www.unibulletin.com
UNIVERSITEPARK BULTEN | BULLETIN
ISSN 2147-351X | e-ISSN 2564-8039
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UNIVERSITEPARK bülten bulletin

RESEARCH ARTICLE

Teaching Amid the COVID-19 Pandemic: An Assessment of Nigerian Colleges of Education Lecturers' Technology Knowledge and Integration

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Received April 26, 2022
Accepted July 13, 2022

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To cite this article: *Kola, A.J., Ajiboye, K., Abdulwasiu, A.A., Attah, J.O., Olosunde, I. (2022). Teaching Amid the COVID-19 Pandemic: An Assessment of Nigerian Colleges of Education Lecturers' Technology Knowledge and Integration. Üniversitepark Bülten, 11(1): 70-80.*

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ABSTRACT

Background/purpose: The emergence of COVID-19 affected global education, which prompted a shift in the teaching paradigm to remote learning. This learning technique requires that lecturers in higher institutions have an adequate knowledge of current technologies and are able to integrate them into the teaching and learning process. Lecturers in Nigerian colleges of education joined their counterparts globally in adopting remote learning practices during the pandemic. The focus of this study aimed at examining their knowledge of relevant technologies and how they were able to integrate them into the classroom.

Materials/methods: The study adopted a survey research method, with a questionnaire used to assess the lecturers. The questionnaire focused on technological knowledge, technological pedagogical knowledge, technological content knowledge, technological pedagogical and content knowledge, and the technologies most frequently used during the COVID-19 pandemic. Data collected from 180 participants were analyzed and the results presented based on descriptive statistics.

Results and conclusion: The analyzed data showed that lecturers possessed relevant knowledge of technology, knew how to select technology appropriate for specific teaching methods, and to integrate them into teaching. However, the lecturers only used limited computer hardware, which was deemed inadequate for technology-based remote learning during a pandemic. Therefore, the authors conclude that the lecturers have adequate technological knowledge and integration skills, but lack the appropriate hardware to deliver effective technology-based remote learning.

Keywords: COVID-19, technological knowledge, pedagogical knowledge, TPACK, technology.

To link to this article– https://dx.doi.org/10.22521/unibulletin.2022.111.5

1. INTRODUCTION

The emergence of COVID-19 brought about many sudden changes to the global economies, of which education and economic activities were perhaps the most severely affected (González-Zamar et al., 2021; Senel & Senel, 2021; Wijaya, 2020). As in many countries, face-to-face education in Nigeria was effectively closed down for many months. Given this situation, the resultant shift in teaching paradigm became inevitable for many countries, both advanced and developing. Remote learning became the only viable alternative for universities and colleges during this period, albeit with significant challenges (Wu et al., 2020). The Nigerian government also joined the rest of the world to call for remote learning in schools during the pandemic. However, critical to the success of this initiative were the challenge of adequate Internet facilities, funding (Legg-Jack, 2021), and the ability of Nigerian lecturers to integrate the relevant technologies into their lessons.

The integration of technology requires that teachers possess adequate knowledge of the relevant technologies. Information and communication technology (ICT) is deemed critical to students' learning, but requires that teachers can efficiently integrate it within the curriculum (Sumathi & Selvarani, 2020). According to Tella (2011), Nigerian teacher educators' knowledge of ICT is low, and Akpan et al. (2009) attributed the challenges of students and teacher educators to a poor understanding of ICT. The pedagogical knowledge of teachers is therefore critical to the integration of technology in education, and as such, Helppolainen and Aksela (2015) stated that teachers need to expand upon their pedagogical knowledge prior to teaching with technology. However, previous studies have shown that most colleges in Nigeria lack adequate ICT devices for the purposes of delivering effective teaching and learning in schools (Oyediran & Dick, 2018; Tella, 2011).

Teaching and learning during the pandemic required the rapid integration of technologies due to the necessity for social distancing. Therefore, it was assumed that teachers who possessed adequate knowledge of technologies and were able to effectively integrate them into their teaching would positively impact students' learning. Thus, the concept of "technological pedagogical and content knowledge," known as TPACK, is vital. Whilst many teachers in Nigerian schools may have already possessed adequate content knowledge of their subject, this was deemed insufficient amid the pandemic. Therefore, all lecturers in tertiary institutions are expected to possess sufficient technology knowledge and to be able to integrate it within the teaching and learning process.

