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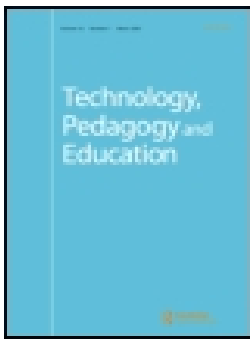
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Understanding the influence of context in technology integration from teacher educators' perspective

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ABSTRACT

The perspective of teachers is important for advancing the use of technology in classrooms. A considerable number of research studies have explained context in ways that have narrowed the understanding of its impact on successful technology integration. This study employs the Technological Pedagogical and Content Knowledge (TPACK) model as a lens in understanding factors influencing teachers' integration of technology in classrooms. Data were collected using focused interviews of 19 teacher educators of three colleges of education from the southern part of Nigeria. The results reveal that among the level contexts, the meso level presented the most challenges to teachers' efforts at integrating Information Communication Technology (ICT) in their classrooms. In addition, the benefits of technology integration were expressed more in terms of the significance, practical use and the opportunities that ICT offers.

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Introduction

The teaching and learning environment is one of many that have been positively influenced by technological developments, as these offer opportunities for improved experiences and new skill sets such as collaborations, innovative application of knowledge, critical thinking and more (Scott, 2015).

Research has shown the benefits of using technology in education (Dahlstrom, 2012; Motiwalla, 2007; Sharples, 2000). Therefore, the question is not whether teachers should incorporate the technology in their delivery of instructions, but how they should successfully harness the benefits of technology in order to transform the learning environments. Effective teachers produce competent future teachers (Hammond et al., 2009; Tondeur et al., 2017) and learners who are equipped with twenty-first-century skills. Teachers are seen as the main drivers whose roles will largely determine the successful application of information technology in pedagogy. In fact, Porras-Hernandez and Salinas-Amescua (2013, p. 233) described teachers as *active constructors of knowledge* in the integration of technology. The understanding of this knowledge and how teachers construct it will be beneficial for designing suitable pedagogical practices that leverage on Information Communication Technology (ICT) usage. Tom-Lawyer (2015) stressed the relevance of professional development of teachers in the quest for achieving the objectives of education. Cviko et al. (2013) showed that teachers' involvement in the planning of technology integration led to improvement in pupils' learning. Consequently, by considering the perspectives of teachers and the impact of their context, this research aims to enrich the ongoing discussion on the advancement of technology integration in education. In other words, this

research was undertaken to better understand the effect of a developing country's context on its teachers' technology integration. In the subsequent sections, we offer some perspectives of research on technology integration. Next, the theoretical framework that underpins the research is explained. Afterwards, the method used in conducting the research is described followed by the presentation of the findings, discussion and conclusion.

Research on technology integration

Technology integration research conducted between 1996 and 2006 was characterised by the traditional theory of constructivism as well as the proliferation of the Internet (Zawacki-Richter & Latchem, 2018). In spite of the fact that constructivist theories were postulated before technological developments influenced teaching and learning environments, some authors (e.g., Anderson, 2016; Mattar, 2018) assert that such theories remain relevant in today's digital age especially for advancing research. Nevertheless, Anderson (2016) pointed out that constructivism predominantly typifies the perspective of learning and, as such, the present study does not find it suitable in understanding the challenges that teachers face in integrating technology. Further, several models have been considered for guiding teachers' technology integration. For example, the Technological Pedagogical and Content Knowledge (TPACK) model by Mishra and Koehler (2006), the Substitution Augmentation Modification Redefinition model by Puentedura (2009), the Replacement Amplification Transformation model by Hughes et al. (2006) and the Technology Acceptance Model by Davis (1989). While these models provide useful perspectives, they are better suited to evaluation studies of technology adoption rates (Kaliisa & Picard, 2017), except TPACK. In addition, these models, unlike TPACK, do not encompass teachers' pedagogical and content knowledge. Koehler and Mishra (2009) describe their model as one in which all three knowledge constructs are mutually related and, thus, it depicts an effective teacher for the twenty-first century.

Factors influencing teachers' decisions on the use of ICT in their classrooms have been discussed by several studies, for example, in the extensive literature review by Mumtaz (2000). Some studies have considered viewpoints of pre-service teachers, for example, Tondeur et al. (2017). Others have examined teachers while highlighting the school contexts (Crompton & Burke, 2018; Drent & Meelissen, 2008; Tondeur et al., 2008). However, the vast majority of such studies have been based on the perspectives of economically developed countries, and less is known of the African continent (Bond et al., 2019; Crompton & Burke, 2018). Moreover, Voogt and Tondeur (2015) recommended that technology integration studies conducted within the context of developing countries can be more effective when such studies take cognisance of the peculiarities of the context. This recommendation suggests another difference between the TPACK and other models, that is, the conspicuous role of context. The lack of contextual explanations in frameworks for guiding educational technology research has theoretical implications (Rosenberg & Koehler, 2015b). As Phillips (2016) explained, a teacher's TPACK is a function of his or her context. Moreover, compared with developed countries, the technology integration experiences vary in the context of developing countries (Tondeur et al., 2015). Such variance is attributed to the motivation behind the implementation (Bhuasiri et al., 2012). That is, while the implementation in the developing contexts is motivated by access to and improvement in the quality of education, the developed counterparts are motivated by economic knowledge growth. In a comparative study on barriers to mobile learning initiatives, Crompton (2017) found that the developing countries struggle more with infrastructural problems. It therefore follows that context occupies a significant position in understanding the challenges that teachers face in integrating technology in their classrooms. Accordingly, this study finds the TPACK framework to be a suitable guide because of the attention to teachers and context.

