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Science Teachers' Teaching Experience and Technological Pedagogical and Content Knowledge (Tpack) In Calabar Education Zone Of Cross River State, Nigeria

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Keywords

Science teachers, years of teaching experience, technological pedagogical and content knowledge, Calabar education zone.

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Abstract

This study examined the influence of science teachers'year of teaching experience on technological pedagogical content knowledge in Calabar Education Zone, of Cross River State, Nigeria. The independent variable is science teachers' year of teaching experience while the dependent variable is technological pedagogical content knowledge (TPACK). One research question and one null hypothesis was formulated to give direction to the study. A reliable and well validated research instrument titled "Science Teachers' Teaching Experience and Technological Pedagogical Content Knowledge Questionnaire" (STETPACK) was used for the study. The study adopted survey design and census sampling technique was used to adopt the whole population(406 respondents) as sample for the study. Mean score was used to answer the research question while the hypothesis was tested using One Way Analysis of Variance (ANOVA). The results of the analysis indicated that there is no significant influence of year of teaching experience on teachers' technological pedagogical content knowledge in public secondary schools in Calabar education zone, Cross River State. Based on the findings of the study, it was recommended amongst others that workshopand seminars should be organised regularly for secondary school teachers on TPACK to boost their integration of technology in the classroom.

Introduction

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence (Science Council, 2015). It is further explained as knowledge which covers general truth or the operation of general laws, mostly when acquired and tested by scientific method (Merriam-Webster, n.d). Science by nature is a process of discovery relying on testable ideas to produce explanation of the natural world. This process, grounded in the nature of science and scientific reasoning has resulted in the fundamental scientific principle allowing scientists to explain natural phenomena and make informed decisions.

With technology many aspect of human existence has been revolutionized and the world is fast becoming a global village. In education, technology usage is becoming very prominent in transforming the way teaching and learning take place to become technologically enhanced. Jimoyannis (2010) opined that technology integration in science education is not just a different way of presenting information, rather technology, pedagogy and content should be combined in such a way that studentsbecome active learners. Teachers require continuous effort towards efficacy in the use of technology for teaching (Ebek et al 2023). Stoic and Stoic (2013) observed that using modern technology in teaching helps students to interact better, receive information better, develop self-directed learning and achieve better.Teachers and learners now interact via technological tools and teachers with technology knowledge can comfortably integrate technology in their instructions. To effectively integrate new technologies in the classroom, teachers need to be updated with most of these ICT tools through training and support with ICT materials to become familiar with best practices for teaching with technology.

Demographic factors of teachers are characteristics that differentiate teachers or the stability of a teacher's behavior across different situation. These factors include age, gender, marital status, education qualification, years of experience and others. According, to Moses (2010) demographic variables could be used as indices to determine teacher effective teaching, adaptation and utilization of technological knowledge in teaching.

Mishra and Koehler (2008) introduced the integration of technology into Shulman (2006) PCK to bring about the interplay that exist between contentand pedagogy knowledge thereby birthing TPACK. A framework which describes three forms of knowledge namely content knowledge, pedagogy knowledge and technology knowledge.

