in CoEs.The research questions guiding this study were as follows: (RQ1) What ICT tools are used by Ghanaian lecturers in CoEs and how frequently are they being used? (RQ2) What purposes do lecturers employ ICT tools for in T&L? (RQ3) What are the reasons behind the lecturers' use of ICT tools for the identified purposes? To address these research questions, a comprehensive literature review was conducted, revealing a dearth of studies specifically examining the adoption of ICT tools in CoEs in Ghana. Therefore, this study fills the existing research gap by providing valuable insights into the ICT tools used by Ghanaian lecturers and the motivations behind their usage. The findings of this study have significant implications for educational policymakers, administrators, and lecturers in Ghana. By understanding the current practices and perceptions surrounding ICT tool adoption, stakeholders can develop targeted interventions to enhance the integration of ICT tools in CoEs, thereby fostering a more effective and engaging T&L environment. Additionally, this study contributes to the broader literature on ICT integration in education by providing a unique perspective on the challenges and opportunities faced by lecturers in a specific educational context.

1

Introduction

The educational system worldwide has been dramatically altered with the advent of technology in the late twentieth century due to technology's capacity to create a constructive, easy-to-access, and all-encompassing teaching and learning (T&L) environment [1]. Many governments around the world have provided various facilities and training opportunities to "enhance the use of advanced technologies in teaching and learning processes worldwide" [1, p. 177]. Researchers have contended that governments' efforts in most countries have similar problems, with teachers failing to use most of the technologies available to them [2–3]. This problem has become a significant issue, as several studies have shown that the incorporation of information and communication technology (ICT) tools into T&L processes considerably improves student academic performance. The application of ICT tools in education adds value to T&L by enhancing the efficacy of T&L and by providing a dimension to T&L that was not previously accessible [4]. ICT tools may also motivate students and help them engage in collaborative learning [5].

Due to the enormous benefits of incorporating ICT tools into T&L, many governments worldwide have developed and implemented national policies on integrating ICT tools into education at various school levels [6–9]. Despite the Ghanaian national policy on the integration of ICT tools integration into T&L and the numerous benefits of using ICT tools for T&L purposes [10–13], it seems ICT tools have not been fully integrated into T&L by lecturers in Colleges of Education (CoEs) in Ghana, as expected.

In the educational milieu, any initiatives and policies to implement technology in an educational programme depend strongly on the support and perception of the teachers or lecturers involved; it is believed that people teach the way they were taught [14–16].

A review of the literature revealed that no study had been conducted to understand the adoption of ICT tools in T&L in Ghana's CoEs; thus, the current study investigated the ICT tools used by Ghanaian lecturers in CoEs by addressing the following research questions (RQ): RQ1: What ICT tools are used by Ghanaian lecturers in CoEs and how frequently are they being used? RQ2: What do the lecturers use the ICT tools for? RQ3: Why do the lecturers use ICT tools for the identified purposes?

1 Theoretical framework

The Technology Acceptance Model (TAM) explains users' intents and behaviour when using technology [17]; see Figure 1. According to the theory, a person's willingness to use (technology adoption) and actual use of technology is influenced by their perceptions of the technology's usefulness (benefit from using it) and ease of use. Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are two belief constructs that determine the intention to use technology in TAM. The user's conviction that ICT tools can increase their job performance is called PU, while the user's view that ICT tools will be simple to use is referred to as PEU.

External variables are elements outside of the users' control that might influence their PU and PEU. For example, self-efficacy has been proven to be crucial in influencing knowledge sharing in e-learning environments [18]. As shown in Figure 1, the TAM suggests some interaction between external variables such as PU and PEU [19] and their ultimate influence on Attitude Towards Use (AU) and Behavioural Intention to Use (BIU). AU relates to how someone responds to and is inclined towards an item, which can be negative or positive [20]. BIU assesses a person's willingness to engage in a specific behaviour or adopt a behaviour system [24]. Teachers' attitudes play an important role in successfully incorporating technology into educational programs [21–22]. "No matter

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how advanced or capable the technology is, its effective implementation depends upon users having a positive attitude toward it" [23, p. 1069]. The TAM suggests that the BIU is influenced by two behavioural beliefs, PU and PEU. In contrast to PU and PEU, which refer to outcome expectation and process expectation [25], BIU leads to a real technological application. These connections have been shown in various settings where technology has been deployed [22, 26].

Actual System Use (AC) is "the indicator to find out if the respondents are using the application frequently or in their daily basis" [27, p. 5]. Furthermore, BIU, or the intentional inclination to use information technology, influences AC. The perceived ease of using information technology and PU, which refers to the benefit gained by users of the relevant information technology tool, influences BIU [28].

