

## **Differences in Technological Pedagogical Content Knowledge Between Experienced and Less Experienced Computer Teachers in Ogun State, Nigeria**

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*(Received: 11<sup>th</sup> November 2023; Accepted: 3<sup>rd</sup> June 2024; Published online: 26<sup>th</sup> July 2024)*

### **Abstract**

This study assessed differences in technological pedagogical content knowledge (TPACK) between experienced and less experienced computer studies teachers in Ogun State, Nigeria. Three research questions were used in the survey research, with a total number of two hundred (200) respondents, using multistage sampling technique. The instrument used was an adapted test scale measuring technological pedagogical knowledge (TPK), technological content knowledge (TCK) and technological pedagogical content knowledge (TPACK). It is divided into two sections with a reliability coefficient value of 0.78, 0.72 and 0.71 respectively, while data was analysed with t-test statistical method. The study revealed no significant difference in the technological pedagogical knowledge (TPK) between experienced and less experienced computer teachers ( $t = 0.346, P > 0.05$ ), significant difference in the technological content knowledge (TCK) between experienced and less experienced computer teachers ( $t = 2.423, P < 0.05$ ) and significant difference in the technological pedagogical content knowledge (TPACK) between experienced and less experienced computer teachers ( $t = 1.306, P < 0.05$ ). In the recommendation, professional development in terms of continuous workshop, in-service training and seminar should be constantly organised for both experienced and less experienced secondary school computer teachers in Ogun State for improved TPK. Also, in-service training and seminar should be constantly provided for less experienced computer teachers in Ogun State for improved TCK and TPACK.

**Keywords:** *TPACK, ICT, In-Service Teachers, Teacher Education, Teaching Experience.*

## INTRODUCTION

The standard of education in any country depends on many factors in which teachers are one of the important parts. To buttress this statement, the Federal Republic of Nigeria (2013) in her National Policy on Education stipulates that no nation can develop more than the quality of its teachers. For teachers to be successful in their career, especially in 21st century where digitisation is revolutionising the world, teachers need to improve their technology, pedagogy and content competencies (Thomas, 2021). The challenge to respond skillfully to this call is highly demanding as teachers are expected to think beyond the box in order to transform their existing classroom practices. In order to integrate information communication technologies (ICTs) with appropriate pedagogy, teachers must show right attitude, be a creative thinker, pay attention to emerging educational technologies and importance of professional development.

In Nigeria, computer is one of the core subjects in Basic Education Classes, a subject in West African Senior School Certificate Examination (WASSCE) and Senior School Certificate Examination (NECO). As a result of this importance, the curriculum of computer education is designed to prepare teachers with basic pedagogy, content and technology competencies to enhance students' learning outcomes. Like other teacher education programmes, in-service computer teachers are considered to have been adequately prepared with required competencies to enhance students' learning outcomes. Ojo (2023) observed that despite the relationship of information technology (IT) with computer technology, some computer teachers are still struggling to understand its integration with pedagogical practices. Therefore, it's arguable if computer teachers in Nigeria really understand how to combine IT with pedagogy and content; and perhaps, the difference in years of teaching has significant impact on their possession of technology pedagogy content knowledge (TPACK).

Classroom instruction, including computer lesson is now characterised by a number of instructional technologies designed to improve efficient instructional delivery and support students' performance (Bosh, 2019). Today, effective instructional delivery is not dependent solely on the content and pedagogical knowledge of the tutor, but the skills to use all manners of traditional and emerging technologies such as computer, smartboard, artificial intelligence, virtual reality, augmented reality, internet of things, 3-D printing, smart classroom, wearable technologies, cloud computing, gamification, online bulletin board, interactive video, multimedia projector, iPod, iPad, audio conferencing, video conferencing, learning management systems, synchronous/asynchronous e-learning, assistive technologies, adaptive technologies, mobile and blended learning. Effective use of instructional media to a large extent has significant reciprocal relationship with learning of subjects in schools (Roy, 2020; Lung, 2023). Objectively, educational technology should provide teachers opportunities for increased creativity skills, problem solving skills, innovative thinking, collaborative skills, communication skills, information technology literacy; thus, school administrators should encourage their teachers to apply principles and practices of educational technology.