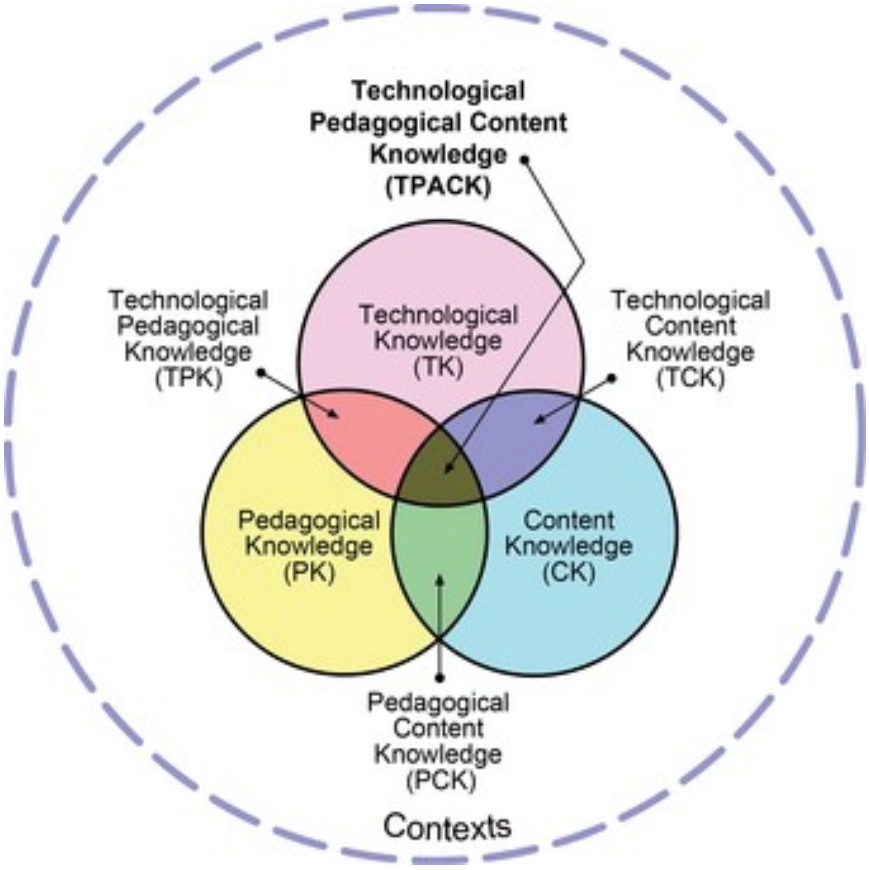


Figure 1: Technological Pedagogical and content Knowledge (TPACK)
Source: Adopted from Mishra and Kohler (2006)

Mishra and Koehler (2008) saw TPACK as the ability to master technology, pedagogy and content. TPACK, connects technology, pedagogy and content and how these could be used in the classroom (Chai et al 2017). Goradia (2018) sees TPACK as a framework for teachers to carry out 21st century's learning. The three forms of knowledge are combine and recombined to give rise to seven components within the framework; TC, PK, CK, TPK, TCK, PCK and TPACK. Kumala et al (2022) said TK is the ability to use technology to meet educational needs, PK is knowledge of methods used in the classroom to understand learners' characteristics while CK is the knowledge of materials and characteristics of content. Mishra and Koehler (2009) asserted that for a teacher to comfortably integrate technology into instruction must be competent in all three forms of knowledge within the framework.

An experienced teacher is defined by Rodniques and Mckay (2010) as a teacher who has taught for five years and above, and are able to motivate students and hold their attention, know how to manage lesson and classroom effectively and can change cause in the middle of the lesson. Bolarinwa et al (2020) affirmed that teaching experience can be measured based on the teachers' ability around comprehension and transformation of knowledge, and concept to be imparted to learners. Bolarinwa et al (2020) suggest that the most significant gains in students' performance will likely be realized when students receive instruction from teachers with good

teaching experience. Darling-Hammond (2009) sees experienced teachers as more effective than teachers with little or no experience. Ewetan and Ewetan (2015) concluded in a study that teachers teaching experience has a significant influence on students' academic performance in Mathematics and English. Adadu (2017) in a study asserted that having more teachers with more than ten years of experience in a school will result to better achievement than schools with teachers with lesser years of experience.

The present study seeks to determine the impact of teaching experience on the TPACK of science teachers in public secondary school in Calabar education zone of Cross River State, Nigeria.

Ademola et al (2021) studied the effects of teachers' factors such as education qualification and years of teaching experience on students' academic achievement, in 4 schools 2 private and 2 public secondary schools with 140 students sample and 20 teacher's sample, using descriptive design, two research instruments with internal reliability of .089 and ANOVA as the statistical tool. 3 null hypotheses and 3 research questions guided the study. The result obtained showed no significant difference between teachers' experience and students' academic achievements but there was a significant difference between teachers' qualification and students' academic achievement.

Anthony et al (2019) carried out a survey research on teachers' TPACK profile: the effect of teacher qualification and teaching experience using 40 item multiple choice instrument from Paidi&Subali (2018) on a hypothetical population in all public schools in Magelang city, central Javaand a sample of 14 high school biology teachers. Data obtained was analyzed using two-way ANOVA at 0.05 level of significance. The finding reveal that teacher qualification and teacher teaching experience have significant scores at 0.05 level of significant, implying that there was a significant effect of teachers' qualification and teaching experience on biology teachers TPACK profile.

Research Question

To what extent does teaching experience influence teachers' technological pedagogical content knowledge in public secondary schools?

Hypothesis

There is no significant influence of teaching experience on science teachers TPACK in public secondary school.