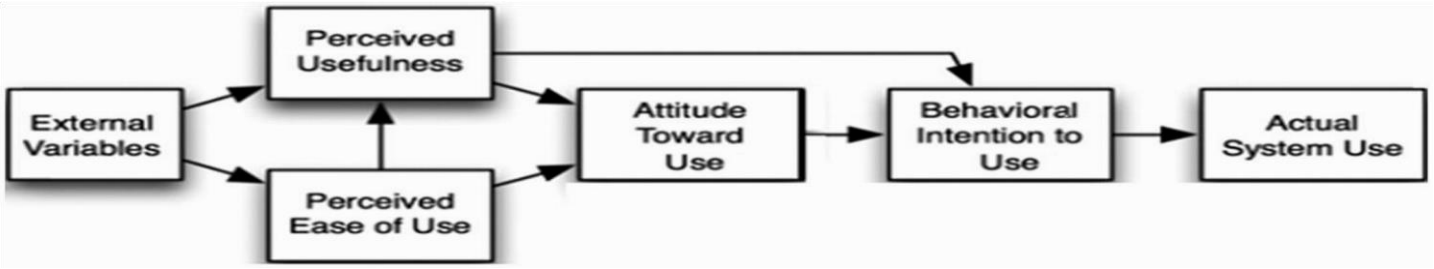

Fig. 1. Technology Acceptance Model

2 Literature review

2.1 ICT tools adopted in higher education institutions

The significance of ICT tools for education cannot be overstated, and they have undoubtedly influenced T&L and research. Several studies have demonstrated and confirmed the benefits of adopting and using different ICT tools in HEIs to improve educational quality worldwide [29].

An international study was carried out that included respondents from Spain, Ukraine and Russia on academic instructors' usage of ICT tools [30]. Their study focused on the authors' typology of ICT tools, dividing them into three groups based on instructional objectives: information, communication, and management. Their results showed that instructors used these tools with varying degrees of intensity. They employed various ICT tools to create digital learning resources to present students with diverse educational possibilities in an e-learning setting. When providing digital material for various learning goals, teachers frequently consider students' preferences. The range of ICT tools available is heavily dependent on instructors' expertise; nevertheless, a university's educational policy, which establishes corporate requirements for competencies relating to the use of ICT tools and regulates the use of e-learning, is no less important.

The usage of audiovisual materials in the Katsina-Ala CoE in Benue State, Nigeria, was investigated; the authors found that college lecturers seldom employed audio-visual materials in their classes and that the chalkboard was the sole audio-visual material used. Adopting audio-visual aids in college is hampered by nonavailability, a lack of supporting infrastructure, and human factors [31].

Trends of pre-service Nigerian teachers' usage and perceived usefulness of social media were investigated by [32]. The author discovered that Facebook and WhatsApp were the most popular social media applications utilised by participants, who mostly used the platforms for socialising rather than academic reasons.

Various types of ICT tools and the roles they played for T&L purposes, used by English lecturers for students in the non-English study program at Institut Agama Islam Negeri (IAIN) Curup in Indonesia, were investigated [33]. The authors found that lecturers always employed the following ICT tools in the classroom while teaching English: the speaker, educational games, and internet resources. They chose these three ICT tools because they were simple to use and inexpensive.

The adoption of technology for T&L purposes was the subject of a second study conducted on English lecturers in Indonesia from various higher education institutions and universities [34]. The research revealed that the types of ICT tools used by lecturers ranged from simple to sophisticated. Some lecturers used the ICT tools provided by their university, while others brought their own equipment to enhance their instruction. While all lecturers have embraced the use of ICT tools for T&L purposes, the results revealed that they still appeared to require traditional mediums, such as a whiteboard, since access to and the variety of ICT tools were lacking in some areas.

2.2 Utilisation of ICT tools in higher education institutions

ICT tools can be used in three ways as part of the learning process as: an object, an aspect, or a medium [35]. As an object, it is a term used to describe learning about ICT tools. Students become familiar with hardware and applications, such as Microsoft Word, Microsoft Excel, and other programmes. The aim is to teach people how to use computers. As an aspect, one refers to ICT tools being used in education the same way they are used in manufacturing. Computer-aided modelling and production, for example, are examples of how ICT tools are used in education. When ICT tools are used to promote T&L, they are called a medium. Because these mediums (laptops, smartphones, tablets, and generally any device with wireless connectivity) make it easier to build knowledge, solve problems, and develop skills in a pervasive and independent manner, students can learn the necessary material at their own pace on their own time [50]. These authors also believed that digital learning tools support teachers both in and outside the classroom hence promoting T&L.

The question of how the digital storytelling procedure affected the digital literacy abilities were investigated [36]. The pre-service teachers' perspectives revealed various challenges in the digital story production process while also highlighting the favourable contribution of the technique in academic contexts. Digital stories received good ratings on the digital story evaluation scale.

2.3 Reasons for the utilisation of ICT tools in higher education institutions

The impact of using ICT tools on the success levels and attitudes of primary teacher trainees toward adopting ICT-based instruction was investigated; it was discovered that using ICT tools for T&L purposes improved the learning of all trainees, with high achievers benefiting more than low achievers [37]. Furthermore, trainees believe that using ICT tools for T&L purposes improves their academic performance and that technology facilitates learning. On the other hand, lecturers failed to acknowledge any educational benefit of employing personal computers and projectors in pre-service teacher education.