Theoretical framework: TPACK

The Technological Pedagogical and Content knowledge (or TPACK) framework has emerged as a theoretical framework needed for understanding teachers' integration of ICT into teaching

(Kitzinger, 1994, p. 105; Willermark, 2018). Recently, studies have started to point towards the effectiveness of technology integration in education by reinforcing the constituents of TPACK (Hutchison et al., 2012; Ke & Hsu, 2015; Kearney & Maher, 2013). The TPACK framework is an advancement of Shulman's work on the knowledge construct (Pedagogical Content Knowledge) required by teachers albeit with the inclusion of technological knowledge. In summary, Koehler and Mishra (2009) described the framework as consisting of three key components of teachers' knowledge: content, pedagogy and technology. The framework also depicts the interaction between and among these components – PCK (pedagogical content knowledge), TCK (technological content knowledge), TPK (technological pedagogical knowledge) and TPACK (technological pedagogical content knowledge). Content knowledge (CK) describes the teachers' knowledge of the subject to be learnt or taught and refers to the importance of teachers having a well-founded knowledge of the field in which they teach. Pedagogical knowledge (PK) represents the teachers' deep knowledge about the systems, approaches, procedures and practices of teaching and learning. According to Koehler and Mishra (2009), the aspect of context within which the knowledge of technology, pedagogy and content is situated is central. Notwithstanding, a number of studies relating to TPACK have emphasised more of the other aspects of the framework and less of the context feature in their investigation (Koh et al., 2014; Porras-Hernandez & Salinas-Amescua, 2013; Rosenberg & Koehler, 2015a, 2015b). Therefore, this study will provide insights on context towards support for the TPACK model.

TPACK framework revised: scope and actors

Porras-Hernandez and Salinas-Amescua (2013) criticised the TPACK framework in terms of the ambiguity surrounding the explanation of context. For example, they identified four main characterisations of context in previous research, namely: student characteristics, classroom and institutional conditions for learning, situated teaching activities and teachers' epistemological beliefs.

Subsequently, the authors revised the TPACK framework by attempting to define how context could be uniformly categorised. Firstly, they suggest that context in terms of *scope* be split into three levels, namely *micro*, *meso* and *macro*. Secondly, they extend the framework by including two knowledge constructs which they refer to as *actors*, namely *teachers* and *students*. In this way, they provide a more robust understanding for context within the TPACK framework, such that they view context as an object of knowledge and as one in which a teacher's individual variable is highlighted.

The *macro* context is described as situations emanating from, for example, global or national policies that continue to evolve and ultimately influence the teachers. As an instance, policies such as the Millennium Development Goals and Education for All have been used as a guide for developing teacher education, whereby all teacher educators are expected to be information technology compliant in Nigeria (Federal Ministry of Education [FMED], 2014). The factors belonging to the *meso* level are those arising from within the school itself and the immediate society where the school is located. The *micro* level consists of the classroom ambience and how it can influence the teaching style.

Research context

Nigeria has a population estimated at 184 million, which accounts for 47% of the West African population and about 20% of Sub-Saharan Africa (World Bank, 2017). Education has been identified as an effective means to develop any country. However, the challenge remains a struggle between affordable education and the increasing Nigerian populace in the midst of decreasing national resources. The National Policy on Education by FMED (2013, pp. 15, 42) documented the significance of ICT for promoting the delivery of education in Nigeria with emphasis on developing teachers, capacity and infrastructure. Yusuf (2005) however, reported the weakness observed between Nigeria's ICT policies and the application in education, which is further reflected in the mismatch of objectives of or strategies for education in relation to the economic relevance of graduates at the job markets, therefore revealing the lack of initiatives that

address such breaches. Further, recent studies in the Nigerian context have predominantly stressed the high penetration level of mobile devices among university students (e.g., Ifinedo et al., 2017; Utulu & Alonge, 2012). Others are indicative of mobile learning initiatives in the country (e.g., Adedoja et al., 2012), but references to studies concerning ICT integration within the Nigerian teacher education domain using qualitative methods are sparse. The National Universities Commission, National Board for Technical Education and National Commission for Colleges of Education (NCCE) are the governing bodies responsible for managing the Nigerian tertiary institutions (that is, universities, polytechnics and colleges of education). The colleges of education are classified according to their proprietors (for example, federally governed, state governed or privately owned) and according to the course programme offered (for example, technical, conventional or special). Indeed, the growing number of colleges of education available in the country is indicative of the significance of teacher education. According to the NCCE (2017), there are presently 85 colleges of education in Nigeria. Teacher educators are expected to be trained and equipped with pedagogical and content skills amidst the constant pervasiveness of technology in the learning environments. It is therefore anticipated that to prepare the future teachers and learners with twenty-first-century skills, the teacher educators themselves should be the front-runners in matters of technology integration.

The research question

The TPACK framework provides the foundation for successful teaching involving the use of ICT, while the description of the expanded levels of context further reveals contextual factors that influence the TPACK construct. In other words, factors emanating from the context levels act as inhibitors or facilitators of the teachers' decision to apply ICT in their teaching practices. In this regard, the objective of this study is to understand the influence of the level contexts on the Nigerian teacher educators' ICT practices. The specific research question studied is, *What factors act as facilitators or inhibitors to the use of ICT from teacher educators' perspective?* In order to elicit more responses that would buttress their position during the discussion, the following questions were subsequently posed:

- Currently do you use or have you had a reason to use ICT in your classrooms?
- Does your school promote the use of ICT in your school? If yes,
- Does your school provide technical support personnel?
- Do the students of your school have access to ICT in the school?

These sub-questions were motivated by previous discussions on technology integration, which align with the different level of the TPACK context levels. From the literature on technology integration, several factors were shown to limit or support teachers' use of ICT in teaching. For example, factors such as infrastructure (Delgado et al., 2015); institutional support including training and technical support (Cheok & Wong, 2015); skills, beliefs and attitude towards use (Buabeng-Andoh, 2012; Ertmer et al., 2012) are some of the major barriers to technology integration.

