ASSESSING PRE-SERVICE TEACHERS' TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE SELF-EFFICACY TOWARDS TECHNOLOGY INTEGRATION IN COLLEGES OF EDUCATION IN SOUTH-WEST NIGERIA

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Abstract
*This study is a comparative investigation of pre-service teachers' technological pedagogical content knowledge (TPACK) self-efficacy towards technology integration. The study employed a descriptive survey research design. A multistage sampling technique was used to obtain the sample, which comprised of 603 NCE II pre-service teachers from south west colleges of education, Nigeria. TPACK self-efficacy questionnaire (**TPACK-SQ**) instrument was used to collect data on pre-service perceived self-efficacy. This instrument consisted of 42 items which was used to measure the 7 TPACK knowledge constructs (technology knowledge, content knowledge, pedagogy knowledge, pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge). The reliability of the instrument was determined using Cronbach Alpha formula within the ranges of 0.71 to 0.86. Mean, Standard Deviation and independent samples t-test were used to analyze the data. The data collected revealed significant difference in technology knowledge (t = 2.431, p = .015)and technological pedagogical content knowledge (t = -2.072, p = .039) self-efficacy. Based on the findings, it was recommended that TPACK framework should be used as a tool to aid effective technology integration and assessment of teachers' knowledge so as to improve teacher education curriculums and build higher self-efficacy in pre-service teachers.*

Keywords: *Technology integration, TPACK framework, Self-efficacy, Pre-service teachers, Teacher education*

Introduction

Technology advancement in the 21st century has remarkably changed the teaching and learning systems thereby given rise to various content and pedagogical approaches influenced by technology. Globally, educators and learners depend on these new technologies as a source of getting information and staying connected. According to Nsofor and Bello (2015), emerging technological trends has made students digitally literate and created more learning opportunities for them to explore. The current and frequent emergence of these technologies has changed the face of education especially in the way teaching and learning are experienced, which has put both the teachers and the students in the context of continuous learning.

Mediums and practices of instruction has also changed, clearly subjecting the teachers to new digital technologies which are unfamiliar to them. This change continued in such a way that technology is now viewed as instructional medium not as content only(Koehler & Mishra, 2009; Mishra & Koehler, 2006). Consequently, teachers are left with no other choice but to acquire new skills in order to meet up with the demands of this technology integrated environments.

Moreover, in developed countries, as technology advances, teachers are eager to explore and integrate technologies as they consistently create new technological oriented ways of pedagogy. On the contrary, some of the teachers are intimidated by the advent of technology. Some maintain an unwelcoming attitude towards the adaptation of technology as they consider it irrelevant for their use in teaching because of its changing and opaque nature compared to other traditional pedagogical approaches (Ramorola, 2013).This advancement has led to so many researches, development and inquiries on the most beneficial ways technology can be understood and incorporated by teachers, stakeholders, and policy makers towards effective teaching and learning (Abanobi & Abanobi, 2017; Ramorola, 2013; Nsofor & Bello, 2015).

For effective teaching and learning, there must be integration of technology. However, effective and efficient integration of technology cannot be achieved until the teachers begin to change their mindsets positively towards the use of technology in their daily educational activities (Chukwuemeka & Iscioglu, 2016). This goes beyond the knowledge of the technology equipment provided through pedagogical theories and teacher education courses, but a student-centered kind of knowledge needed for meaningful learning in conjunction with integration of technology. This kind of knowledge can only happen by the awareness of the individual teacher who can rethink technology in vision to developing new paradigms so as to serve as a model to colleagues or coach to students (Nsofor & Bello, 2015). Technology integration is bringing together or combining technology with teaching and learning strategies in order to meet the curriculum standards and learning outcomes of each lesson, unit, or activity. Technology integration is the amalgamation of ICTs into the whole structure of the school system, which enables the teacher success towards the achievement of the teacher education goals (Ramorola, 2013). Therefore, more of technology integration embraced by teacher education will yield positives impacts on the pre-service teacher.