1.1 Purpose of the Study

The crux of the study was to assess Nigerian colleges of education lecturers' knowledge of technology and integration amid the COVID-19 pandemic. Specifically, the research investigated the following:

- Lecturers' knowledge of technologies in teaching;
- Lecturers' knowledge of how to use technologies to teach subject content using various teaching methods;
- Lecturers' knowledge of how to integrate technologies into teaching; and,
- The most frequently used technologies in lecturers' classrooms.

1.2 Research Questions

The following four research questions were generated from the research purpose to succinctly assess the lecturers' knowledge of technology integration.

- RQ1: Do lecturers in Nigerian colleges of education possess adequate technological knowledge for their teaching?
- RQ2: Do lecturers in Nigerian colleges of education possess technological knowledge suitable for different teaching methods?
- RQ3: Do lecturers in Nigerian colleges of education possess adequate knowledge in selecting and integrating technologies in teaching subject contents?
- RQ4: What were the most frequently used technologies by lecturers in Nigerian colleges of education during COVID-19 pandemic?

1.3 Research Design

The study employed a survey research method that adapted a questionnaire developed and validated by Schmidt et al. (2009). In total, 184 out of 200 lecturers returned the completed questionnaire. Analysis of the collected data was performed using descriptive statistics. Anonymity of the research participants was considered critical, and was strictly safeguarded by the researchers. For the purpose of maintaining anonymity of the participants, and in assuring the confidentiality of their data, the actual names of the colleges were withheld and replaced by pseudonyms within the manuscript.

2. LITERATURE REVIEW

2.1 ICT and Teacher

The integration of ICTs into teaching and learning remains key to the delivery of a sound education across all educational institutions in today's world (Nordin et al., 2013). However, Babatunde and Braimoh (2018) revealed several issues in the case of Nigerian teacher education, of which one was a lack of ICT knowledge required to personalize curricula and to assist trainee teachers with problem-solving exercises.

A good teacher is essential to deliver quality education (Aina & Olanipekun, 2015). However, studies have demonstrated that teachers must be able to include technology in their instruction effectively in the 21st century (Abdalla & Ali, 2017). As a result, the importance of TPACK to the teaching profession is considered essential (Tseng, 2014). According to Abdalla and Ali (2017), TPACK encompasses three crucial components in the learning scenario; pedagogy, content, and technology, with other vital elements overlapping with these three fundamental components (Sahin, 2011; Tseng, 2014). It has been suggested that for a teacher to be effective, they must possess adequate current knowledge of pedagogy, content, and technology (Sahin, 2011).

Both teachers and students benefit from incorporating technology into the classroom (Gur & Karamete, 2015). For starters, it aids children in developing a desire to learn (Sahin, 2011). Second, it enables teachers to alter their established teaching philosophy (Gur & Karamete, 2015). TPACK relies heavily upon teacher's computer-based skills; however, research has shown that many teachers in schools lack such knowledge and skill (Kafyulilo et al., 2015). According to empirical investigations, many Nigerian teachers' expertise of computer use in the classroom is lacking (Aina & Olanipekun, 2018); whereas, comparatively, Tanzania has made the use of ICT a priority in its education policy (Kafyulilo et al., 2015). However, despite computers being readily available and accessible in the classrooms of many Nigerian schools, most teachers still do not utilize them (Hosseini & Kamal, 2013).

2.2 Technological knowledge

"Technological knowledge" or TK refers to a teacher's capacity to employ various sorts of technology for the purposes of delivering instruction (Tseng, 2014). Bingimlas (2018) defined technological knowledge as a broad understanding of technologies that require specialized abilities, such as the use of whiteboards, applications, software, intelligent devices, and social media. Knowledge on operating a computer and the related software, for example, is considered technological knowledge (Gur & Karamete, 2015). Going beyond the traditional concept of computer literacy, TK necessitates a broader and more critical grasp of the technology required to process information, communicate, and resolve problems (Harris et al., 2009).

2.3 Technological Content Knowledge

Understanding how technology and content impact and strongly support one another is known as "technological content knowledge" or TCK (Harris et al., 2009). It entails teachers comprehending how a specific technology affects students' learning and practice concepts in a particular subject (Schmidt et al., 2009). According to Harris and Hofer (2011), a teacher's knowledge of the topic they are teaching should also be complemented by a grasp of the technologies they should or could be using in their teaching.