Methodology

The study area is Calabar education zone of Cross River State, Nigeria.Made up of seven (7) local government areas with 88 public secondary schools and 406 science teachers. The

research design is survey design andcensus sampling technique was used to choose the population for the study. Science teachers' teaching experience and technological pedagogical content knowledge questionnaire (STETPACK) a two-part questionnaire, wherePart A has information on teacher factor, teaching experience classified into three 5years and below, 6-10 years, and 11years and above and B part was based on 4 point Likert scale with 42 items, 7item for each TPACK component was used for collecting data. The reliability index that ranged from .78 - .83. was obtained using Cronbach Alpha after a trial test on 50 respondents who were not part of the sample. The instrument was face validated by two experts in measurement and evaluation 2 science educators from the university of Calabar. Means score was used to answer the research question while one-way analysis of variance was used to test the hypothesis.

Results

The result of the research question and hypothesis is presented on table 1 and 2at 0.05 level of significance.

RQ1- To what extent does teaching experience influence teachers' technological pedagogical content knowledge in public secondary schools?

To provide answer to this research question, mean scores were used in matching the subjects' teachers' teaching experiencewith their levels of technological pedagogical content knowledge. This was done in order to estimate the extent to which teaching experience can be influenced by science teachers' technological pedagogical content knowledge. The result was presented in Table 1. The entries in table 1shows that the mean score of science teachers with teaching experience with 11years and above (21.7083) was the highest, followed by mean score of teachers with teaching experience 6-10years (21.4615), then followed by teacher with teaching experience 5years and below (21.3736) for teachers' knowledge of technology. This imply that teachers with teaching experience 11years and above had highest knowledge of technology, followed by teachers with teaching experience 6-10years, then followed by teachers with teaching experience 5years and below.

The mean score of science teacherswith teaching experience 6-10 years (21.8410) highest, followed by mean score of teachers with teaching experience 11years and above (21.5167), then followed by teacherswith teaching experience 5years and below (21.0440) for teachers' pedagogical knowledge. This imply that teachers with teaching experience 6-10 years has the highest pedagogical knowledge, followed by teachers with teaching experience 11years and above then followed by teachers with teaching experience 5years and below.

The mean score of science teachers with teaching experience 6-10 years (21.7385) highest, followed by mean score of teacherswith teaching experience 11years and above (21.4833), then followed by teachers with teaching experience 5years and below (21.0020) for teachers' content knowledge. This imply that teachers with teaching experience 6-10years has the

highest content knowledge, followed by teachers with teaching experience 11years & above then followed by teachers with teaching experience 5years and below.

The mean score of science teacherswith teaching experience 5 years and below (21.8462) highest, followed by mean score of teachers with teaching experience6-10years (21.5590), then followed by teachers with teaching experience 11years and above (21.2167) for teachers' pedagogical content knowledge. This imply that teachers with teaching experience 5 years and below has the highest technological content, followed by teacher with teaching experience 6-10years, then followed by teachers with teaching experience 11years and above.

The mean score of science teacherswith teaching experience 5 years and below (21.6593) highest, followed by mean score of teachers with teaching experience11years and above (21.6083), then followed by teacherswith teaching experience 6-10years (21.5436) for teachers' technological content. This imply that teachers with teaching experience 5 years and below has the highest technological content, followed by teachers with teaching experience 6-10years, then followed by teachers with teaching experience 11years and above.
The mean score of science teacherswith teaching experience 5 years and below (21.7582) highest, followed by mean score of teachers with teaching experience 6-10years (21.5728), then followed by teachers with teaching experience 11years and above (21.1750) for teachers' technological pedagogical knowledge. This imply that teachers with teaching experience 5 years and below has the highest technological pedagogical knowledge, followed by teachers with teaching experience 6-10years, then followed by teachers with teaching experience 11years and above.

The mean score of science teacherswith teaching experience 11years and above (21.9667) highest, followed by mean score of teachers with teaching experience 6-10years (21.7795), then followed by teachers with teaching experience 5years and below (21.0659) for teachers' knowledge of technology. This imply that teachers with teaching experience 11years and above highest knowledge of technology, followed by teacher with teaching experience 6-10years, then followed by teachers with teaching experience 5years and below.

Ho:1
There is no significant influence of teaching experience on teachers' technologicalPedagogical content knowledge (in terms of teachers' knowledge of technology, teachers' pedagogical knowledge, teachers' content knowledge, teachers' pedagogical content knowledge, teachers' technological content knowledge, teachers' technological pedagogical knowledge and teachers' technological pedagogical content knowledge) in public secondary schools.

