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Evaluating the Technological, Pedagogical and Content Knowledge (TPACK) of ICT Teachers in Junior High Schools: A Case Study of the Abuakwa South Municipality in Ghana.

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ABSTRACT
The study sought to examine ICT teachers' knowledge regarding technology, pedagogy and content using the TPACK model. In all, 44 teachers were randomly sampled from the 54 Junior High Schools in the Abuakwa South Municipality. A questionnaire was used to gather quantitative data. ANOVA was used to interpret the data collected. The findings suggested that the overall teachers' knowledge in TPACK was moderate, however, the knowledge of teachers in technology was high. The results also indicated a positive relationship among the various TPACK domains. However, the result rejected the null hypothesis and accepted the alternative hypothesis which shows that statistically there is a significant difference among the various TPACK domains. It was concluded that a lot must be done to help improve the teachers' TPACK. The study recommended a regular professional learning session to close the gap of the teachers' knowledge in technology, pedagogy and content in the municipality.

Keywords: Technological, Pedagogical Content Knowledge (TPACK), Information and Communication Technology (ICT)

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INTRODUCTION
The use of technology has a great impact on the effectiveness of people who use it for various professions such as medicine, engineering, agriculture and education. Technological knowledge has the capacity to use certain hardware and software. This suggests that a teacher's level of technological knowledge and skills can be measured by their ability to use a computer and its components effectively.[1]

According to Voogt et al., the knowledge of teachers is influenced by their formal training, experience and their personal teaching conviction.[2] Teachers' use of ICT is defined by their understanding of ICT's knowledge and educational beliefs. Yet, deficiency of technological knowledge and skills in subject-focused areas hamper teachers' effectiveness in the use of technology in their classroom.[3] Rotherham and Willingham posit that Educational leaders must concentrate on training teachers to provide students with the skills of the 21st century so they can teach in ways that facilitate the production of these skills.[4] On his part, Sprenger emphasised that most of the students are now digital natives.[5] This is because today's learners are brought up in technological age and are conversant with the use of computers and the internet. This serves as a wake-up call for teachers to improve their knowledge and skills in the use of technology, especially for teaching.

1 Drew Polly, "Developing Teachers' Technological, Pedagogical, and Content Knowledge (TPACK) through Mathematics Professional Development," *International Journal for Technology in Mathematics Education* 18, no.2 (2011a): 83.
2 Joke Voogt, Jo Tondeur P. Fisser and van Braak Johan, "Using Theoretical Perspectives in Developing Understanding of TPACK." *Handbook of Technological Pedagogical and Content Knowledge (TPACK) for Educators,*(New York, NY, USA: Routledge, 2016).
3 Douglas D. Agyei and Joke Voogt "Developing Technological Pedagogical Content Knowledge in Pre-Service Mathematics Teachers through Collaborative Design," *Australasian Journal of Educational Technology* 28, no.4 (2012).
4 Andrew J. Rotherham and Daniel Willingham, "21st Century Skills: The Challenges Ahead." *Educational Leadership* 67, no.1 (2009): 16.
5 Marilee Sprenger, *Brain-Based Teaching: In the Digital Age*, (Alexandra, ASCD, 2010).

One of the proposed tools used to assess teachers' knowledge is the Technological, Pedagogical Content Knowledge (TPACK) framework.[6] The TPACK framework focuses on areas of intersection between the three main areas of technological application, incorporation into the classroom and the mastery of subject matter. However, it is ideal for all these three components to meet in the joined TPACK competency where the infusion of technology into a classroom is conducted in a manner such as that both students and instructors benefit from the amalgamation of pedagogical and content-based knowledge in a significant and suitable way. Teachers' successful integration of the TPACK framework can make a huge difference in learners' achievement of set targets in any learning field.