2.4 Technological Pedagogical Knowledge

The term "technological pedagogical knowledge," or TPK, refers to a teacher's capacity to employ technology-assisted teaching practices (Tseng, 2014). TPK aids in comprehending how teaching and learning changes due to the employment of various technologies. Tseng (2014) defined TPK as the integration of technological tools and equipment with appropriate instructional designs and methodologies while considering their strengths and limits. TPK is an understanding of how to use technology to support teaching methodologies and instructional practices (Bingimlas, 2018). Teachers must understand how technology influences teaching (Gur & Karamete, 2015), and the knowledge of how teaching and learning change when specific technologies are used is known as TPK (Harris et al., 2009). As most popular software packages are not designed to be used within an educational setting, the usage of technology must be adaptable (Harris et al., 2009), and teachers must acquire the relevant knowledge and skills necessary to employ technology for educational purposes (Harris et al., 2009). TPK refers to how various technologies are used in the classroom and how this affects the way in which teachers teach (Schmidt et al., 2009).

2.5 Technological Pedagogical and Content Knowledge (TPACK)

The heart of technology integration today is technological pedagogical and content knowledge (TPACK) (Nordin et al., 2013). Teachers require sound content knowledge and pedagogy, but today, knowledge of technology is also considered critical, making the issue of TPACK imperative for every teacher (Abdalla & Ali, 2017). Whist it is useful to assess teachers' knowledge in content, pedagogy, and technology separately, the measurement of TPACK, which combines all three components, is now widely accepted and practiced (Sahin, 2011). TPACK is an instrument used to assess how teachers' professional development influences their classroom performance (Bingimlas, 2018). Integrating technology into teacher training programs requires TPACK (Yigit, 2014).

3. RESULTS

Table 1. Mean of TK, TPK, TCK, and TPACK

	Domain / Item	*M*	*SD*
	TK (Technological Knowledge)		.
1	I know how to solve my own technical problems.	3.9061	0.94105
2	I can learn technology easily.	3.9451	1.05498
3	I keep up with necessary new technologies.	3.9891	0.88943
4	I frequently play around with technology.	4.0223	1.02198
5	I know about a lot of different technologies.	3.9500	1.06899
6	I have the technical skills I need to use technology.	3.8402	1.08201
7	I have had sufficient opportunities to work with different technologies.	3.6524	1.27551
	TPK (Technological Pedagogical Knowledge)		
8	I can choose technologies that enhance the teaching approach for a lesson.	4.2143	0.78888
9	I can choose technologies that enhance students' learning for a lesson.	4.1093	0.99949
10	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	4.1148	0.80038
11	I am thinking critically about how to use technology in my classroom.	4.0330	0.96857
12	I can adapt the use of the technologies that I learned to different teaching activities.	4.1038	0.88027
	TCK (Technological Content Knowledge)		
13	I know about technologies that I can use for understanding and doing science.	4.0615	0.93714
	TPACK (Technology Pedagogy and Content Knowledge)		
14	I can teach lessons that combine science, technologies, and teaching approaches appropriately.	4.1038	0.92886
15	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	4.2582	0.91296
16	I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom.	4.0335	0.96512
17	I can provide leadership in helping others coordinate the content, technologies, and teaching approaches at my school.	4.1278	0.87823
18	I can choose technologies that enhance the content of a lesson.	4.2303	0.96713

Table 2.
Means of Different Domain

Domain	*M*	*SD*

Technological Knowledge (TK)	3.9198	.82310
Technological Pedagogical Knowledge (TPK)	4.1275	.71511
Technological Content Knowledge (TCK)	4.0674	.93637
Technological Pedagogical and Content Knowledge (TPACK)	4.1565	.81214

Table 3.
Frequently used technologies

s/n	Technology
1	Laptop personal computer
2	Desktop personal computer
3	Auto card
4	Projector
5	Smartphone
6	Smartboard
7	Tablet personal computer
8	Digital camera
9	Whiteboard
10	Calculator
Ownership of technology devices	
38% owned by lecturers	
62% owned by others (government, college management, department/unit, etc.)	

4. DISCUSSION

Four components out of the seven identified by Schmidt et al. (2009) in their TPACK framework are presented in Table 1 and Table 2. First, Table 1 shows the mean scores of the respondents to items under each component. The first domain, TK, has seven items and the mean scores are all higher than 3.50. The second domain, TPK, has five items, with mean scores all above 4.00. Then, there is TCK with just one item and a mean score above 4.00, and finally, TPACK has five items which all have mean scores above 4.00.