Methodology

This study is part of a larger study in which both quantitative and qualitative approaches were employed to investigate the use of ICT in Nigerian colleges of education using TPACK as a guide. In our previous study, a self-reporting survey was used to evaluate the Nigerian teacher educators' seven knowledge constructs, that is, their TPACK (see Ifinedo et al., 2019). In this article, we present the details and analysis relating to the data collected qualitatively. Specifically, a focused interview was used to obtain in-depth understanding and explanation of the perception of teacher educators' teaching experience in the use of ICT. A focus interview is one consisting of a group of interviewees and the facilitator with the aim of creating an atmosphere for interaction and discussion of a specific issue of significance to the researcher (Bryman et al., 2011). This technique was believed to be the optimal way to collect the needed data since

firstly, the topic of interest and aim were clearly defined. Secondly, it provides an opportunity for the participants within the group to interact, reflect, argue and jointly construct meanings, which in the end offers the researcher a practical account of the participants' opinions. Such interactions are made feasible since the teacher educators belong to a pre-existing group (for example, the teacher educators are staff of the respective schools where the interviews were conducted), and as such, they are familiar with the *social context within which ideas are formed and decisions made* (Kitzinger, 1994). Thirdly, a focus interview is cheaper and less time-consuming than interviewing the 19 participants individually. The schools in which the focus interviews were conducted were chosen by convenience.

Participants

The participants of the study consist of teacher educators from various departments of three colleges of education in the southern part of Nigeria. The focus interviews were conducted in January 2018, and prior to this, the three schools were observed to have websites on which their history, vision statements and other information were displayed. During the interview, six teacher educators were present for each of the schools I and II, while there were seven teacher educators in school III. Altogether, there were 19 teacher educators; seven were females while 12 were males. In each of the three interviews, the participants reserved the office of a fellow colleague, which ensured a comfortable and free environment for discussion. The first author using face-to-face communication facilitated the discussions, beginning with a general introduction to the discussants and the faculty they represented. Thereafter, the motivation for the study was briefly presented, and the main question was asked. In this way, the interviews were semi-structured and lasted one hour, 39 minutes and eight seconds in total. English language was used to conduct the interviews, and the facilitator, who is a native, understood any slang used by the participants. The participants gave their permission to be video-recorded with the assurance of strict confidentiality. Accordingly, pseudonyms are used rather than real names, while in the videos and pictures, faces have been blurred.

Characteristics of participants

During the focus interview, three types of individuals were observed and were classified by the facilitator as: the active, the reflective and the few words. The active ones were very vocal and usually the first to begin the discussion. They would answer a question and go ahead to finish off statements of other participants; sometimes they would buttress the view of another participant with examples of their own experiences. The reflective ones looked as if they took some time to ponder on the discussion going on and the exchange of views, but once they were ready to speak, they expressed their views with passion (researcher's interpretation of hand movements, raised voices and facial expressions). [Figure 1](#) is an example of a reflective participant who, at first, is seen looking down, later his hands are crossed, and when he is ready to join in the discussion, he uses facial and hand expressions with a high tone of voice (see link to video clip of such an example on the first page of this article). The ones referred to as the few words spoke calmly, with confidence, sometimes not agreeing with the opinions of the others initially and then at some point modifying their views based on the view of the others or simply nodding to show understanding of what was unclear. Interpretations of this type of group dynamic are provided in this article to show the context of the quotes and discussion. Generally, in each school interview, agreement was signalled by how the participants sighed, chorused, extended, adlibbed or completed each other's comments (see link to video clip of an example on the first page of this article). Sometimes, recounting an experience seemed to remind another participant of a similar experience faced. Overall, the facilitator ensured that everyone's opinion was voiced during the discussion.

Data analysis

The use of video recording helped the researcher to focus on facilitating the discussion and observe the process by which the collective creation of meanings was occurring among the participants.



Figure 1. A reflective participant.

Replaying the video recording made it easier during the transcription process to identify who said what and especially in cases where a participant spoke over another. Moreover, the richness of data captured in video recording is observed in how the participants said what they said. This is an advantage that enables the use of group dynamics in the production of data (Catterall & Maclaran, 1997). For example, the gesticulations, facial expressions and general body language gleaned from the video improve the data collection process. In all, utilising the video recording was beneficial in reducing possible disruptions during the focus interview process and thereby achieving the aim of the research.

In this study, the data analysis consisted of open, focused and theoretical coding (Thornberg & Charmaz, 2013). The data were managed manually, and the video recordings were transcribed. Open coding was used initially to explore the data sentence by sentence (see Figure 2 as an example) for each interview followed by focused coding (illustrated in Table 1). In the process, descriptive themes, which were relevant to the study and common in the transcribed interviews, were found and selected. At both stages of analysis, the codes were compared with the data in order to ensure harmony. Next, the video recordings were watched severally in order to observe the group dynamics and interpret them accordingly. Further analysis emerged, resulting from theoretical coding which involved establishing the links between the themes earlier found and the TPACK level context. The initial research question prior to the interviews was, *How significant is the use of ICT for teaching from teacher educators' perspective?* However, from the inductive approach used in analysing the data, whereby the codes generated matched the interview data, the process indicated that the teacher educators perceived the significance of ICT use in relation to what was prevalent within the context of their respective institutions. Therefore, the research question was modified to: *What factors act as facilitators or inhibitors to the use of ICT from teacher educators' perspective?*

Results

The findings from the interview of the three focus interviews are presented according to the TPACK framework with the scope and actors' constructs as developed by Porras-Hernandez and Salinas-Amescua (2013).

then, I think student had access to free internet service within the college at least to do their assignment and for other academic purpose but eh because of policy summersault we normally have in Nigeria, government - one government goes, one government comes in with a different this thing and having invested much money, they won't continue. If not, we have at least something to show that we have presence of ICT but the number one question we ask is that even the manpower that are available, how competent and skillful are they to really deploy these? Then do they have access to these? No, they don't even have access, just like the... my oga here rightly identified. Sometimes you have a computer somewhere, the software there are outdated because they are not used at all, so they are just mere, there for mere decoration. And I equally want to really say that, whatever effort is being used at maybe err ... integrating emm ICT to either teaching and learning, it is at individual level where you see an individual student or an individual teacher is striving to just do that, but as a policy statement in the college, I don't think, even though if it exists, it's not really being given a strong voice and that is why you don't see even public address system, is on extinction list eh, where you have a large class for example I teach the whole student in the college by virtue of the course I teach okay, and it is a combination of both ICT and err the traditional method of teaching but by and large I still use chalk. what I mean by chalk

Availability of manpower
Competence & Skill
Access
Equipment + out dated software
→ NO USE

Figure 2. Open coding of transcript.