In a bid to embrace these advancement, the Federal Government of Nigeria (FGN) through its National Policy on Education, had highlighted key goals towards the development of the pre-service teacher. These goals as stated in section 71 of the FGN national policy on education (Abanobi & Abanobi, 2017), encourages the provision of highly motivated conscientious and efficient classroom teachers for all level of our educational system, developing the spirit of enquiry and creativity in teachers, helping teachers to fit into the social life of the community and society at large and enhancing their commitment to the national goals, providing teachers with the intellectual and professional background adequate for their assignment and making them adaptable to changing situations, and enhancing teachers' commitment to the teaching profession (Abanobi & Abanobi, 2017). For these goals to be achieved, the Colleges of Education as one of the pillars of tertiary educations in Nigeria has been saddled with the primary responsibility of teacher education.

Teacher education is a programme that is related to the development of teacher proficiency and competence that would enable and empower the pre-service teacher to meet the requirements of the profession and face the challenges therein (Abanobi & Abanobi, 2017). A pre-service teacher is a student teacher in training to become a teacher. Pre-service teacher education is a programme that systematically mentors the student into the teaching role either in primary or post primary levels. Therefore, through teacher education pre-service teachers are to be trained to understand the continuous changes that technology is making to his or her environment and to acquire the skill and knowledge of technology integration (Aina, 2013; Harris *et al.*, 2017).

For this to be achieved, the teacher education programme is required to have the capacity to pass on Technological Pedagogical Content Knowledge (TPACK) to the pre-service teachers. Technological Pedagogical Content Knowledge is the knowledge required by teachers towards the integration of technology with content and pedagogy. Mishra and Koehler, (2006) defined TPACK as a way of thinking about the knowledge teachers need to understand to integrate technology effectively in their classrooms. Koh, Chai, and Tsai (2013) viewed TPACK as a theoretical framework that describes teachers' expertise for information and communication integration. Jang and Tsai (2013) defined TPACK as a consolidated knowledge system that promotes students learning. TPACK therefore, is a framework for describing and assessing teachers' knowledge levels required for effective technology integration in teaching and learning.

The concept of TPACK framework revealed seven knowledge constructs that will aid teacher education programme to efficiently and effectively integrate technology (Koehler & Mishra, 2009). These includes; Technological Knowledge (TK) which is the knowledge of technology tools such as computers, projectors, interactive white boards, the internet, educational and productivity hardware and software; Content knowledge (CK) is the knowledge a teacher has about a particular subject area(s) and Pedagogical Knowledge (PK) is the knowledge of teaching methods, practices, strategies and processes of teaching. The intersection of these three knowledge constructs gave rise to additional four knowledge constructs of the new and burgeoning areas of educational technology research today (Kazu & Erten, 2014; Koh *et al*., 2013). These additional four knowledge constructs are:

Pedagogical Content Knowledge (PCK) is the knowledge of methods and practices for representing or communicating content knowledge; Technological Content Knowledge (TCK) is the knowledge of how to use technology tools to represent and interpret content knowledge (any content area or subject matter); Technological Pedagogical Knowledge (TPK) is the knowledge of how to use technology to implement or adopt different pedagogical methods and Technological Pedagogical Content Knowledge (TPACK)is the knowledge of how to teach any content area with pedagogy using appropriate technology. It is the knowledge, which arises from the synthesizing of technology, pedagogy, and content knowledge. Figure 1 illustrates the intersection and synchronization of these knowledge constructs.