The impact of ICT tools on the quality of T&L at a Nigerian university was investigated; the findings revealed a distinct pattern indicating that lecturers are eager to accept ICT tools, and students with prior educational experience believe that the implementation of ICT tools would have a profoundly positive impact on the teaching and learning environment at the university [37]. These authors also emphasised the importance of using ICT tools for T&L purposes within the university. In a study conducted in Nigeria, it was found that the use of ICT tools has the potential to shape T&L in Nigerian universities by exposing students to "quality and enormous learning resources, encourage learners to take control of their own knowledge by guiding them to the desired knowledge, motivates both learners and teachers alike, and encourages good communication plus collaboration among colleagues" [38, p. 48]. In another study in Nigeria, the impact of the use of ICT tools on the competency of lecturers in Nigerian higher learning institutions was investigated, and it was found that ICT tools had a tremendous multiplier effect on university education regarding lecturers' proficiency [39].

The effectiveness of using ICT tools to improve T&L in polytechnic institutions in Bangladish was explored; it was found that incorporating ICT tools into the T&L process would make the entire process easier, more engaging, and more time-efficient [40]. More than half of technical education instructors strongly felt that ICT tools are critical to improving the T&L process in polytechnic institutions [40]. The impact of the integration of ICT tools

in teaching English to college students was explored, and the findings indicated that the use of ICT tools improved language learning experiences and may be used effectively for both T&L [41].

3 Methodology

The current study was conducted using a descriptive research design using a mixed-methods approach. Using a survey (distributed as hard copies and online) and lesson observations, quantitative and qualitative data were gathered to achieve the primary objectives of obtaining a broad and deep understanding of the subject and verification [42–43]. The current study was split into two phases: Phase I and Phase II. During Phase I (survey), quantitative data (open-ended questions of the survey) and qualitative data (closed-ended questions of the survey) were collected, while in Phase II (lesson observation), only qualitative data were collected. Nested concurrent sampling was used in which non-probability purposive sampling was employed in Phase I (survey) to select 400 lecturers from a target population of all the lecturers at Ghana's CoEs, and 390 answered the survey. Of the 390, 136 were sampled synchronously using convenience (haphazard) sampling for Phase II (lesson observation). Quantitative and qualitative data collection and analysis were conducted separately but concurrently. Descriptive statistics were used to analyse the quantitative data collected [44], while the qualitative data (open-ended questions) of the survey and the lesson observation checklist were analysed using thematic and qualitative content analysis [45]. The results and findings from the quantitative and qualitative phases were then integrated during the interpretation phase of the current study.

4 Results and findings

4.1 Type of ICT tools used by the lecturers

In the survey, the lecturers were asked to indicate which ICT tools they used from a list of 23 possible pedagogical ICT tools by simply replying "yes" they use it to "no" they don't use it, and the results are summarised in Table 1.

Table 1. Survey – ICT tools used by the lecturers (*n* = 390)

ICT Tool	**Percentage**
Social media (e.g., WhatsApp, Facebook, Twitter, Skype, Instagram, Telegram, Messenger)	96.4%
Mobile devices	95.4%
Personal computer	94.9%
Internet	93.1%
Projector	91.3%
Learning management system	86.7%
Microsoft Office*	86.7%
Video conference (e.g., Zoom, BlueJeans)	86.2%
Video websites (e.g., YouTube, Hulu, Netflix, Vimeo)	69.0%
E-mail	68.2%
Online word processors (e.g., Google Docs, Zoho Writer, ONLYOFFICE Personal)	40.3%
Printer	30.3%

Mathematics software (e.g., Maple, GeoGebra, Geometer's Sketchpad)	29.0%
CD/DVD ROM	25.4%
Scanner	23.10%
Note sharing (e.g., Evernote, Onenote)	22.80%
Camera	19.0%
Statistical analysis software (e.g., MATLAB, SPSS, Minitab)	18.2%
Cloud storage service (e.g., Drop Box, OneDrive, iCloud)	16.4%
Television	16.4%
Smartboard/interactive whiteboard apps. (e.g., Explain Everything, Educreations, Jamboard)	14.9%
E-portfolios	14.1%
Intranet (e.g., school network)	7.7%

Notes: *When "Microsoft Office" is used in this document, it refers to all the well-known Microsoft Office programmes like Word, Excel, Access, and PowerPoint.

From Table 1, almost all the lecturers indicated that they use social media, mobile devices, personal computers, projectors, the internet and projectors in their T&L. The lecturers were then asked to indicate their frequency of use, and the ICT tools were ranked from the most frequently used to the least frequently used (see Table 2).

Table 2. Survey – ICT tools frequency of use by the lecturers (n = 390)

ICT Tool	**Percentage**
Personal computer	35.6%
Projector	23.8%
Social media (e.g., WhatsApp, Facebook, Twitter, Skype, Instagram, Telegram)	13.8%
LMS	6.2%
Mobile device	4.4%
Video conference (e.g., Zoom, BlueJeans)	3.6%
Internet	3.1%
Microsoft Office*	2.8%

Mathematics software (e.g., Maple, GeoGebra, Geometer's Sketchpad)	2.1%
Printer	1.8%
Video websites (e.g., YouTube, Hulu, Netflix, Vimeo)	1.0%
Television	0.8%
SmartBoard/Interactive Whiteboard Apps (e.g., Explain Everything, Educreations, Jamboard)	0.4%
E-mail	0.3%
Scanner	0.3%

Notes: *When "Microsoft Office" is used in this document, it refers to all the well-known Microsoft Office programmes like Word, Excel, Access, and PowerPoint.