Table 1. Illustrating focused coding of transcript.

Focused coding	Focus interview transcript
How is significance of ICT described?	Interviewer: How do you see the usefulness of ICT as you have been teaching in your courses? Is it valuable or not relevant ... feel free to say?
Significance. Good for both students and teachers – (actors). Reduce stress for teachers: How? Less things to say, easier for us. Students: How? See (visual), opportunities for interaction. Students are motivated, involved.	Interviewee D, S1: But it's good both ways, it's good for us, it makes, it reduces the stress ... ehnnn a lot of things that we may have to explain verbally, we can now use the various technologies and the students see, they can interact. So it's easier for us and at the same time it helps to motivate the students because it's different from them sitting in the class and having just ordinary lectures so that involvement is both ways
Significance. Acknowledging ICT is helpful in education, teaching (Specifies actor). Acknowledges challenge of non-availability. (Scope: Whose responsibility?)	Interviewee B, S2: What I would say is that ordinarily technology has actually helped in improving education, even in teaching. But the challenge here is that, non-availability
Significance. Best way of teaching students (both actors). How? Students see (visual)	Interviewee E, S3: Yeah, there is no way we can say that using device is not very okay. It is absolutely the best way of teaching students. Because it makes them see the reality in what they are doing ...

Scope

The response to the significance of technology for education in the teacher educators' experience revealed attributes as shown in Table 2. Even though they agreed on the importance of technology integration in their delivery of instruction, their views were expressed more in terms of the challenges they faced in applying it in the classrooms. The categorisations consist of the main themes that emerged from the data and fit into the three levels of context, namely macro, meso and micro. These themes emerged from their description of factors that inhibit their integrating ICT in their classroom. From the macro-level context, they mentioned challenges due to infrastructure at the national level the most (four times). An example of the infrastructure mentioned is the lack of a steady power supply. In addition, in their view, the allocation for education in the national budget was low, and this attribute was mentioned three times.

Of the level contexts, it appeared that the attributes relating to the meso level were most prominent during the interview with issues relating to inaccessible/unutilised/outdated/limited/non-functional facilities being mentioned the most (16 times). Other issues discussed were poor curriculum planning in terms of obsolete content and policy issues at institutional level, for example, a change in school leadership sometimes results in a change of some policies which in the long run affect the teachers. The micro-level context consists of the least number of attributes. The issues arising from this level revolved around the belief that the students could not afford the cost of mobile phone data and had no access to the devices required in the classroom spaces. Another

Table 2. Main themes for scope.

Scope of level context	Attributes
Macro	Infrastructure (4), National budget (3), Policy issues (3), Value for education (3), No funding (3), High cost of living/data (2), Ignored research (2), Poor attitude to ICT implementation, Poor feedback, Pollution.
Meso	Facilities are inaccessible/unutilised/outdated/limited/non-functional (16), Manpower/training/competency (7), Institutional policies/issues (7), Lack of finance (4), Poor curriculum (2), Teacher's view is not considered.
Micro	Teacher's attitude (3), Student-related issues (5).

attribute at this level was the teacher educators' attitude, for example, their 'laziness to prepare slides' and their poor ICT skills. As Interviewee D of School III describes:

The challenge is that I can't really use those devices. Maybe I will say because we are old school [meaning older generation] or we are not, you know, trained that way unlike the people now [younger generation], they have actually been trained. In those days we were not trained, we didn't have access to all these things [ICT devices] and if we had access to them, they are expensive so we couldn't really make do of those things unlike the new generation.

This comment was explained with a smile and hand movement, which shows she was not shy to state what hinders her use of ICT in her classroom. Nevertheless, her statement reiterates the difficulty some teachers face in finding themselves confronted by rapid technological developments that are not in tandem with the training they received, as also acknowledged by Koehler and Mishra (2009). It goes without saying therefore, that ICT skill is a necessity for teachers' successful technology integration.

Actors

Teachers

Table 3 presents the three main categories in which the teacher educators described the significance of technology integration in their teaching experience. The word *easy* (with other variations like *easily*, *easiest*) was the most used as it was mentioned 18 times. For example, 'in fact, it is one of the easiest ways of teaching using electronic device and to drive your point home,' said Interviewee B of School III. Some of the tasks for which they used ICT are in result preparation, teaching concepts and searching for ideas on the Internet on how to improve their teaching skills. They also acknowledged that teaching with the use of ICT had become more student centred as opposed to the traditional methods that previously existed.

Students

The teacher educators also discussed the significance of applying ICT in the classrooms in terms of the benefits to their students. Table 4 presents three main categories of their responses. They believed that integrating ICT in their teaching allowed for the students to easily complete and submit assignments, verify information, obtain visual representation of subjects taught and so on. As

Table 3. Significance of technology integration in their teaching experience.

Categories	Attributes
Significance of ICT	Easy (18), good/best (4), effort (3), faster (3), relevant/important/significant/beneficial (6), fine, sweet, lively, sharper, nice, right thing, helped, growth, simple.
Practical use of ICT	Result preparation, information storage and retrieval, teaching aid, teaching concepts, developing ideas, organising instructions, drive points home, mastery of teaching skill, imparting knowledge (2), monitor student progress.
Perceived role/teaching style when integrating ICT	Teacher as guide, practical oriented, teacher's active participation, student-centred, innovative teaching.