Banji et al. mention that, the teaching of ICT in Junior High Schools (JHS) in Ghana has been coupled with a lot of challenges, from the unavailability of ICT tools to teachers' incompetency in teaching the subject.[7] In Ghana, ICT is taught in basic school and is examinable at the Basic Education Certificate Examination (BECE) taken at the end of the JHS. However, teachers who complete the Colleges of Education do not specialise in the teaching of ICT. The subject is taught to teacher trainees at the introductory level, this means that unless the teacher obtains some basic ICT literacy or takes a specialized course in ICT, they would not be competent enough to teach the subject at that level. A lot of studies have been done on the problems facing the teaching and learning of ICT in schools.[8] These challenges offer excuses for teachers and students for the poor performance in ICT during the BECE. The low levels of performance in ICT are a concern to educational stakeholders and a challenge to the country's technological future. To research the reasons for these low standards, it is imperative to evaluate various factors that affect students' performance in certain subjects. Among these factors are teachers' competencies in the use of technology in teaching. This study seeks to examine teachers' knowledge in the three TPACK domains namely; technological, pedagogical and content knowledge.

The study will specifically focus on the following objectives:

1. What are the levels of ICT teachers' TPACK?
2. What is the relationships among the teachers' TPACK and teaching ICT?

Hypothesis

H_0: Statistically, there is no significant difference between the teachers TPACK in teaching ICT
H_1: Statistically, there is a significant difference between the teachers TPACK in teaching ICT

TPACK framework

TPACK framework coined by Mishra and Koehler focuses on three elements: technological, pedagogical and content knowledge, by distinguishing between these three forms of knowledge. The TPACK model summarises how what is taught and the manner in which the teacher conveys that content must form the foundation for any effective application of technology in education.[9] This order is essential because the technology applied will convey the content and encourage the pedagogy so that the learning experience of students is improved. Teachers need to be more comfortable with classroom technology before they can reach TPACK. Before TPACK can be accomplished, teachers must feel more comfortable about the use of technology in the classroom. So their technological knowledge, pedagogical knowledge and content knowledge must be assured. The TPACK framework has been used in recent years by many researchers to explore teachers' TPACK. Roig-Vila et al. conducted a quantitative non-experimental study in Preschool and Primary Education Centers in the province of Alicante (Spain) to examine TPACK in terms of teachers' ICT integration into their teaching responsibilities. According to the findings, teachers possess more content and pedagogical expertise than technological expertise.[10] In terms of mathematics education research, Depaepea et al. conducted a systematic examination of the concepts and studies in PCK. The findings revealed that there are many ideas of PCK, which have a different impact on the methodologies used to analyze PCK.[11]The paragraphs below briefly explain the three components of the TPACK framework.

Technological Knowledge (TK)

This describes the expertise of teachers and their ability to use various technologies and their related resources. TK is

[6] Punyan Mishra and Mathew J. Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," *Teachers College Record,* 108, no.6 (2006a): 1017.

[7] Maxwell O. Peprah, "ICT Education in Ghana: An Evaluation of Challenges Associated With the Teaching and Learning of ICT in Basic Schools in Atwima Nwabiagya District in Ashanti Region." *European Journal of Alternative Education Studies*, 1 no.2 (2016): 27.

[8] George T. Banji, Stephen Okyere, Bridget Kornu and Philip Migbordzi, "Challenges Junior High School Pupils Face in the Use of Information and Communication Technology (ICT) Tools for Learning in Ghana." *Asian Journal of Education and Social Studies* 11 no.3 (2020):37..

[9] Mishra and Koehler, "*Technological Pedagogical Content Knowledge,"* 1017..

[10] Rosabel Roig-Vila, Santiago Mengual-Abdres and Patricia Quinto-Medrano, "Primary Teachers ' Technological, Pedagogical and Content Knowledge," *Media Education Research Journal,* 23, no.45 (2015): 151.