Table 2 shows that personal computers are the ICT tool most used by the lecturers for T&L purposes, followed by projectors and social media. The percentage for all other ICT tools was below 10%, with the smallest percentages being e-mails and scanners, representing 0.3% each. From the lesson observations, the ICT tools used by the lecturers in the classroom are presented in Table 3.

Table 3. Lesson observation – ICT tools observed being used by the lecturers during the lesson (n = 136)

ICT Tool	**Percentage**
Personal computer	100.0%
Projector	100.0%
LMS	16.9%
Microsoft Office*	8.1%

Notes: *When "Microsoft Office" is used in this document, it refers to all the well-known Microsoft Office programmes like Word, Excel, Access, and PowerPoint.

From Table 3, it can be seen that the three ICT tools that were used most by the lecturers were personal computers, projectors, and LMSs. The fact that Table 3 lists only four ICT tools, whereas Tables 1 and 2 list a greater variety of ICT tools, could be attributed to the fact that some lecturers use these ICT tools outside of the classroom for class preparation or other purposes, such as research.

5.2 What do lecturers use ICT tools for?

Section 3 of the survey sought to elicit the lecturers' use of particular ICT tools. The responses were analysed using thematic analysis since it was an open-ended question [46]. The findings on what the lecturers use ICT tools for are summarised here:

Storing, retrieving, and sharing of files and information. In their accounts, 84 lecturers (21.5%) highlighted that personal computers facilitate storing information and files and make retrieval and sharing of that information and files very easy. One of the lecturers from the Department of Education and Professional Studies, in one of the CoEs, stated that a personal computer "helps in lesson preparation and storing of information". Another lecturer recounted that a personal computer helps with "easy retrieval of information" and is "useful for storing and sharing

documents". Another lecturer supported the assertion that a personal computer has the greatest impact on T&L by stating that a personal computer "makes retrieval of information from the web", "enhances easy gathering of information", "helps in lesson preparation and storing of information", and "for storing large information". Another lecturer said, "Cloud Storage Service" also impacts T&L by stating, "Cloud Storage is used for storing personal information". Two other lecturers also supported the claim by saying that "we record live lesson with Camtasia, upload it on OneDrive and share the link with student-teachers" and "can be used to store resource materials for future reference". Another lecturer believed that mobile devices have the greatest impact by stating that mobile devices "assist in searching, storing, and sharing texts, images, photos, and videos, for the purpose of teaching and learning and personal development".

Research. Some lecturers (63, 16.2%) asserted that the internet as an ICT tool helps them search for information for personal development and the preparation and delivery of their lessons. They also confirmed that the internet helps their students' learning in the courses they teach by stating that "the student-teacher uses this to access documents and other files on the internet easily", "enables the learners in doing their research", "allows students and facilitators to do their research", and "to make research of difficult notes". Other lecturers stated that the internet is used "for a quick research and personal development", "for a research and class presentation", "it enhances easy gathering of information", "promotes research", and "gives access to a great deal of information and resources". These statements related to the use of the Internet use were confirmed during a lecture on "Historical Development of Number and Algebra" in a second-year mathematics class in a "Nature of Mathematics" course the first author of this manuscript observed. The lecturer engaged the students in doing group research on ancient numeration systems. The lecturer then used a presentation approach to explain the evolution of the Egyptian, Babylonian, Roman, and Hindu-Arabic Numeration Systems.

One languages lecturer believed that the personal computer has the biggest impact on research because it can be used "for easy research". Other lecturers supported the claim by stating that the personal computer "helps in the search of information" and "aids in research and preparation of lesson notes".

The use of ICT tools for T&L was investigated to see what they do with the ICT tools during the lesson. The observations are summarised in Table 4.

Table 4. Lesson observation – uses of ICT tools by the lecturers from the (n = 136)

Ways of Using ICT Tools	**Percentage**
Presentation	100.0%
Assessment	44.9%
Interaction and communication	19.9%

Table 4 shows that all lecturers utilised ICT tools for presentation, approximately half for assessment purposes, and roughly one-fifth for interaction and communication.

5.3 Why do lecturers use ICT tools?

The study also investigated why the lecturers use ICT tools for T&L purposes. Data to address the reason the lecturers use ICT tools was collected using the survey. The questionnaire was divided into three sections. The demographic information of lecturers was presented in Section 1. Section 2 of the survey was designed to extract lecturers' ICT tools used in T&L. The third section of the questionnaire asked lecturers on the impact of the ICT tools they use to teach. Lecturers were asked to identify the ICT tools that they felt had the greatest influence on T&L and to explain why. Section 3 of the survey sought to elicit the reasons for using particular ICT tools to address RQ3. The main reasons the lecturers use ICT tools are summarised here:

Aids in lesson preparation and delivery, and for personal development. Some lecturers (33, 8.5%) reported that implementing ICT tools in their teaching aids them in the preparation to deliver their lessons and helps them enact those lessons. One of the lecturers stated that the "Internet is very convenient and supports virtual teaching and learning". This claim was confirmed during the lesson observation. An instructor of a second-year English course on the topic "Theories of Semantics" instructed the students to use the internet to research and present information on the theories of semantics, followed by a class-wide discussion on the theories.