Table 4. Teacher educators' perception of students' knowledge in ICT integration.

Categories	Attributes
Perceived significance of ICT	Easy (9), Help (2), relevant/important (2), Enjoy, quick.
Practical use of ICT	Make research, assignment completion (4), understand/assimilation (3), learning (2), information retrieval, impart knowledge, make real, assignment submission, accessing lesson notes, meaningful learning, verification of information.
Opportunities ICT offers	Interaction, visual aid (2), motivation, active participation, student-centred, find (search) challenging concepts, leverage, ability to recall/remember (3), choice (hard or soft copy), practical-oriented view (2), continuous learning, sharing, collaboration.

a result, ICT offered the students possibilities such as interacting and seeking out information on concepts that were difficult to understand.

Discussion

This study suggests that there is a significant effect of context on the integration of technology by teacher educators in their classrooms. Voogt and Tondeur (2015) proposed recognition of such contextual peculiarities, whereas Rosenberg and Koehler (2015a) advocated the inclusion of context in research relating to the TPACK model, in order to facilitate a clearer understanding of the already complex framework. Accordingly, we explain the major contributions of this research as identifying the various components of the context at play in the institutions studied, namely micro, meso, macro, teacher and student.

Firstly, the responses of the teacher educators were more in terms of the challenges they faced in integrating ICT in their classrooms. Further, among the level contexts, the meso level was most prominently perceived as a challenge. This result is in conformance with the research outcome of studies (Tondeur et al., 2008; Voogt & Tondeur, 2015) that showed that successful technology integration could be influenced at the level of the institution by factors such as appropriate policies, teachers' involvement in the planning process and provision of the facilities needed. Besides, when the conversations on technology integration in classrooms are viewed and compared from the individual perspective of the three schools, the following explanation can be offered.

The teacher educators of School I affirmed that the school authority promotes the use of ICT in the classrooms; and to corroborate this fact, they went on to explain that they were all provided with laptops. In addition, the students are given free access into the school's digital library and are able to seek assistance when needed from the technical support staff available. It can be deduced that this factor encouraged them to integrate the use of technology in their various classrooms and is possibly the reason why they did not express any concern in terms of challenges arising from any of the context levels compared to the two other schools. This may be suggestive of the fact that the school culture, in providing these facilities, has contributed largely to shaping the values placed on the role of technology in the school and concurs with the assertion by Angeli and Valanides (2009). Moreover, the school's support was reflected as they spoke most confidently about the availability of, and access to, Internet and ICT personnel support. The use of chorus answers and nodding in the affirmative to the question *Does your school support the use of ICT?* showed consensus among the participants of this school. Noticeably, they were satisfied with their perception of what their school-level context affords them, particularly the meso level, which in their case was the existing school policies and provision of the facilities that enable technology integration for themselves and the students.

In contrast, the case of the teacher educators at School II showed that they first identified with the fact that context varies and in their case acts as a challenge to the integration of technology in their classrooms. They understood that even though they believed technology integration to be an advantage, the evaluation of its importance poses a constraint in the sense that what is achievable in one context may be far-fetched in another. For example, in this school, the first person to respond

to how significant the use of ICT has been in their teaching experience, did so by asking a question 'Please let's narrow it down, role of technology in Nigeria per se or is it where you [pointing to the facilitator] are coming from ...?' Another participant then takes up the discussion with an attempt to clarify the question his colleague has posed. Interviewee E of School II had at the time over 10 years' teaching experience in computer science from different schools. He exuded confidence in his ability to integrate technology in his classroom but explains:

in different countries, the way you rate the role of technology will be quite different. Like in Africa, in Nigeria here, there is still a lot of limitation as per the use of technology. Normally, technology would have been the best thing to ever happen to education if the facilities are accessible, available and being utilised.

This comment had the other participants nodding, showing unanimity with the view of the participant speaking, indicating that their belief in the significance of technology integration is not enough to ensure successful technology integration in their classroom, but the context within which they operate is a major factor to acknowledge. Moreover, it shows that context is explained differently for different educational environments and geographical locations. In addition, the teacher educators in this institution considered more of the barriers to integrating technology than their willingness and knowledge of the importance of integrating technology in the classroom. They described barriers that are affiliated with all the levels of context as well as the actors but most especially the meso level. They attributed their lack of use of ICT to the school and government using words like 'our school', 'our government'. This school reportedly did not provide the training or facilities needed; in some cases the facilities provided were not functional or were outdated. One participant recounted that for the almost 10 years he had been working in the school, he had never attended any training sponsored by the school. In fact, Interviewee C further argues: 'like this institution of ours, you are talking about four months' salary, how does educational technology now come into play?' At a different moment, he accuses the government of lack of commitment to education, then he moves to school-level issues and rounds up with 'we are talking of salary, your money that you are supposed to get at the end of the month, somebody is paying a deaf ear to it. Not to talk of buying equipment for you' (stressing the point that underlying issues such as unpaid salaries should be addressed before dealing with problems associated with ICT integration). Further, in their opinion, the students could not afford the necessities and the school did not consider their (teachers') input or perspectives concerning curriculum and policy formulation. As pointed out by Cviko et al. (2013), the participation of teachers in the design of ICT-based practices in schools would lead to the development of a sense of ownership and, eventually, ICT-based practices that are sustainable.