Table 2 provides a summary of the domains, and shows that TK has a total mean of 3.9198, implying that teachers have the required technological knowledge for their teaching. The TPK mean of 4.1275 and the TPACK mean of 4.1565 both indicate that lecturers know how to select and integrate technologies in the teaching of subject contents. In Table 3, the most frequently used technologies were mostly hardware-based, of which only a lower percentage (38%) were owned by lecturers. Critical analysis of the devices used shows that laptop personal computers and smartphones were the most relevant to teaching and learning during the COVID-19 pandemic. However, many of the software programs considered crucial to e-learning during the COVID-19 lockdown were not included among the frequently used devices.

The current results show similarity with previous studies, and also equally indicated some variance from the existing literature. The reported outcome from the current study is in agreement with Makinde et al. (2013) in that teachers in some schools in Nigeria are ICT literate. Onifare et al. (2017) reported in their study that colleges of education in Nigeria have a positive attitude toward the use of ICT; however, Ifinedo et al. (2019) observed that teachers in developing countries like Nigeria face certain challenges with technologies. Similarly, Jimoh (2019) showed concern about the poor ICT skills of Nigerian teachers when

compared to elsewhere on the African continent, and Kafyulilo et al. (2015) equally reported that some teachers have insufficient levels of ICT knowledge. Research studies have shown that adequate knowledge of technology is critical to learning in the 21st century due to its central role in much of today's teaching and learning processes. Additionally, Harris et al. (2016) reiterated the importance of technology to students' academic achievement and motivation.

Teacher education in Nigerian colleges of education has been shown to be deficient in the use of digital technology in pedagogical practices (Ifinedo et al., 2019). Different from the current study, Obielodan et al. (2020) reported that teachers lack adequate pedagogical knowledge to use ICTs effectively for teaching in Kwara state schools. This outcome is also similar to that stated by Adeoye and Ojo (2014), where an average number of teachers were unable to correctly choose technologies that enhanced their teaching paradigm in schools.

Integrating technology into teaching is critical to current-day education (Ifinedo et al., 2019; Omoso & Odindo, 2020), which makes the findings from the current study encouraging. However, Oyediran and Dick (2018) revealed that a significant number of teachers in Ogun State, Nigeria, did not use modern ICTs to teach in their classes, contrary to the results revealed in the current study. Similarly, Owolabi et al. (2013) raised concerns that teachers in Nigeria are not using ICTs for teaching in schools.

One critical outcome from the current study is with regards to the issue of frequently used technologies. The software required for e-learning was found to be completely missing from the technologies identified as being used by lecturers in their teaching. This outcome is an indication that most lecturers may face the challenge of poor Internet connectivity. Olanrewaju et al. (2021) identify poor Internet connectivity in Nigeria as a challenge to the delivery of e-learning during the COVID-19 pandemic. This result is similar to that reported by Senel and Senel (2021), where some higher institutions in Turkey lacked the required tools to deliver e-learning during the COVID-19 pandemic. The current study revealed that only a few lecturers in Nigerian colleges of education have access to the required technologies, which signals a severe problem being faced in terms of delivering online learning, and especially during the pandemic. One of the advantages of online teaching and learning is that it can occur at any place where there is a suitable and stable Internet connection. Therefore, any teacher who does not have an appropriate digital device will likely not be able to teach outside of the physical school environment, making technology-based remote teaching somewhat challenging. Sahu (2020) observed that many university teachers were unable to broadcast lectures from their homes due to a lack of digital devices.

5. CONCLUSION

The study evaluated lecturers' technological knowledge and ability to integrate technology into Nigerian colleges of education. The findings demonstrated that the lecturers are mostly technologically aware, can select the appropriate technology for a given teaching paradigm, and can successfully integrate technology into their lessons. However, the lecturers only have access to a limited amount of computer equipment, and only a few of them own computers. As a result, technology-based remote teaching during the COVID-19 pandemic was seen as a critical issues in these colleges.

6. RECOMMENDATIONS

- The government of Nigeria and all stakeholders in teacher education should provide additional hardware and software in order to allow for seamless electronic teaching and learning within all educational institutions.
- As teaching is no longer tied to a particular location, all lecturers should guarantee that they possess appropriate personal digital equipment required for the development and delivery of technology-based remote learning.

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