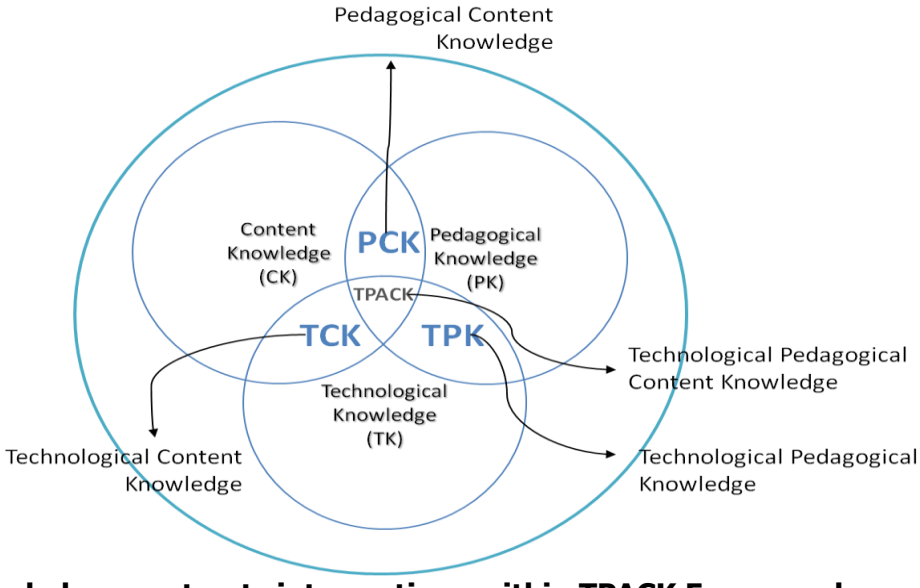

Figure 1: Knowledge constructs intersections within TPACK Framework

Since pre-service teachers are the future teachers and bedrock of the educational system, investigating their self-efficacy will help ascertain to what extent the teacher education programme has affected their technology integration as well as their general knowledge.

Statement of the Research Problem

There have been a concentration on the development of pedagogy and content knowledge as it concerns teacher development programme (Aina, 2013; Harris *et al.*, 2017). However, the emergency of instructional technologies has placed a demand on the need for technology knowledge. Abanobi and Abanobi (2017), emphasizes the need for pre-service teacher development so as to be adaptable to the various technological changes in teaching and learning. Amosun, Falade and Falade (2015) posits that the teacher training program and development in Nigeria is currently facing numerous challenges of which the problem of technology integration is major amongst many. The gap still exists that teachers are not trained to think about teaching and learning as an interactive process that encourages the use of technology, thereby lacking the technology integration know-how which agrees with Amosun *et al.* (2015) observation about south-west pre-service teachers' ICT knowledge and attitudes.

This gap has deepened since there is no clear understanding of what constitutes the knowledge required for technology integration thereby hindering the ICT knowledge advancement in Nigeria through poor development training programme. For this reason, it is imperative for colleges of education and the pre-service teacher to understand, assess, and expand their knowledge levels so as to effectively think, improve and apply technology in teaching and learning processes.

Thus, this study draws upon the TPACK framework conceptualization proposed by the Koehler and Mishra (2009) as a theoretical framework to describe and measure the knowledge constructs needed by teachers to effectively integrate technology in instruction. Hence, the need to investigate technological pedagogical content knowledge (TPACK) self-efficacy towards technology integration in instruction among pre-service teachers in South-West Colleges of Education, Nigeria.

Research Questions

i. What is the Technological Pedagogical Content Knowledge self-efficacy level of pre-service teachers in Colleges of Education in South West Nigeria?
ii. Is there any difference in Technological Pedagogical Content Knowledge (TPACK) self-efficacy of Federal and State pre-service teachers in Colleges of Education in South West Nigeria?

Research Hypotheses

HO_1: There is no significant difference in Technological Pedagogical Content Knowledge (TPACK) self-efficacy of Federal and State pre-service teachers in Colleges of Education in South West Nigeria.

Methodology

This study employed descriptive survey research design. The population of the study comprised of pre-service teachers in south-west colleges of education, Nigeria. The samples consisted of 603 NCE II pre-service teachers from six out of eleven colleges of education selected through multistage sampling method. Clustered sampling was used to select 54% of the sample from Federal Colleges of Education while 46% from State Colleges of Education while male and

females were selected through the purposive random administration of online questionnaires using general class courses.