Another lecturer stated that "these tools can be used to complement face-face teaching and learning". This assertion was corroborated during the lesson observation. A lecturer of a "Databases" course taught an Information Technology (IT) class using a personal computer and a projector to supplement the presentation on the topic "The Relational Model and Normalisation". The lecturer showed the class a YouTube video explaining the concept of "normalisation".

Some lecturers (21, 5.4%) indicated that ICT tools "Promote lesson preparation and delivery". This claim was again confirmed during the lesson observation where a lecturer delivered on the topic "linear and exponential series" in an "algebraic thinking" second-year mathematics class. The lecturer used PowerPoint to present "arithmetic and geometric sequences and series, infinite geometric sequences, and recursively defined sequences".

Easy accessibility and user-friendliness. Just over one-tenth (53, 13.6%) reflected on the theme that some ICT tools can be easily accessible and user-friendly to them and their students. One language lecturer said social media impacts T&L regarding easy accessibility and user-friendliness by stating that social media has an "ease of accessibility" capacity. Six other lecturers supported the assertion by saying that "Everyone has access", "Students access them easily", "Almost all students have a WhatsApp account", "Easy to use, very affordable in terms of data", and "flexible to use". Three other respondents attested to this assertion by stating that social media "are very accessible and commonly known", "easy access to students", and "it is easy to access and not difficult to use". These quotations from four lecturers demonstrate their belief that mobile devices influence T&L in terms of user-friendliness and accessibility: "readily available for use", "easy access", "easily accessible and can be used by all", and "they are very accessible and commonly known". Two of the lecturers supported the claim by stating that mobile devices "can be used anywhere and also convenient" and one can "have access to it all the time". One lecturer also stated that Cloud Storage Service "makes remote file access easy" and LMS are "user friendly and it is common".

Portability and time-saving. Some lecturers (15, 3.9%) explained that they incorporated ICT tools into their instruction due to their portability and efficiency. They supported the claim by stating that ICT tools "have portability advantage", are "portable and very convenient", "it saves time and makes learning easy", "it is portable and easy to use", and "it's portable". One respondent claimed that social media is "comparatively economical", and another said that a personal computer is "portable and easy [to] use".

Increased productivity. Some lecturers (17, 4.4%) reported that some ICT tools increase their efficiency in discharging their lecturers' duties and help their students in their learning. They pronounced the use of ICT tools "increase productivity" and serve as "productivity tools that help students practice". One lecturer believed that mobile devices are used "for easy communication". Although mobile devices are primarily used for communication, some educators are beginning to see them as an essential element of instructional activities at educational institutions that provide suitable conditions for formal and informal education [47]. Therefore, mobile devices can be seen as an ICT tool that can increase productivity in educational institutions. Another lecturer stated that a personal computer "is versatile", leading to increased productivity. A computer is a multifunctional tool that allows a user to fully use its various functions if the human-computer interaction design is flexible and resilient, which can, in turn, boost the productivity of the user [48]. In their study, other researchers found that

software, namely the Thesis Supervision System, may enable supervisors to interact effectively, resulting in higher quality thesis outputs and less thesis process [49].

5 Discussion

The current study sought to examine the lecturers' adoption of ICT tools in Ghanaian CoEs by exploring which ICT tools are used by Ghanaian lecturers, what they use them for and why they use specific ICT tools. The results showed that, regarding the ICT tools used by the lecturers, more than two-thirds of the lecturers use personal computers, projectors, social media and LMSs for T&L purposes. Contrary to the findings of the current study, another study found that lecturers used social media platforms for social purposes rather than academic ones [32]. Again, in contrast to the findings of another study in which participants refused to recognise the educational value of using computers and projectors in pre-service teacher education [37], the results and findings from the current study on this research topic are conflicting. Instead, the lecturers in the current study acknowledged the educational value of computers, projectors, social media, and LMSs in pre-service teacher preparation hence employing them in their T&L process. According to the findings of the current study, lecturers use ICT tools not only to teach but also to store, retrieve, and share files and information, and to conduct research. This being said, the findings from the current study failed to acknowledge ICT tools being used by the lecturers from CoEs in Ghana as an object and as an aspect, as opined by [35]. However, the current study established that lecturers of CoEs in Ghana mostly use ICT tools as a medium to promote T&L, as suggested by [35]. The current study also found that, as instructors utilise these ICT tools, they develop professionally, corroborating the findings of a previous study which concluded that ICT tools have a significant multiplier effect on university education in terms of lecturers' proficiency [39].

According to the findings, the lecturers employed the ICT tools in their teaching due to their portability, timesaving capabilities, easy accessibility and user-friendliness. This revelation was corroborated with the findings of another study in which the lecturers always used three types of ICT tools because they were simple to use and inexpensive [33]. A different study also confirmed this revelation, where participants of their study believed that incorporating ICT tools into the T&L process would make the entire process easier, more engaging, and more time-efficient [40]. Finally, ICT tools help with lesson preparation and delivery, personal development, and increasing productivity, according to the lecturers who participated in the current study.