The adoption of digital learning technologies has placed new responsibilities on teachers, including computer teachers who must acquire the ability to develop and implement technology-driven lessons that support students' potentials for global citizenship (Sunderling & Monica, 2018). Good enough, the advancement in instructional technologies has contributed to the development of a conceptual framework that lays out the skills teachers should possess to utilise technology meaningfully in instructional process (Koehler et al., 2014). Technological Pedagogical Content Knowledge (TPACK) describes the understanding needed for teachers to effectively teach with technology. This structure emphasises the interactions between content, pedagogy and technology obtained from Shulman's (1987) technology pedagogical content knowledge concept. The three

domains of TPACK are of equal importance and interdependent in lesson delivery, especially in the 21st century smart classrooms.

Since introduction of TPACK, teacher educators and educational technology experts welcome the technological pedagogical content knowledge framework as a tool for integrating technology meaningfully in teacher education (Chai et al., 2013; Kay, 2023). Researchers have explored approaches for adopting TPACK in order to equip teachers with knowledge, skill and attitude related to effective technology integration (Toy & Simeon, 2018). Basret and Pretti (2019) noted that TPACK may help educators understand greatly the contribution of new learning technologies in education. TPACK framework can be used to assess how teachers' professional development significantly influence their performance in the classroom with the use of information technologies. An innovative instructional system designer (ISD) often strives to mix technology with methods and content while planning instructional activities (Harris, 2023). The added value of TPACK can be found in the support it provides for teachers through technology in education and technology of education (Wonderson & Damtel, 2020).

There are seven elements of TPACK teacher education focuses on and these range from: technological knowledge (TK); content knowledge (CK); pedagogical knowledge (PK); pedagogical content knowledge (PCK); technological content knowledge (TCK); technological pedagogical knowledge (TPK); and technological pedagogical content knowledge (TPACK). This study is interested in only three elements of TPACK: technology and pedagogy; technology and content and; technological, pedagogical and content knowledge because of the importance of educational technology in teacher training and development.

Technological Pedagogical Knowledge (TPK) is teachers' understanding how various educational technologies can be applied in teaching and understanding that using technologies may change learners' academic achievement and attitude positively. Washington (2024) hinted that a creative teacher understands the benefits of integrating technologies with robust methods for effective instructional delivery. It is about teachers' understanding how to combine innovative technologies with various instructional strategies to achieve predetermined objectives. In other word, it connotes understanding specific technological devices to combine with the appropriate teaching methods to achieve specified instructional objectives. In its own, technological content knowledge (TCK) is understanding how to utilise educational technologies within a specific content area, e.g using spreadsheet to present accounting data. It is teachers' understanding of various educational technologies and ability to select wisely or combine them with the subject matter to learn. In other words, it is balancing of technology with curriculum contents, concepts, syllabuses, topics and sub-topics. Technological pedagogical content Knowledge (TPACK) is teachers' understanding the interactions among technology, pedagogy and content. It is teachers' skills to combine appropriate technology with specific instructional strategy and content. In instructional process, it is not only how you teach (pedagogy) and what you teach (content) but the instructional technologies combined for smooth delivery (Zar, 2018). It has been established in several studies such as Chai et al. (2013), Ratten and Raper (2020) and Dalman (2024) that teachers' level of TPACK significantly influenced students' academic performance.

Researchers in educational technology have explored teachers' demographic factors such as age, gender, teaching experience, information technology expertise and their significant relationship with TPACK. Teaching experience is a factor that generally affects teachers' performance and that has been empirically established in studies. Teaching experience is accumulation of pedagogy experiences, instructional orientations, competencies, knowledge, skills and exposure obtained by

teachers over time through constant practices. Teacher experience can enhance students' performance in the ways they display technological, pedagogy and subject matter. In most study, an experienced teacher is one with 10 years and above practice while a less experienced teacher has only spent less than 10 years practice in the classroom. Adeyemi (2019), in a study found significant correlation between years of teaching experience and teaching competency by teachers. The study found that teachers who have spent 10 years above showed excellent competency than teachers with less than 10 years teaching experience. Balogun (2021), in a study examined relationship of teaching experience and teachers' creativity and found that experienced teachers displayed significant creativity skills than less experienced teachers.