The instrument used for this study was adapted and modified to Technological Pedagogical Content Knowledge Self-Efficacy Questionnaire (TPACK-SQ instrument) for the Nigeria pre-service teachers after thorough review of the first TPACK survey instrument developed by Schmidt *et al.*, (2009) and similar adaptations by other researches (Kazu & Erten, 2014; Schmidt *et al.*, 2009; and Koh *et al.*, 2013). The questionnaire contained demographic section and seven section (six items each) which are structured in a five-point scale of strongly agree (5), agree (4), neither agree or disagree (3), disagree (2) and strongly disagree (1), which elicited responses on technology, content, pedagogy knowledge and four other knowledge constructs. The cutoff point response of above 3.00 was considered as "Agree" (high level efficacy), 3.00 was regarded as moderate level, and while a mean response of below 3.00 was considered as "Disagree" (low level efficacy) (Kazu & Erten, 2014). The reliability of the research instrument was determined using Cronbach Alpha formula and found reliable ranges from 0.71 – 0.86. The overall reliability of the TPACK-SQ instrument was 0.79. In accordance with Hinton *et al.* (2014) reliability results of 0.70 and above should be considered as high reliability. The data gathered from the administration of the research instruments were analyzed using Mean, Standard Deviation and independent sample t-test and the significance of hypothesis was ascertained at 0.05 alpha level.

Results

Research Question 1: What is the Technological Pedagogical Content Knowledge self-efficacy level of pre-service teachers in Colleges of Education in South West Nigeria?

In answering research question 1, the researcher presented the mean and standard deviation statistics of 603 pre-service teachers from Federal and State colleges of education in Table 1.

Table 1: Mean and Standard Deviation of pre-service teachers' Technological Pedagogical Content Knowledge Self-efficacy

Constructs	Group	N	Mean ($\bar{X}$)	SD	Remarks
Technology Knowledge	Federal	323	3.05	.698	High
	State	280	2.90	.749	Low
Content Knowledge	Federal	323	3.69	.639	High
	State	280	3.63	.613	High
Pedagogical Knowledge	Federal	323	3.72	.647	High
	State	280	3.70	.563	High
Pedagogical Content Knowledge	Federal	323	3.73	.627	High
	State	280	3.72	.484	High
Technological Content Knowledge	Federal	323	2.94	1.015	Low
	State	280	2.97	.956	Low
Technological Pedagogical Knowledge	Federal	323	2.93	.996	Low
	State	280	3.01	.963	High
Technological Pedagogical Content Knowledge	Federal	323	2.84	.985	Low
	State	280	3.00	.937	Moderate

Table 1 result revealed mean responses of the federal and state pre-service teachers self-efficacy respectively as follows; technology knowledge Federal ($\bar{X}$= 3.05, *SD* = *.698)*, State ($\bar{X}$ = 2.90, *SD = .749)*; content knowledge Federal($\bar{X}$= 3.69, *SD = .639)*, State ($\bar{X}$ = 3.63, *SD = .613)*; pedagogical knowledge Federal($\bar{X}$= 3.72, *SD = .647)*, State($\bar{X}$ = 3.70, *SD = .563)*;

pedagogical content knowledge Federal($\bar{X}$= 3.73, *SD* = .627), State ($\bar{X}$ *= 3.72, SD = .484)*; technological content knowledge Federal($\bar{X}$ *= 2.94, SD = 1.015)*, State *($\bar{X}$ = 2.97, SD = .956);* technological pedagogical knowledge Federal ($\bar{X}$= 2.93, *SD = .996)*, State($\bar{X}$ = 3.01, *SD = .963)*and technological pedagogical content knowledge Federal *($\bar{X}$ = 2.84, SD = .985)*; State *($\bar{X}$ = 3.00, SD = .937)*.This implies that the pre-service teachers from federal colleges of education perceived to have high self-efficacy of their technology, content, pedagogical, pedagogical content knowledge while they perceived low of their technological content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge self-efficacy towards technology integration in teacher education programme. The state pre-service teachers perceived high self-efficacy of content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK) and technological pedagogical knowledge (TCK) while they perceived low of technology knowledge (TK) and technological content knowledge (TCK) self-efficacy towards technology integration in teacher education programme. Meanwhile, technological pedagogical content knowledge (TPACK) self-efficacy was perceived as moderate.