[11] Fien Depaepea, Lieven Verschaffelb and Geert Kelchtermansa, "Pedagogical Content Knowledge: A Systematic Review of the Way in Which the Concept Has Pervaded Mathematics Educational Research," *Teaching and Teacher Education,* 34(2013): 12.

about identifying technology, assessing its possibilities for a specific area of study, learning to recognize when to support or obstruct learning, and constantly learning and modifying to new technologies. As suggested by the National Research Council's Committee on Information Technology Literacy (NRC, 1999), TK is a concept that is close to Fluency of Information Technology (FITness) in TPACK.[12] However, TK is considered both procedural and conceptual.[13] It is also a piece of knowledge about working with technology, tools and resources and understanding how to work with technology to make it productive in the everyday life of users.[14] Many authors view TK as a competence measure in current digital technologies enabling individuals with available technology to achieve personal and professional goals.[15] Others describe it as having the ability to use particular hardware and software.[16] TK is about learning how to run a machine and how to use different technologies and troubleshoot difficult circumstances.[17]

Pedagogical Knowledge (PK)

This describes methods teachers apply in the classroom situation. It includes all the knowledge and skills the teachers display in the classroom for the purpose of achieving the learning outcomes. This involves lesson planning, class control, assessment procedures, learning activities among others.[18]

Content Knowledge (CK)

This defines the instructor's understanding of the subject matter in their field of profession. CK means knowledge of teachers on the subjects to be learned or taught.[19] As pointed out, this knowledge should comprise knowledge, concepts, theories, ideas, organizational frameworks, facts and evidence, as well as current methods and approaches for enhancing knowledge.[20] Teacher content knowledge may influence the way they impart content to the student and subsequently affect their performance in the subject area. There can be excessive costs of not being able to offer a strong database of content knowledge; students for example can acquire incorrect information and create misunderstandings about the content sector.[21] Content knowledge, however, is a mal-structured field, which shows that problems relating to curriculums can be highly controversial and disagreeable, as the culture wars.[22]

TPACK and the 21st - century teacher

Teachers cannot keep on teaching the way they were taught in the past. 21st - century skills such as creative thinking, critical thinking, problem-solving, communication, collaboration and innovation are what learners need to fit in today's world. Teachers need to be aware of these skills to keep up with the demand of the curriculum in order to guide learners in achieving their potentials. This can be achieved if teachers adopt several pedagogical methods with the infusion of ICT to help the 21st-century skills of their students.[23] These 21st-century skills are classified as: learning and innovation skills (creativity, critical thinking, problem-solving, communication and collaboration); information, media and technology skills; and life and career skills.[24] When properly done, this would help learners to be competitive in their fields of endeavour. Teachers must possess the requisite technological, pedagogical and content knowledge in their professional fields to be able to integrate technology into their teaching so that they can meet the demand of their learners.

Using TPACK in the classroom

It is always a herculean task to integrate technology into the classroom because of the need to carefully plan, examine

[12] National Research Council.. *Being Fluent with Information Technology Literacy*. (Washington, DC: National Academy Press, 1999).

[13] Lorin W. Anderson (Ed.), Krathwohl, *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*, (New York: Longman, D.R. 2001).

[14] Mathew J. Koehler and Punyan Mishra, "What Is Technological Pedagogical Content Knowledge?" *Contemporary Issues in Technology and Teacher Education* 9, no.1 (2009): 6070.

[15] Romina Jamieson-Proctor, Glenn Finger and Peter Albion, "Auditing the TPACK Capabilities of Final Year Teacher Education Students: Are They Ready for the 21st Century?" In *Proceedings of the 2010 Australian Computers in Education Conference (ACEC),* (2010):1.

[16] Drew Polly, "Examining Teachers' Enactment of Technological Pedagogical and Content Knowledge (TPACK) in Their Mathematics Teaching after Technology Integration Professional Development," *Journal of Computers in Mathematics and Science Teaching* 30, no. 1 (2011b): 37.

[17] Choroula Angeli and Nicos Valanides, "Epistemological and Methodological Issues for the Conceptualization, Development, and Assessment of ICT–TPCK: Advances in Technological Pedagogical Content Knowledge (TPCK)." *Computers and Education,* 52, no. 1 (2009): 154.

[18] Koehler and Mishra, "What Is Technological Pedagogical Content Knowledge?" 6070...

[19] Koehler and Mishra, "What Is Technological Pedagogical Content Knowledge?" 6070.

[20] Lee S. Shulman, "Those Who Understand: Knowledge Growth in Teaching." *Educational Researcher,* 15, no.2 (1986): 4.

[21] National Research Council, 2000. *How People Learn: Brain, Mind, Experience, and School*. (Washington, DC: National Academy Press).