From the response of the teacher educators in the case of School III, the situation appears to be a mixture of the two other schools in the sense that they and the students at one time were provided with the facilities (that is, access to ICT training, computer laboratory in the school environment with appropriate personnel). Further, they pointed out that the ICT training was once a prerequisite for promotion, and as such, it became a motivation for them to seek to undergo this training. However, at the time of the interview, they disclosed that this school culture had waned. The statement by Interviewee C in this school shows that an ICT laboratory in the school exists:

Well, well, we have the technology, the educational technology unit. Where most of these devices, in fact, very wonderful ICT devices are there. But the ... like err everything, many people don't utilise it. We are still trying, we are still undergoing transformation and the transformation is taking a veeery [stretching the word] long time to actualise but like he said [pointing to the previous speaker] hopefully we will get there. Really speaking, we really do need technical support because if we do have that, for instance, if you are trying to use a device and you don't actually know how to use it, you need someone to actually assist you. I think that's where we lack this technical support ...

However, another participant corrects that statement by adding that the ICT laboratory is usually locked and requires *connection* (having a certain level of rapport with the authority) to be able to access the facility. The problems influencing the teachers as highlighted here are the school policy,

ICT training for teachers which had stopped as well as free access to the ICT laboratory and ICT support personnel.

Despite this school's situation, some of the teacher educators expressed their willingness to integrate the technology at the individual level. For example, Interviewee C indicates his efforts to use ICT in his teaching:

For me, using technology is very, very, beneficial. Yes, for me using technology is highly significant. I cannot remember when I used chalk last. Yes, because what I do is, I organise my instructions on my system, on my computer and I put them on PowerPoint and I teach with it. It's very simple and students seem to enjoy it [the classes] when they see you use such devices to teach.

Interviewee E mentioned his intention to introduce a collaborative platform for his students based on available resources:

I wanted to bring up an idea whereby I will start using, there is this [searching for words] ... not WhatsApp, there is a software not WhatsApp – they call it telegram. Now telegram simply means that, in telegram, not using WhatsApp, I will now advise my students to go and download telegram. You see these students, all of them have Facebook account and that simply means they have Facebook account, they should also have an email account. So, most of them have phones and Android-driven phones so just download telegram and once after teaching, we now come into group, I can be in my bedroom, everybody can be in their bedroom and we can be chatting on the telegram on topics, on issues, you now find out that the students will be learning at very fast rate [tapping his fingers for emphasis].

This supports the assumption that teachers who are innovative in their use of technology in classrooms, despite perceived institutional challenges, can create possibilities to engage with the ICT applications available (Drent & Meelissen, 2008; Porras-Hernandez & Salinas-Amescua, 2013).

Secondly, the findings of this research clearly reveal that the teacher educators perceived the integration of technology in their delivery of instruction as significant. Most of these responses were in relation to the ease with which they executed their teaching tasks. For example, they believe that integrating technology makes preparing results, organising instructions and producing finer output designs in Art classes easier. They also expressed the significance of technology integration in the classroom in relation to the positive impact it had on the students, therefore attesting to the knowledge that they have of their students and at the same time recognising the students and themselves as principal actors, as portrayed in the favoured version of the TPACK model.

Conclusion

The limitations of the study are, firstly, that the interviews were conducted at the beginning of the academic year, and as such, the school administrators were usually not available due to other engagements they had. Secondly, since lectures had not resumed at the time of the data collection, it was not possible to observe actual teaching scenarios. Thirdly, the research captures only the viewpoints of teacher educators from three public colleges of education in the southern region in Nigeria. Future studies can enrich the results of our study by providing the perspectives of school administrators and conducting observation studies on teachers' context and ICT integration. Further, increasing the number of schools, adding the perspectives of the northern region of the country and conducting comparative studies from other developing countries would be beneficial for the research literature. Despite these limitations, the results of the study are in conformance with previous research. For example, in a 28-year literature review on technology use in education, Delgado et al. (2015) found that, among other challenges, infrastructural problems, access to available technology and technical support discouraged teachers the most from using ICT for teaching. Cheok and Wong (2015) described school support such as technical support and professional training as factors at the organisational level that promote teachers' satisfaction in teaching courses with online learning.

In reality, ICT will continue to develop and influence the learning and teaching environments. The practical implication for the barriers highlighted in this study is that the teachers of these schools

may not teach all courses using ICT. However, taking into consideration the need to increase access to education and the limited resources in developing countries (Kaliisa & Picard, 2017), the technology integration activities of these teachers can be enhanced. The adequate financing of education at the macro level (through policymakers at the national level) can lead to provision of technological infrastructure, which can create possibilities for teachers to innovate their teaching strategies. For example, courses that run in parallel with traditional teaching methods can be designed using models such as Bring Your Own Device, Massive Open Online Courses, electronic learning, blended learning, mobile learning and flipped classroom. At the meso level, teachers will need to be continuously trained, developed and supported by their schools according to the applicable technology-enabled teaching model. These forms of national and school support will in turn improve teachers' skills, beliefs and attitude towards ICT use in their classroom.

Our study gives credence to that of Philips (2016) that showed that teachers' TPACK level is influenced by their context. Theoretically, this research clearly highlights the effect of the contextual levels of the TPACK framework on teachers' integration of technology. The various levels of contexts that emerged in this study's findings align with the TPACK model as expanded by Porras-Hernandez and Salinas-Amescua (2013) in terms of the scope (micro, meso and macro) and the actors (teacher and students). Most of the challenges faced in integrating technology in their classrooms correspond to the meso context level. Similarly, it was observed that teachers are better prepared to integrate technology when they perceive the support of their school. Thus, successful technology integration could be largely achieved at the meso-level context. The study is intended to advance discussions on the TPACK framework, specifically as the teachers in this study described the influence of context on their technology integration. Our study provides a basis to strengthen research on initiatives that motivate teachers to innovatively apply ICT in their classrooms despite the challenges that may abound in their various contexts.