Cullen and Faren (2019) examined Bulgarian Pre-Service Teachers' TPACK level and findings revealed pre-service teachers are slightly above average in each element of TPACK. However, the study did not examine impact of pre-service teachers' teaching experience on TPACK elements. Brown (2023), in a survey of teachers' boldness in the use of TPACK found no significant difference in boldness between experienced and less experienced teachers in technology related knowledge based such as TK, TPK, TCK and TPACK. Hew (2024), in a study on influence of teacher factor on information communication technology (ICT) use in the classroom found no significant difference in the use of ICT related knowledge between experienced and less experienced teachers. In the study, both categories of teachers showed almost similar understanding in using technology to manage classroom, drive instructional activities and evaluate lesson.

Hut (2023), in a study of TPACK' confidence among elementary science teachers found that experienced elementary science teachers had higher rating in TPK and TCK than less experienced teachers. Lawless et al. (2024), in another study reported significant difference between experienced and less experienced teachers in the use of information technology to develop lesson plan, content and learning experiences. Experienced teachers were able to use IT with pedagogy and content significantly better than less experienced teachers because of professional development on the use of emerging technologies. Richy (2023) examined level of TPACK acceptance among science teachers and found experienced secondary science teachers had significantly higher level of acceptance in TPK, TCK and TPACK compared to less experienced teachers. Chen (2024) similarly found significant difference between experienced and less experienced teachers in effective implementation of ICT-driven lesson, ICT- developed content, media and lesson delivery. Studies have highlighted factors influencing teachers' adoption of TPACK but none was directed towards influence of teaching experience variable on in-service teachers' TPACK.

It is noted from literature that technological pedagogical content knowledge (TPACK) framework provides understanding of interactions between technological, pedagogical and content knowledge to improve teacher education. It should be noted carefully that with the emergence of a number of digital teaching-learning technologies the traditional learning methods need to be changed to the use of innovative strategies. Even with significant contribution of information technology (IT) to teaching-learning, most studies conducted focused on pre-service teachers' pedagogical knowledge (PK) and content knowledge (CK) in isolation; without looking at the combination of technology with pedagogy knowledge (TPK), technology with content knowledge (TCK) and technology with pedagogy and content knowledge (TPACK) which is the global framework for the 21st century teacher training. Also, few studies if existed at all have examined possibility of significant difference in possession of TPACK by computer teachers based on year of teaching experience. Therefore, this study aims to assess if there is significant difference in possession of technological pedagogical knowledge (TPK), technological content knowledge (TCK) and technological pedagogical content

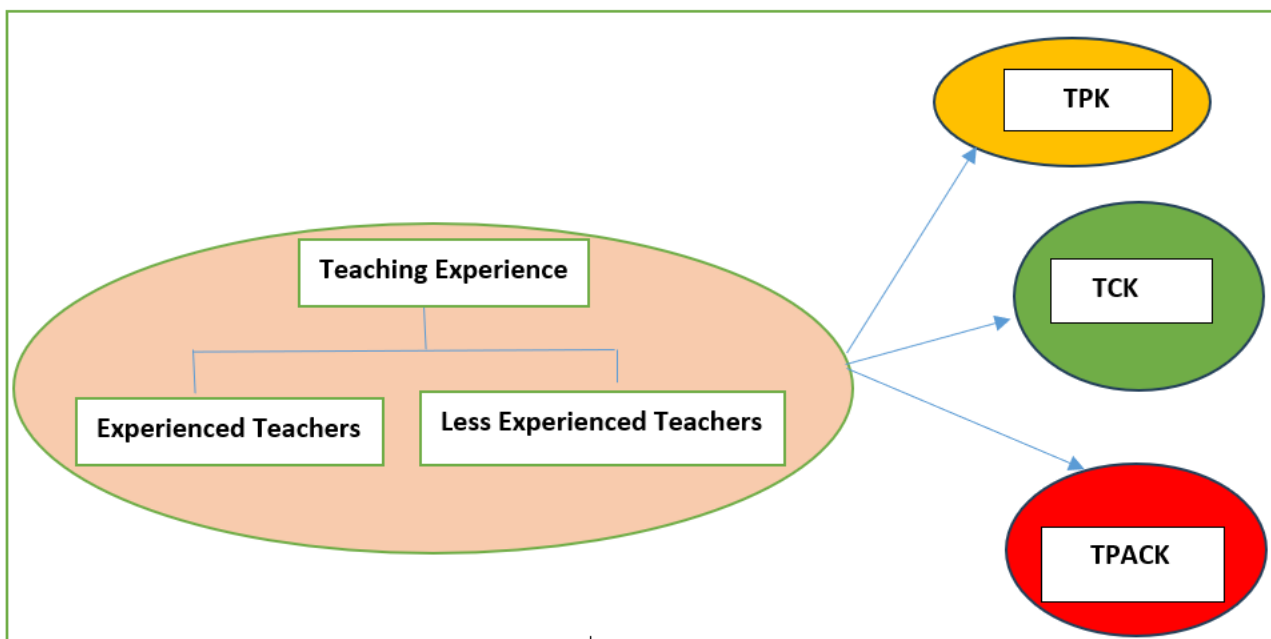
knowledge (TPACK) between experienced and less experienced in-service computer teachers in Ogun State, Nigeria.