Research Question 2: Is there any difference in Technological Pedagogical Content Knowledge (TPACK) self-efficacy of Federal and State pre-service teachers in Colleges of Education in South West Nigeria?
To answer this question a null hypothesis was formulated. Thus, there is no significant difference in Technological Pedagogical Content Knowledge (TPACK) self-efficacy of Federal and State pre-service teachers in Colleges of Education in South West Nigeria.

To determine whether there was significant difference in the self-efficacy of pre-service teachers according to college type – federal and state, Independent samples t-test was conducted as shown in Table 2.

Table 2. Independent samples T-Test of TPACK Constructs and College Type

Source	Constructs (T)	*t*	Sig. (p)	Mean Difference
College type	Technology Knowledge	2.431	.015*	0.143
	Content Knowledge	1.087	.278	0.056
	Pedagogical Knowledge	0.363	.717	0.018
	Pedagogical Content Knowledge	0.215	.830	0.010
	Technological Content Knowledge	-0.410	.682	-0.033
	Technological Pedagogical Knowledge	-1.022	.307	-0.082
	Technological Pedagogical Content Knowledge	-2.072	.039*	-0.163

**p<0.05(2-tailed)*

An examination of Table 2revealed significant difference at Technology Knowledge (t = 2.431, p = .015) and Technological Pedagogical Content Knowledge (t = -2.072, p = .039) which indicates that the Means of the federal and state pre-service teachers were statistically different in technology knowledge and technology pedagogical knowledge. There was no significant difference between groups in content knowledge (t = 1.087, p = .278), pedagogical knowledge (t = 0.363, p = .717), pedagogical content knowledge (t = 0.215, p = .830), technological content knowledge (t = -0.410, p = .628) and technological pedagogical knowledge (t = -1.022, p = .307) this implies that the difference between group means is by chance as p value was greater than 0.05. Thus, the null hypotheses was rejected.

Further analysis within each groups using the mean and standard deviation statistics obtained in Table 1, showed that the Technology Knowledge self-efficacy mean of federal pre-service teachers ($\bar{X}$= 3.05, *SD* = .698) was higher than state pre-service teachers($\bar{X}$= 2.90, *SD* = .749). The follow up analysis for group wise comparison indicated that the mean scores of pre-service teachers (federal, *M* = 2.84, *SD* =.985) and (state, *M* = 3.00, *SD* = .937) on technological pedagogical content knowledge self-efficacy were significantly different in favour of pre-service teachers from state colleges of education.

Thus, the federal pre-service teachers' perception of technological knowledge self-efficacy was significantly higher than the state pre-service teachers while the state pre-service teachers' perception of technological pedagogical content knowledge self-efficacy was significantly higher than the federal pre-service teachers.

Discussion

Findings from this study showed that the pre-service teachers from federal colleges of education had high self-efficacy level of technology knowledge (TK) which implies that they have sufficient opportunities to work with different technologies, know how to use technologies like Moodle, Articulate storyline, Adobe e-learning suite, Sakai CLE, blackboard learn efficiently and effectively, setup new training technologies on their own, solve their own technical problems encountered when using technologies, create technologies for learning and teaching using other technologies such as web page, forums, PowerPoint and also can use social media like Blog, Wiki, Facebook. Thus, this is the criteria for possessing TK as highlighted by Koehler and Mishra (2009). Therefore, we can conclude that federal pre-service teachers see themselves as highly sufficient for technology knowledge in agreement with Kazu and Erten (2014). AlthoughKazu and Erten (2014), went further to argue that the teachers do not have enough opportunities to use technology knowledge which is not the same for federal colleges of education in this study.