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References

Adedoja, G., Botha, A., & Ogunleye, O. S. (2012). The future of mobile learning in the Nigerian education system. In P. Cunningham & M. Cunningham (Eds.), *IST-Africa conference proceedings* (pp. 1–8). International Information Management Corporation. <http://hdl.handle.net/10204/6095>

- Anderson, T. (2016). Theories for learning with emerging technologies. In G. Veletsianos (Ed.), *Emergence and innovation in digital learning: Foundations and applications* (pp. 35–50). Athabasca University Press. <https://doi.org/10.15215/aupress/9781771991490.01>
- Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, 52(2009), 154–168. <https://doi.org/10.1016/j.compedu.2008.07.006>
- Bhuasiri, W., Xaymoungkhoun, O., Zo, H., Rho, J. J., & Ciganek, A. P. (2012). Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty. *Computers & Education*, 58(2), 843–855. <https://doi.org/10.1016/j.compedu.2011.10.010>
- Bond, M., Zawacki-Richter, O., & Nichols, M. (2019). Revisiting five decades of educational technology research: A content and authorship analysis of the British Journal of Educational Technology. *British Journal of Educational Technology*, 50(1), 12–63. <https://doi.org/10.1111/bjet.12730>
- Bryman, A., Bell, E., Mills, A. J., & Yue, A. R. (2011). *Business research methods*. Oxford University Press.
- Buabeng-Andoh, C. (2012). An exploration of teachers' skills, perceptions and practices of ICT in teaching and learning in the Ghanaian second-cycle schools. *Contemporary Educational Technology*, 3(1), 36–49. <https://doi.org/10.30935/cedtech/6066>
- Catterall, M., & Maclaran, P. (1997). Focus group data and qualitative analysis programs: Coding the moving picture as well as the snapshots. *Sociological Research Online*, 2(1). <https://journals.sagepub.com/doi/pdf/10.5153/sro.67>
- Cheok, M. L., & Wong, S. L. (2015). Predictors of e-learning satisfaction in teaching and learning for school teachers: A literature review. *International Journal of Instruction*, 8(1), 75–90. <https://doi.org/10.12973/iji.2015.816a>
- Crompton, H. (2017). The global mobile learning story so far. In J. Traxler (Ed.), *Capacity building in a changing ICT environment 2017* (pp. 27–34). International Telecommunication Union. https://www.itu.int/dms_pub/itu-d/opb/phcb/D-PHCB-CAP_BLD.01-2017-PDF-E.pdf
- Crompton, H., & Burke, D. (2018, August). The use of mobile learning in higher education: A systematic review. *Computers & Education*, 123, 53–64. <https://doi.org/10.1016/j.compedu.2018.04.007>
- Cviko, A., McKenney, S., & Voogt, J. (2013). The teacher as re-designer of technology integrated activities for an early literacy curriculum. *Journal of Educational Computing Research*, 48(4), 447–468. <https://doi.org/10.2190/EC.48.4.c>
- Dahlstrom, E. (2012). With foreword by Charles Dziuban and J.D. Walker. (2012) Educause Center for Applied Research [ECAR] study of undergraduate students and information technology (research report). ECAR. <https://library.emory.edu/~media/?les/library/2012/9/ers1208.pdf?la=en>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Delgado, A. J., Wardlow, L., McKnight, K., & O'Malley, K. (2015). Educational technology: A review of the integration, resources, and effectiveness of technology in K-12 classrooms. *Journal of Information Technology Education*, 14(2015), 397–416. <https://doi.org/10.28945/2298>
- Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education*, 51, 187–199. <https://doi.org/10.1016/j.compedu.2007.05.001>
- Ertmer, P. A., Ottenbreit-Lefthich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, 59(2), 423–435. <https://doi.org/10.1016/j.compedu.2012.02.001>
- Federal Ministry of Education. (2013). *National policy on education*. FMED.
- Federal Ministry of Education. (2014). *National teacher education policy*. FMED.
- Hammond, M., Crosson, S., Fragkouli, E., Ingram, J., Johnston-Wilder, P., Johnston-Wilder, S., & Wray, D. (2009). Why do some student teachers make very good use of ICT? An exploratory case study. *Technology, Pedagogy and Education*, 18(1), 59–73. <https://doi.org/10.1080/14759390802704097>
- Hughes, J., Thomas, R., & Scharber, C. (2006). Assessing technology integration: The RAT – Replacement, amplification, and transformation – Framework. In C. Crawford, R. Carlsen, K. McFerrin, J. Price, R. Weber, & D. Willis (Eds.), *Proceedings of Society for Information Technology & Teacher Education international conference 2006* (pp. 1616–1620). Association for the Advancement of Computing in Education (AACE). <https://www.learnlib.org/p/22293/>
- Hutchison, A., Beschoner, B., & Schmidt-Crawford, D. (2012). Exploring the use of the iPad for literacy learning. *The Reading Teacher*, *International Reading Association*, 66(1), 15–23. <https://doi.org/10.1002/TRTR.01090>
- Ifinedo, E., Kankaanranta, M., Neittaanmäki, P., & Hämäläinen, T. (2017). Exploring Nigerian university students' perception towards mobile learning. In J. Johnson (Ed.), *Proceedings of EdMedia 2017* (pp. 833–842). Association for the Advancement of Computing in Education (AACE). <https://www.learnlib.org/p/178392/>
- Ifinedo, E., Saarela, M., & Hämäläinen, T. (2019). Analysing the Nigerian teacher's readiness for technology integration. *International Journal of Education and Development Using Information and Communication Technology*, 15(3), 34–52. <https://eric.ed.gov/?id=EJ1227419>