**Theoretical framework**

This study is deep-seated on Koehler et al. (2014) TPACK model which is a structure that introduces the relationship between three basic components: technology, pedagogy and content knowledge. TPACK is understanding about how to combine information technology, pedagogy, and content for specified learners in ways that show the added values provided by educational technology (Philips & Stunt, 2023). Undoubtedly, information technology will provide teachers opportunities for collaborative, problem solving, social, critical thinking, creative thinking, media literacy, cultural competence, communication, and interactive skills that would assist them to deliver excellently in 21st century classrooms. In the past, teaching used to focus on pedagogy and content knowledge, but with the advancement in information technology, teacher education now lays emphasis on how appropriate instructional technologies can be matched with specific instructional strategy and content by teachers to facilitate worthwhile learning outcomes. Technology is unexceptional of any pedagogy, obviously the success of any technology-driven pedagogy is largely dependent on the choice of technology and its implementation. Therefore, computer teachers should leverage on the use of cutting-edge technologies to support other teaching skills for all round development of their potentials.

**Figure 1**

*Conceptual framework for the study*



Note : TPK = Technological Pedagogical Knowledge, TCK= Technological Content Knowledge , TPACK = Technological Pedagogical Content Knowledge

## **OBJECTIVE OF THE STUDY**

This study seeks to:

- 1) assess differences in technological pedagogical knowledge (TPK) between experienced and less experienced computer teachers in Ogun State.
- (ii) assess differences in technological content knowledge (TCK) between experienced and less experienced computer teachers in Ogun State.
- (iii) assess differences in technological pedagogical content knowledge (TPACK) between experienced and less experienced computer teachers in Ogun State.

## **METHODOLOGY**

### **Research Design**

The research design employed for the study is purely a survey design type with the aim of examining differences in TPK, TCK and TPACK between experienced and less experienced computer teachers in Ogun State, Nigeria.

### **Target Population**

The population of the study consists of all in-service computer studies teachers of public secondary schools in Ogun State, Southwest Nigeria. This is the entire group that the researchers are analysing, while the sample is usually drawn from the target population for the purpose of generalization.

### **Sample and Sampling Technique**

Two hundred (200) computer studies teachers constitute the sample for the study. Multistage sampling technique was employed. At the first stage, ten (50%) out of the twenty local government areas of Ogun State were selected through proportional sampling method. At the second stage, in each of the ten selected local government areas (LGAs) five public secondary schools were randomly selected, making a total number of fifty (50) schools. At the third stage, in each of the selected schools, four professionally qualified computer studies teachers were purposively selected making a total number of two hundred (200) respondents.