This finding supported another study that found that adopting ICT tools in the classroom improved learning for all students, positively impacted their academic achievement, and made learning simpler [37]. Participants in another study suggested that ICT tools can be utilised effectively for T&L and language acquisition, further supporting this finding [41]. Furthermore, the findings of another study were consistent with the results and findings of the current study in that the participants stated that ICT tools provided excellent and substantial learning resources, encouraged students to take responsibility for their own learning by directing them to the knowledge they desired, motivated both students and teachers, and promoted effective communication and collaboration between staff members [38].

6 Conclusions and recommendations

The current study investigated the acceptance and use of ICT tools by lecturers of CoEs in Ghana and found that some lecturers currently use personal computers, projectors, social media and LMSs for T&L purposes. Apart from using these ICT tools to teach their courses, they also use some ICT tools for storing, retrieving, and sharing files and information and research. The lecturers attributed these benefits of the ICT tools to their portability, time-saving capabilities, easy accessibility, and user-friendliness. Therefore, it is recommended that the Ghanaian government continue to provide the necessary pedagogical ICT tools to lecturers, thereby changing their perceptions of the integration of ICT tools for T&L purposes. These tools must be made available to enhance the

use of ICT tools in the classrooms because the adoption of these ICT tools may be hampered by non-availability and a lack of supporting infrastructure [31].

The findings of the current study showed that less than one-tenth of lecturers use ICT tools for daily teaching. This low percentage could be due to a lack of training in how to effectively integrate ICT tools in the classroom or a lack of the advantages of understanding of ICT tools [30]. As a result, workshops and seminars should be held for all lecturers in the CoEs in Ghana on how to apply some common pedagogical ICT tools. These workshops and seminars should also highlight the advantages of integrating ICT tools for T&L purposes. If lecturers have limited knowledge about the integration of ICT tools and their advantages, it negatively impacts their use. As a result, lecturers must be trained to have the knowledge and abilities to effectively support their students' use of ICT tools in T&L. Put another way, implementing ICT tools in education successfully depends on training and competence. These recommendations will enhance lecturers' teaching techniques to promote effective learning and fulfil 21st-century teaching skills.

7 Ethics approval and permissions

Ethics approval was granted by the Ethics Committee at the Faculty of Education, University of Pretoria (ethics number EDU129/20) before commencement of the current study, and the standards were followed to assure ethical compliance. All responders indicated their informed consent. The data collection instruments did not contain any element that sought any personal and identifying information about respondents or their students to ensure the confidentiality of the lecturers. The use and adaptation of Figure 1 are allowed under a Creative Commons Attribution 3.0 Unported Licence (CC BY 3.0) [51].

REFERENCES

S. Ghavifekr and W. A. W. Rosdy, "Teaching and learning with technology: Effectiveness of ICT integration in schools," *International Journal of Research in Education and Science*, vol. 1, no. 2, 2015, pp. 175–191. https://doi.org/10.21890/ijres.23596

R. Jamieson-Proctor, P. Albion, G. Finger, R. Cavanagh, R. Fitzgerald, T. Bond, and P. Grimbeek, "Development of the TTF TPACK survey instrument," *Australian Educational Computing*, vol. 27, no. 3, 2013, pp. 26–35.

J. K. Nakayima, "Perceived usefulness, perceived ease of use, behavioural intention to use, and actual system usage in Centenary Bank," Doctoral dissertation, Makerere University, Uganda, 2011.

M. Ahmad, J. Badusah, A. Z. Mansor, A. A. Karim, F. Khalid, M. Y. Daud, R. Din, and D. F. Zulkefle, "The application of the 21st century ICT literacy model among teacher trainees," *Turkish Online Journal of Educational Technology*, vol. 15, no. 3, 2016, pp. 151–161.

H. Heflin, J. Shewmaker, and J. Nguyen, "Impact of mobile technology on student attitudes, engagement, and learning," *Computers & Education*, vol. 107, 2017, pp. 91–99. https://doi.org/10.1016/j.compedu.2017.01.006

S. Albugami and V. Ahmed, "Success factors for ICT implementation in Saudi Secondary schools: From the perspective of ICT directors, head teachers, teachers, and students," *International Journal of Education and Development Using Information and Communication Technology*, vol. 11, no. 1, 2015, pp. 36–54. https://doi.org/10.4018/ijicte.2015040101

I. Blau and T. Shamir-Inbal, "Digital competences and long-term ICT integration in school culture: The perspective of elementary school leaders," *Education and Information Technologies*, vol. 22, no. 3, 2016, pp. 769–787. https://doi.org/10.1007/s10639-015-9456-7

M. Brun and J. E. Hinostroza, "Learning to become a teacher in the 21st century: ICT integration in initial teacher education in Chile," *Journal of Educational Technology & Society*, vol. 17, no. 3, 2014, pp. 222–238.