[22] Jonathan Zimmerman, *Whose America? Culture Wars in the Public Schools.* (Cambridge, MA: Harvard University Press, 2002).

[23] Teemu Valtonen et al.,"TPACK Updated to Measure Pre-Service Teachers' Twenty-First Century Skills." *Australasian Journal of Educational Technology* 33, no.3 (2017).

[24] Bri Stauffer, "What are 21st century skills?" *Applied Educational Systems*, accessed March 19, 2020, https://www.aeseducation.com/blog/what-are-21st-century-skill.

the technological tools and their effectiveness. The role of Teachers in integrating ICT in education is very crucial.[25] Technology-based instruction improves classroom teaching and learning by motivating both teachers and students.[26] Using TPACK in the classroom helps to tailor teaching to suit the individual differences in learners.[27] The proper integration of TPACK in the classroom will further facilitate collaborative learning among students.[28] The use of TPACK can also encourage students to learn on their own, enhance how students critically think and reflect on their learning.[29] From the above literature, it is obvious that the use of TPACK in the classroom situation is very beneficial and should be encouraged. It will help enhance the traditional classroom to meet the demand of the 21st century classroom.

Limitations to implementation of TPACK

The importance of integrating technology into the classroom cannot be overemphasised. However, the majority of the teachers face obstacles in using technology in the classroom. Ling Koh et al. have suggested three essential obstacles related to the TPACK model namely; how teachers perceive technology, policies that bind the school and accessing technology physically.[30] These factors can potentially affect the three components associated with this model. Most teachers also lack the requisite knowledge on how to use technology in the classroom.

Lee and Kim recommend that to overcome these challenges teachers must come together to share their experiences to help each other surmount these challenges.[31] There should be a forum for dialogue and experience sharing so that mistakes are reduced or eliminated completely. Again, there is the need for proper training of teachers to successfully incorporate ICT into their classroom teachings.[32]

METHODOLOGY

This research is an exploratory survey study that adopted the descriptive research design. The target population for this study was the entire in-service teachers in Abuakwa South Municipality in the Eastern Region of Ghana teaching ICT. According to the Municipal Education records of schools, there are 7 zones of clusters consisting of 54 JHS and 57 teachers teaching ICT in the JHS in the Municipality. Each zone consists of 8 schools with exception of two zones which had 9 and 5 schools respectively. Random sampling was used to sample 44 teachers out of the 57.

A questionnaire was the instrument used to collect quantitative data for this study. A self-assessment scale known as TPACK for 21st-century skills (TPACK-21) was modified and used to collect data on the ICT teachers'[33] The questionnaire consisted of 15 items under three TPACK domains. The questionnaire also used a Likert scale of 5 (five) for the statements. Strongly Disagree = 1, Disagrees = 2, Natural = 3, Agrees = 4 and Strongly Agrees = 5. Out of the 57 questionnaires distributed, 44 were fully completed and returned representing a response of 77.2% of the target respondents. The study collected data on teachers' qualifications and their technological knowledge in five areas namely; word processing, spreadsheet, presentation, internet of things and multimedia authoring.

The data collected from the instrument was analysed using descriptive statistics and inferential statistics. The descriptive statistics measured the means and standard deviations of the data while ANOVA and correlations were used to analyse the inferential statistics like the relationship among the teachers' computer self-efficacy in the three areas. The following points measured the TPACK of teachers.

Table 1

Mean	***Level***
1.0 - 2.4	*Low*
2.5 - 3.0	*Moderate*
3.1 - 3.9	*High*

[25] Elen J. Instefjord and Elain Munthe, "Educating Digitally Competent Teachers: A Study of Integration of Professional Digital Competence in Teacher Education." *Teaching and Teacher Education,* 67(2017): 3..

[26] Kun Li and John M. Keller, "Use of the ARCS Model in Education: A Literature Review." *Computers & Education,* 122 (2018): 54.

[27] Lai Kwok-Wing and Lee A Smith, "Tertiary Students' Understandings and Practices of Informal Learning: A New Zealand Case Study," *Australasian Journal of Educational Technology* 32, no.2 (2017): 115.