### **Instrumentation**

An Adapted Technological Pedagogical and Content Knowledge Scale (TPACKS) from Ride and Peter (2018) was used to collect data for the study. The instrument has two sections, section A and B. Section A contains information on teachers' demography such as years of teaching experience, which is interpreted as less than 10 years and above 10 years. Section B is sub-divided into three; (a) contains 20 items on fundamentals of integrating technological and pedagogical knowledge, (b) contains 20 items on fundamentals of integrating technological and computer content knowledge and (c) contains 20 items on fundamental of combining technological pedagogical and content knowledge of computer studies. All the items were in the form of objective test questions with four options

each. Each question has a correct answer with three other distracters. The questions were subjected to item analysis, and out of 90 items initially developed they were reduced to 20 each in the sub-scales based on those that survived or discriminated positively. For construct validity, the instrument was given to experts in educational evaluation and computer science education. Sample of the instrument was administered on 30 computer studies teachers who were not part of the main study but have homogenous characteristics with the selected teachers. Split-half method was used to determine the reliability coefficient of the instrument which gave values of 0.78, 0.72 and 0.71 respectively.

### Method of Data Collection

The researchers and research assistants administered the instruments directly to the selected teachers by visiting them in their respective offices in each selected school. Ethically, the respondents were assured of confidentiality of their identity in order to get objective response. The selected teachers provided their appropriate responses to the items in the instrument and were instantly collected for further processing.

### Method of Data Analysis

Data collected from the instrument was analysed with inferential statistics of *t*-test. A *t*-test is a statistical method that is used to determine if there is statistically significant difference between the means of two variables.

## RESULTS

### Differences in the Technological Pedagogical Knowledge (TPK) Between Experienced and Less Experienced Computer Teachers in Ogun State

**Table 1**

*T*-test Analysis of Significant Difference in the Technological Pedagogical Knowledge (TPK) between Experienced and Less Experienced In-service Computer Teachers.

Teaching Experience	N	Mean	SD	Df.	t	Sig.
Experienced	152	43.98	5.895	198	0.346	0.065
Less Experienced	48	43.37	6.320			

Table one reveals a non-significant difference in the technological pedagogical knowledge between experienced and less experienced in-service computer teachers ( $t = 0.346$ ,  $P > 0.05$ ). Less experienced teachers recorded mean score of 43.37 while experienced teachers recorded mean score of 43.98 which is an indication that both category of teachers possessed almost similar TPK.

**Differences in the Technological Content Knowledge (TCK) Between Experienced and Less Experienced Computer Teachers in Ogun State**

**Table 2**

*T-test Analysis of Significant Difference in the Technological Content Knowledge (TCK) between Experienced and Less Experienced In-service Computer Teachers*

Teaching Experience	N	Mean	SD	Df.	t	Sig.
Experienced	152	43.21	6.342	198	2.423	0.028
Less Experienced	48	26.04	4.741			

Table two reveals significant difference in the technological content knowledge between experienced and less experienced in-service computer teachers ( $t=2.423$ ,  $P < 0.05$ ). Experienced teachers recorded mean score of 43.21 while less experienced teachers recorded mean score of 26.04, meaning that experienced teachers possessed higher technological content knowledge that less experienced teachers.

**Difference in Technological Pedagogical Content Knowledge (TPACK) Between Experienced and Less Experienced Computer Teachers in Ogun State**

**Table 3**

*T-test Analysis of Significant Difference in the Technological Pedagogical Content Knowledge (TPACK) between Experienced and Less Experienced Computer Teachers*

Teaching Experience	N	Mean	SD	Df.	t	Sig.
Experienced	152	54.21	5.341	198	1.306	0.032
Less Experienced	48	32.03	4.536			

Table three reveals a significant outcome of difference in technological pedagogical content knowledge between experienced and less experienced in-service computer teachers ( $t = 1.306$ ,  $P < 0.05$ ). Also, experienced teachers recorded mean score of 54.21 while less experienced teachers recorded mean score of 32.03, meaning that experienced teachers possessed higher technological pedagogical content knowledge than less experienced teachers.

**DISCUSSIONS**

In research question one, findings of this study reveal no significant difference in the technological pedagogy knowledge (TPK) between experienced and less experienced in-service computer teachers. This finding is in consistent with Brown (2023), in a survey of teachers’ boldness in the use of TPACK which found no significant difference in boldness between experienced and less experienced teachers in technology related knowledge-based such as TK, TPK, TCK and TPACK. This finding also agrees with Hew (2024), in a study on influence of teacher factor on information communication technology



use, which found no significant difference in the use of ICT with pedagogy and content between experienced and less experienced teachers. In the study, both categories of teachers show almost similar understanding in using technology to manage classroom, drive instructional activities and evaluate lesson. The reason both possessed almost similar knowledge of technology pedagogy might be that experienced teachers do benefit from in-service training on ICT or learn it from young teachers and; they reciprocally provide adequate guidance on teaching methods to the less experienced teachers.