K. Drossel, B. Eickelmann, and J. Gerick, "Predictors of teachers' use of ICT in school – the relevance of school characteristics, teachers' attitudes and teacher collaboration," *Education and Information Technologies*, vol. 22, no. 2, 2016, pp. 551–573. https://doi.org/10.1007/ s10639-016-9476-y

W. Ali, "Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic," *Higher Education Studies*, vol. 10, no. 3, 2020, pp. 16–25. https:// doi.org/10.5539/hes.v10n3p16

M. K. Amedeker, "Changing educational policies: Implications for ICT integration in science instruction and performance of students in Ghanaian senior high schools," In Proc. ICEduTech International Conference on Educational Technologies, 2020, pp. 72–78. https:// doi.org/10.33965/icedutech2020_202002L010

E. Goh and M. Sigala, "Integrating Information & Communication Technologies (ICT) into classroom instruction: Teaching tips for hospitality educators from a diffusion of innovation approach," *Journal of Teaching in Travel & Tourism*, vol. 20, no. 2, 2020, pp. 156–165. https://doi.org/10.1080/15313220.2020.1740636

K. A. Sabiri, "ICT in EFL teaching and learning: A systematic literature review," *Contemporary Educational Technology*, vol. 11, no. 2, 2019, pp. 177–195. https://doi.org/10.30935/ cet.665350

D. Bradley and J. S. Goble, "Making sure it's about what's best for students: Following on Regelski's tractate," *Action, Criticism, and Theory for Music Education*, vol. 19, no. 1, 2020, pp. 1–5. https://doi.org/10.22176/act19.1.1

D. C. Lortie, *Schoolteacher: A Sociological Study*, 2nd ed, Chicago: University of Chicago Press, 2002. https://doi.org/10.7208/chicago/9780226773230.001.0001

T. Teo, "Modelling technology acceptance in education: A study of pre-service teachers," *Computers & Education*, vol. 52, no. 2, 2009, pp. 302–312. https://doi.org/10.1016/j.compedu.2008.08.006

F. D. Davis, R. P. Bagozzi, and P. R. Warshaw, "User acceptance of computer technology: A comparison of two theoretical models," *Management Science*, vol. 35, no. 8, 1989, pp. 982–1003. https://doi.org/10.1287/mnsc.35.8.982

S. A. Hosseini, S. M. Bathaei, and S. Mohammadzadeh, "Does self-efficacy effect on knowledge sharing intention in e-learning system? A motivational factor analysis in Open University Malaysia OUM," *Kuwait Chapter of Arabian Journal of Business and Management Review*, vol. 3, no. 11, 2014, pp. 35–46. https://doi.org/10.12816/0018687

S. H. Hong and J. H. Yu, "Identification of external variables for the Technology Acceptance Model (TAM) in the assessment of BIM application for mobile devices," *IOP Conference Series: Materials Science and Engineering*, vol. 401, 2018, p. 012027. https://doi.org/10.1088/1757-899X/401/1/012027

I. Ajzen and M. Fishbein, "The influence of attitudes on behavior," in *The Handbook of Attitudes*, D. Albarracín,

B. T. Johnson and M. P. Zanna, Eds. Lawrence Erlbaum Associates, 2005, pp. 173–221.

D. H. Kisanga, "Determinants of teachers' attitudes towards e-learning in Tanzanian higher learning institutions," *The International Review of Research in Open and Distributed Learning*, vol. 17, no. 5, 2016, pp. 109–125. https://doi.org/10.19173/irrodl.v17i5.2720

T. Teo and O. F. Ursavaş, "An assessment of pre-service teachers' technology acceptance in Turkey: A structural equation modeling approach," *The Asian-Pacific Education Researcher*, vol. 21, no. 1, 2012, pp. 191–202.

S.-S. Liaw, H.-M. Huang, and G.-D. Chen, "Surveying instructor and learner attitudes toward e-learning," *Computers & Education*, vol. 49, no. 4, 2007, pp. 1066–1080. https://doi.org/ 10.1016/j.compedu.2006.01.001

G. Y. Bundot, et al., "Technology Acceptance Model of intention to use ICT by academics in Nigerian higher education," *Online Journal for TVET Practitioners*, vol. 2, no. 1, 2017, pp. 1–7.

S.-S. Liaw, "Understanding user perceptions of world-wide web environments," *Journal of Computer Assisted Learning*, vol. 18, no. 2, 2002, pp. 137–148. https://doi.org/10.1046/ j.0266-4909.2001.00221.x

M. Fusilier and S. Durlabhji, "An exploration of student internet use in India," *Campus- Wide Information Systems*, vol. 22, no. 4, 2005, pp. 233–246. https://doi.org/10.1108/ 10650740510617539

A. Khairani, A. Daud, and M. Adnan, "Students' acceptance of the use of google classroom as a platform in blended learning," *AL-ISHLAH: Jurnal Pendidikan*, vol. 12, no. 1, 2020, pp. 1–16. https://doi.org/10.35445/alishlah.v12i1.193

H. S. W. Nugroho, H. B. Notobroto, and L. Rosyanti, "Acceptance model of a mandatory health information system in Indonesia," *Healthcare Informatics Research*, vol. 27, no. 2, 2021, pp. 127–136. https://doi.org/10.4258/hir.2021.27.2.127

F. J. Agbo, et al., "A review of thematic growth of international journal of education and development using ICT," *International Journal of Education and Development Using Information and Communication Technology*, vol. 17, no. 2, 2021, pp. 17–36.

T. Noskova, et al., "The use of ICT tools by academic teachers in the international comparative context," *CEUR Workshop Proceedings*, vol. 2401, 2019, pp. 1–15.