- Kaliisa, R., & Picard, M. (2017). A systematic review on mobile learning in higher education: The African perspective. *The Turkish Online Journal of Educational Technology*, 16(1), 1–18. <https://researchrepository.murdoch.edu.au/id/eprint/56285/>
- Ke, F., & Hsu, Y. C. (2015). Mobile augmented-reality artifact creation as a component of mobile computer-supported collaborative learning. *Internet and Higher Education*, 26, 33–41. <https://doi.org/10.1016/j.iheduc.2015.04.003>
- Kearney, M., & Maher, D. (2013). Mobile learning in maths teacher education: Using iPads to support pre-service teachers' professional development. *Australian Educational Computing*, 27(3), 76–84.
- Kitzinger, J. (1994). The methodology of focus groups: The importance of interaction between research participants. *Sociology of Health & Illness*, 16(1), 103–121. <https://doi.org/10.1111/1467-9566.ep11347023>
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70. <https://www.learntechlib.org/p/29544/>
- Koh, J. H. L., Chai, C. S., & Tay, L. Y. (2014, September). TPACK-in-action: unpacking the contextual influences of teachers' construction of technological pedagogical content knowledge (TPACK). *Computers & Education*, 78, 20–29. <https://doi.org/10.1016/j.compedu.2014.04.022>
- Mattar, J. (2018). Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. *RIED. Revista Iberoamericana de Educación a Distancia*, 21(2), 201–217. <https://doi.org/http://dx.doi.org/10.5944/ried.21.2.20055>
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Motiwalla, L. F. (2007). Mobile learning: A framework and evaluation. *Computers & Education*, 49(3), 581–596. <https://doi.org/10.1016/j.compedu.2005.10.011>
- Mumtaz, S. (2000). Factors affecting teachers' use of information and communications technology: A review of the literature. *Journal of Information Technology for Teacher Education*, 9(3), 219–341. <https://doi.org/10.1080/14759390000200096>
- National Commission for Colleges of Education (NCCE). (2017). *List of colleges of education in Nigeria*. NCCE. <http://www.ncceonline.edu.ng/colleges.php>
- Phillips, M. (2016). Re-contextualising TPACK: Exploring teachers' (non-)use of digital technologies. *Technology, Pedagogy and Education*, 25(5), 555–571. <https://doi.org/10.1080/1475939X.2015.1124803>
- Porras-Hernandez, L. H., & Salinas-Amescua, B. (2013). Strengthening TPACK: A broader notion of context and the use of teacher's narratives to reveal knowledge construction. *Journal of Educational Computing Research*, 48(2), 223–244. <https://doi.org/10.2190/EC.48.2.f>
- Puentedura, R. R. (2009, February 4). *As we may teach: Educational technology. From theory into practice*. Ruben R. Puentedura's weblog. <http://www.hippasus.com/rpweblog/archives/000025.html>
- Rosenberg, J. M., & Koehler, M. J. (2015a). Context and teaching with technology in the digital age. In M. L. Niess & H. Gillow-Wiles (Eds.), *Handbook of research on teacher education in the digital age* (pp. 440–465). IGI Global. <http://doi:10.4018/978-1-4666-8403-4.ch017>
- Rosenberg, J. M., & Koehler, M. J. (2015b). Context and technological pedagogical content knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education*, 47(3), 186–210. <https://doi.org/10.1080/15391523.2015.1052663>
- Scott, C. L. (2015). *The futures of learning 2: What kind of learning for the 21st century?* Working papers series, No. 14. UNESCO ERF. <http://unesdoc.unesco.org/images/0024/002429/242996E.pdf>
- Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education*, 34(2000), 177–193. [https://doi.org/10.1016/S0360-1315\(99\)00044-5](https://doi.org/10.1016/S0360-1315(99)00044-5)
- Thornberg, R., & Charmaz, K. (2013). Grounded theory and theoretical coding. In U. Flick (Ed.), *The SAGE handbook of qualitative data analysis* (pp. 153–169). Sage. <https://doi.org/10.4135/9781446282243>
- Tom-Lawyer, O. O. (2015). Lecturers' perception of the revised English language Nigeria certificate in education curriculum. *Journal of Education and Practice*, 6(12), 181–193. <https://www.iiste.org/Journals/index.php/JEP/issue/view/1824>
- Tondeur, J., Krug, D., Bill, M., Smulders, M., & Zhu, C. (2015). Integrating ICT in Kenyan secondary schools: An exploratory case study of a professional development programme. *Technology, Pedagogy and Education*, 24(5), 565–584. <https://doi.org/10.1080/1475939X.2015.1091786>
- Tondeur, J., Roblin, N. P., Van Braak, J., Voogt, J., & Prestridge, S. (2017). Preparing beginning teachers for technology integration in education: Ready for take-off? *Technology, Pedagogy and Education*, 26(2), 157–177. <https://doi.org/10.1080/1475939X.2016.1193556>
- Tondeur, J., Van Keer, H., Van Braak, J., & Valcke, M. (2008). ICT integration in the classroom: Challenging the potential of a school policy. *Computers & Education*, 51(2008), 212–223. <https://doi.org/10.1016/j.compedu.2007.05.003>
- Utulu, S. C., & Alonge, A. (2012). Use of mobile phones for project based learning by undergraduate students of Nigerian private universities. *International Journal of Education and Development Using Information and Communication Technology*, 8(1), 4–15. <https://files.eric.ed.gov/fulltext/EJ1084143.pdf>
- Voogt, J., & Tondeur, J. (2015). Towards design-based approaches for ICT integration in African education. *Technology, Pedagogy and Education*, 24(5), 527–535. <https://doi.org/10.1080/1475939X.2015.1099564>

- Willermark, S. (2018). Technological pedagogical and content knowledge: A review of empirical studies published from 2011 to 2016. *Journal of Educational Computing Research*, 56(3), 315–343. <https://doi.org/10.1177/0735633117713114>
- World Bank. (2017). *Nigeria overview*. World Bank. <http://www.worldbank.org/en/country/nigeria/overview>
- Yusuf, M. O. (2005). Information and communication technology and education: Analysing the Nigerian national policy for information technology. *International Education Journal*, 6(3), 316–321. <https://files.eric.ed.gov/fulltext/EJ854985.pdf>
- Zawacki-Richter, O., & Latchem, C. (2018). Exploring four decades of research in *Computers & Education*. *Computers & Education*, 122(2018), 136–152. <https://doi.org/10.1016/j.compedu.2018.04.001>