The independent variable in this hypothesis is education qualification while the dependent variable is teachers' Technological Pedagogical Content Knowledge (in terms of teachers'

knowledge of technology, teachers' pedagogical knowledge, teachers' content knowledge, teachers' pedagogical content knowledge, teachers' technological content knowledge, teachers' technological knowledge and teachers' technological pedagogical content knowledge). In testing this hypothesis, teachers teaching experience were classified into three group (5years & below, 6-10years and 11year & above). Based on the classification, One Way Analysis of Variance was used in testing the hypotheses based on seven (7) sub-variables ofteachers' Technological Pedagogical Content Knowledge. The results of the analysis are presented in Table 1 and 2.

Table 1: Group means and standard deviation of teaching experience on teachers' technological pedagogical content knowledge (N=406)

Sub- variables	Group	N	Mean	SD
Knowledge of Technology	5years & below	91	21.3736	2.4973
	6-10years	195	21.4615	2.7959
	11yrs & above	120	21.7083	2.7175
	Total	406	21.5148	2.7050
Pedagogical Knowledge	5yrs & below	91	22.0440	2.8826
	6-10 years	195	21.8410	2.7602
	11rs & above	120	21.5167	2.7224
	Total	406	21.7906	2.7770
Content knowledge	5yrs & below	91	21.0020	2.4870
	6-10 years	195	21.7385	2.7617
	11yrs &above	212	21.4833	2.7378
	Total	406	21.5025	2.7041
Pedagogical content knowledge	5yrs & below	91	21.8462	2.5163
	6-10 years	195	21.5436	2.6633
	11yrs & above	120	22.2167	2.5078
	Total	406	21.5222	2.5893
Technological content knowledge	5yrs & below	91	21.6593	2.4686
	6-10 years	195	21.5438	2.7077
	11rs & above	120	21.6083	2.6324
	Total	406	21.5887	2.6276
Technology pedagogical knowledge	5 yrs& below	91	21.7582	2.5401
	6-10 years	195	21.5728	2.3383
	11 yrs& above	120	21.1750	2.4722
	Total	406	21.4680	2.4278
Technology pedagogical content knowledge	5 yrs& below	91	22.0659	2.7801
	6-10years	195	21.7795	2.3383
	11yrs & above	120	21.9667	2.6693
	Total	406	21.8990	2.5699

Table 2: Results of analysis of variance of the teachers' teaching experience on their teachers' technological pedagogical content knowledge(N=406)

Sub-variables	Source of Variables	SS	Df	MS	F-calp-value	
Knowledge of technology	Between groups	6.861	2	3.431	.468	.627
	Within groups	2956.850	403	7.336		
	Total	2963.411	405			
Pedagogical knowledge	Between groups	15.342	2	7.671	.995	.371
	Within groups	3107.863	403	7.712		
	Total	3123.204	405			
Content knowledge	Between groups	31.913	2	15.957	2.195	.113
	Within groups	2929.584	403	7.269		
	Total	2961.498	405			
Pedagogical content knowledge	Between groups	21.016	2	10.508	1.572	.209
	Within groups	2694.285	403	6.686		
	Total	2715.300	405			
Technological content knowledge	Between groups	.897	2	.449	.065	.937
	Within groups	2795.411	403	6.937		
	Total	2796.308	405			
Technology pedagogical knowledge	Between groups	18.350	2	9.180	1.562	.211
	Within groups	2388.724	403	5.878		
	Total	2387.084	405			
Technological pedagogical content knowledge	Between groups	5.871	2	2.935	.443	.642
	Within groups	2668.989	403	6.623		
	Total	2674.860	405			

$p > 0.05$ df = 2, 403, F- critical = 3.00

The result presented in Table 2 shows the calculated F value of influence of teaching experience on science teachers' technological pedagogical content knowledge in secondary schools in term of teachers' knowledge of technology(F=.468; p=.627), teachers' pedagogical knowledge(F=.995; p=.371), teachers' content knowledge(F=2.195; p=.113), teachers' pedagogical content knowledge(F=1.572; p=.209), teachers' technological content knowledge(F=.065; p=.937), teachers' technological pedagogical knowledge(F=.1.562; p=.211) and teachers' technological pedagogical content knowledge(F=.443; p=.642) are each lower than the critical F-value of 3.00 at .05 alpha level with 2 and 403 degrees of freedom (two-tailed test). With this result, the null hypothesis was retained while the alternative was rejected. Hence, there is nosignificant influence of teaching experience on teachers' Technological Pedagogical Content Knowledge (in terms of teachers' knowledge of technology, teachers' pedagogical knowledge, teachers' content knowledge, teachers' pedagogical content knowledge, teachers' technological content knowledge, teachers' technological knowledge and teachers' technological pedagogical content knowledge) in public secondary schools at the 0.05 level of significance.

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