D. Ashaver and S. M. Igyuve, "The use of audio-visual materials in the teaching and learning processes in colleges of education in Benue State-Nigeria," *IOSR Journal of Research & Method in Education*, vol. 1, no. 6, 2013, pp. 44–55. https://doi.org/10.9790/7388-0164455

U. I. Ogbonnaya, "Adoption and perceived usefulness of social media by pre-service teachers in Nigeria," *International Journal of Interactive Mobile Technologies*, vol. 13, no. 6, 2019, p. 52. https://doi.org/10.3991/ijim.v13i06.10299

E. Apriani and J. Hidayah, "The ICT used by the English lecturers for non English study program students at STAIN Curup," *Vision: Journal for Language and Foreign Language Learning*, vol. 8, no. 1, 2019, pp. 26–37. https://doi.org/10.21580/vjv8i13280

D. Aminatun. "ICT in university: How lecturers embrace technology for teaching," *Jurnal SMART*, vol. 5, no. 2, 2019, pp. 71–80.

T. Plomp, A. Ten Brummelhuis, and W. J. Pelgrum, "New approaches for teaching, learning and using information and communication technologies in education," *Prospects*, vol. 27, no. 3, 1997, pp. 427–443. https://doi.org/10.1007/BF02736642

E. Çetin, "Digital storytelling in teacher education and its effect on the digital literacy of pre-service teachers," *Thinking Skills and Creativity*, vol. 39, 2021, p. 100760. https://doi.org/10.1016/j.tsc.2020.100760

A. K. Teotia, "A study on the use of ICT in pre service teacher education in Delhi," *Psychology and Education Journal*, vol. 57, no. 9, 2021, pp. 6535–6546. https://doi.org/10.17762/ pae.v57i9.3355

I. R. Lawal and M. O. Oloyede, "Enhancing the quality of learning and teaching via information communication and technology (ICT)," *International Journal of Applied Information Systems*, vol. 5, no. 4, 2013, pp. 42–50.

S. A. Olumade. "Information and Communications Technology (ICT) and lecturers' proficiency in Nigerian universities," *Malaysian Online Journal of Educational Management*, vol. 3, no. 3, 2015, pp. 45–60.

M. R. H. Shamim and M. A. Raihan. "Effectiveness of using ICTs to promote teaching and learning in technical education: Case of Bangladesh," *International Journal of Vocational and Technical Education*, vol. 8, no. 2, 2016, pp. 12–19.

A. Hashemi, "The impact of information and communication technology (ICT) on teaching English to college students," *EFL Journal*, vol. 1, no. 3, 2016, pp. 203–218. https://doi. org/10.21462/eflj.v1i3.20

O. Bentahar and R. Cameron. "Design and implementation of a mixed method research study in project management," *Electronic Journal of Business Research Methods*, vol. 13, no. 1, 2015, pp. 3–15.

B. Bozdağ, "Examination of psychological resilience levels of high school students," *World Journal of Education*, vol. 10, no. 3, 2020, pp. 65–78. https://doi.org/10.5430/wje.v10n3p65

A. Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed., London: SAGE Publications Limited, 2018.

M. Vaismoradi and S. Snelgrove, "Theme in qualitative content analysis and thematic analysis," *Forum: Qualitative Social Research*, vol. 20, no. 3, Sep. 2019. https://doi.org/10.17169/ fqs-20.3.3376

V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, 2006, pp. 77–101. https://doi.org/10.1191/1478088706qp063oa

H. F. Amir, A. Huda, and H. Maksum, "Development of mobile learning for simulation and digital communications," *Journal of Education Technology*, vol. 4, no. 3, 2020, pp. 310–316. https://doi.org/10.23887/jet.v4i3.28537

N. Dhanaraj, N. Hewitt, C. Edmonds-Estes, R. Jarman, J. Seo, H. Gunner, A. Hatfield, T. Johnson, L. Yifru, J. Maffeo, G. Pereira, J. Gross, and Y. Gu. "Adaptable Platform for Interactive Swarm robotics (APIS): A human-swarm interaction research testbed," *2019 19th International Conference on Advanced Robotics*, IEEE, Dec. 2019, pp. 720–726. https://doi. org/10.1109/ICAR46387.2019.8981628

M. Almeatani, H. Alotaibi, E. Alasmari, M. Meccawy, and B. Alghamdi, "Thesis supervision mobile system for enhancing student-supervisor communication," *Int. J. Interact. Mob. Technol.*, vol. 13, no. 06, Jun. 2019, pp. 4–14. https://doi.org/10.3991/ijim.v13i06.9533

F. J. Tapia Moreno and H. A. Villa-Martinez, "Digital learning tools for mobile devices for accomplish hypothesis testing of statistical parameters," *Int. J. Interact. Mob. Technol.*, vol. 13, no. 06, Jun. 2019, pp. 15–26. https://doi.org/10.3991/ijim.v13i06.10436Nippie, "File: Technology Acceptance Model.png," Wikimedia Commons,2011[Online].Availablhttps://commons.wikimedia.org/wiki/File:Technology_Acceptance_Mo del.png. [Accessed: Nov. 10, 2021].