However the teacher training programme has not be able to create the required technological content knowledge, technological pedagogical knowledge and technological pedagogical content knowledge self-efficacy towards technology integration in teacher education programme (Amosun *et al.*, 2015). Thus, the reason for federal pre-service teachers' low self-efficacy.

Findings from this study showed that the pre-service teachers from state colleges of education have high self-efficacy content knowledge, pedagogical knowledge, and pedagogical content knowledge. This is an indication that the pre-service teachers had a full grasp of knowledge of their subject matters, teaching strategies and general classroom management skills and the use of these teaching strategies to convey subjects. This shows that the teacher education training programme meet the requirement on content, pedagogy and pedagogical content knowledge.

Although the state pre-service teachers' technological pedagogical content knowledge self-efficacy was moderate, teacher education training programme has not been able to create the required technology knowledge, technological content knowledge and technological pedagogical knowledge as their self-efficacy towards technology integration in teacher education programme was found to be low. Thus, the reason for state pre-service teachers' low self-efficacy. This is in agreement with Kazu and Erten (2014), although they went further to argue that the teachers do not have enough opportunities to use technology knowledge which is the same situation for state colleges of education.

Further findings on the content knowledge, pedagogical knowledge, and pedagogical content knowledge showed that federal and state pre-service teachers had a full grasp of knowledge of their subject matters, knowledge on teaching strategies and general classroom management skills and knowledge on how to use these teaching strategies to convey subjects. This is in consonance with the findings of Kazu and Erten (2014).

Conclusion

Conclusively the study, revealed that the pre-service teachers from the federal colleges of education perceived higher TPACK self-efficacy in the following knowledge constructs; technology knowledge, content knowledge, pedagogical knowledge, and pedagogical content knowledge than those from the state. On the other hand, the pre-service teachers from the state colleges of education perceived higher TPACK self-efficacy in technological content knowledge and technological pedagogical knowledge and technological pedagogical content knowledge constructs.

The colleges of education being saddled with the responsibility of training teachers for basic education programme have done reasonably well in impacting the pre-service teachers with the right content and pedagogical knowledge. However, the curriculum has not been able to embrace the practical aspect of technology pedagogical content knowledge as to affect the pre-service teachers' knowledge on the interactions of technology with content and pedagogy individually.

In addition, the TPACK framework was able to expose the short falls in technology knowledge and other knowledge areas that synthesized with technology knowledge such as technological content knowledge and technological pedagogical knowledge and technological pedagogical content knowledge.

Recommendations

The study therefore recommends as follows:

(i) The increasing emergence of technologies has led to the increasing demand for the incorporation of technology in education. To this, the stakeholders and policy makers of federal and state colleges of education should be informed so as to provide technological infrastructure and curriculum reforms in line with the development and changes in information and communication technologies which will aid in building higher self-efficacy in the pre-service teachers.

(ii) The TPACK framework can also be adopted for periodical assessment and professional development of the in-service teachers' technological pedagogical content knowledge and to keep them informed of current issues regarding technology integration because it is their image that is seen in the quality of the pre-service teachers.

(iii) Practical aspects of TPACK can be carried out using experimental research method as to determine the attitudes and competency level of teachers towards technology integration.

(iv) Researches on TPACK and Specific Subject matter are new areas of research to be considered. For example TPACK and Genetics, TPACK and Mathematics, TPACK and Chemistry, as this will help teachers understand technologies and technological pedagogies needed specifically to convey such subject matter.

(v) The researchers encourages that more researches on TPACK should be carried out in the African/Nigerian context towards the development of our teacher education training programme as there are limited research works and empirical studies in this area.

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