The study also reveals in research question two significant difference in the technological content knowledge (TCK) between experienced and less experienced in-service computer teachers. The finding is in line with the study of Hut (2023), which found that experienced elementary science teachers had higher rating in TPK and TCK confidence than less experienced teachers. Lawless et al., (2024), also reported significant difference between experienced and less experienced teachers in the use of information technology to develop lesson plan, content and worthwhile learning experiences. The reason experienced teachers possessed higher mean value in technology and content knowledge might be as a result of long-time classroom practices on principles of teaching, in-service training in ICT and they frequently use ICT with content because they are more familiar with the curriculum.

The study further reveals in research question three significant difference in the technological pedagogical content knowledge (TPACK) between experienced and less experienced in-service computer teachers. The finding is in line with Richy (2023), who examined level of TPACK acceptance among science teachers and found experienced secondary school science teachers had significantly higher level of acceptance of TPK, TCK and TPACK compared to less experienced teachers. Chen (2024), also found significant difference between experienced and less experienced teachers in ICT-driven lesson, ICT developed content, media and lesson delivery. The reason experienced teachers possessed higher technological pedagogical content knowledge might be as a result of long-time practice, frequency of in-service training on how to use ICT to present instruction and develop content.

## CONCLUSION

The increasing demand for smart classroom learning environments necessitates that teachers integrate advanced technologies into their pedagogy and content delivery. This study examined the differences in Technological Pedagogical Content Knowledge (TPACK) between experienced and less experienced in-service computer teachers in Ogun State public secondary schools. The findings reveal no significant difference in Technological Pedagogical Knowledge (TPK) between the two groups, suggesting that continuous professional development and mutual learning help bridge the gap in technological pedagogical skills. However, experienced teachers possess significantly higher Technological Content Knowledge (TCK) and Technological Pedagogical Content Knowledge (TPACK) compared to their less experienced counterparts. These differences are likely due to experienced teachers' prolonged classroom practice, familiarity with the curriculum, and frequent use of ICT in content development. These findings underscore the importance of continuous professional development and in-service training for teachers, emphasizing the need for tailored programs that enhance ICT skills and their application in pedagogy and content delivery.

Furthermore, the study highlights a critical gap in professional development opportunities for teachers in Sub-Saharan Africa, calling for urgent investment in comprehensive ICT training programs to ensure teachers can create effective and engaging learning experiences. The necessity for adopting the TPACK framework is clear, as it allows for a more integrated approach to teaching that can significantly enhance students' learning outcomes by merging technology with pedagogy and content. Additionally, fostering a collaborative environment where experienced teachers can mentor their less experienced peers can contribute to overall improvements in teaching quality. The findings

from this study serve as a call to action for policymakers to address the professional development needs of teachers, ensuring they have the necessary skills to thrive in modern educational settings and support student achievement effectively. In conclusion, while experienced teachers show greater adeptness in utilizing ICT, continuous efforts must be made to elevate the proficiency of all educators to meet the evolving demands of 21st-century education.

### **RECOMMENDATIONS**

Training makes positive difference to those who received it; thus, continuous mentorship, workshop, in-service training, and seminar should be provided for all categories of secondary school computer teachers in Ogun State in the element of technological pedagogy content understanding. Specifically, in-service trainings and seminars should be constantly organized for secondary school computer teachers in Ogun State who are less than ten years in service in order to improve their technological content knowledge like the experienced teachers. Similarly, in-service trainings and seminars should be constantly organized for secondary school computer teachers in Ogun State who are less than ten years in service to enhance their technological pedagogical content knowledge.

### **ACKNOWLEDGEMENT**

The authors thank the participants that have provided the study with valuable data. The authors also thank the anonymous reviewers who have helped the study to be significantly improved.

### **FUNDING**

There are no specific grant or funding from any agency from the public, commercial or any of the profit or non-profit organization.

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