[28] Hye P. Kyung, Park Kwi Hwa and Chae Su Jin, "Experiences of Medical Teachers in Flipped Learning for Medical Students: A Phenomenological Study." *Korean Journal of Medical Education* 30, no. 2 (2018): 91..

[29] Genevieve P. Zipp, Catherine Maher and Valerie Olson, "SOLO-Framed Flipped Learning Environment: Speaking the Language of Today's Learner." *Journal of Physical Therapy Education* 31, no. 3 (2017):141..

[30] Joyce H. Ling Koh, Chai S. Chai and Lee Y. Tay, "TPACK-in-Action: Unpacking the Contextual Influences of Teachers' Construction of Technological Pedagogical Content Knowledge (TPACK)," *Computers & Education,* 78(2014): 20.

[31] Chia-Jung Lee and ChanMin Kim, "An Implementation Study of a TPACK-Based Instructional Design Model in a Technology Integration Course," *Educational Technology Research and Development* 62, no.4 (2014): 437.

[32] Monty W. Jones and Sarah Dexter, "How Teachers Learn: The Roles of Formal, Informal, and Independent Learning," *Educational Technology Research and Development* 62, no.3 (2014): 367.

[33] Valtonen et. al, "TPACK Updated to Measure Pre-Service Teachers'

4.0 - 5.0	*Very high*

RESULTS

The study sample of 44 respondents consisted of 33 male and 11 female teachers. Out of the 44 teachers, 18(40.9%) had a Bachelor's Degree in Education and 26(59.1%) a Diploma in Basic Education. In the programme of specialisation of the teachers, the data gathered showed that the majority of the teachers 34 (77.3%) teaching ICT in the JHS in the Abuakwa South District did not have any specialization in ICT related courses, while only 10 (22.7%) had specialised in ICT related courses. The results for the research focus and hypothesis are displayed and analysed below.

Level of ICT teachers' in technology, pedagogy and content knowledge (TPACK)

To get the answer to the question above, a mean and standard deviation score was used to find the level of the ICT teachers' knowledge in the three TPACK domains and the results are displayed in Table 2 below.

Table 2: Means and Standard deviation on teachers' computer self-efficacy in three ICT skill areas

TPACK Domains	Mean	STDEV	Decision
Technological knowledge			
1. I can use word processor to create a document	3.4286	1.13	High
2. I can use presentation software to create slides for teaching	3.6190	1.16	High
3. I can use spreadsheet to calculate data using formulas and functions to analyse students test scores	3.6190	1.16	High
4. I can use multimedia authoring tools to create teaching and learning materials	3.5238	1.15	High
5. I can use internet tools to effectively search for information and for communication	3.6190	1.16	High
Total	**3.5619**	1.15	**High**
Pedagogical Knowledge:			
6. I am capable of assessing my students using ICT	2.8571	1.03	Moderate
7. I can adapt my teaching style to different learners	3.0476	1.06	Moderate
8. I can apply different learning theories and approaches in my teaching.	2.8095	1.02	Moderate
9. Collaborate with colleagues	2.0952	0.88	Moderate
10.I am familiar with common student understandings and misconceptions	2.9048	1.04	Moderate
Total	**2.7429**	**1.01**	**Moderate**
Content knowledge			
11. I have sufficient knowledge about ICT	2.0000	0.86	Moderate
12. I follow up-to-date resources like books, journals in ICT	2.4286	0.95	Moderate
13. I can use my knowledge to develop class activities and projects in ICT	2.6190	0.99	Moderate
14. I follow recent developments and applications in ICT.	2.6667	1.00	Moderate
15. To create a courseware for teaching and learning	2.6190	0.99	Moderate
Total	**2.4667**	**0.96**	**Moderate**
Overall Total Mean	**2.96**		**Moderate**

From Table 2 the results suggest that the teachers' technological knowledge was (M=3.5619, SD=1.15). However, the result showed that the teachers' pedagogical and content knowledge was, (M=2.7428, SD=1.01) and (M=2.4667, SD=0.96) respectively. Overall teachers TPACK in ICT (M=2.9638, SD=1.16).

Relationship among the three TPACK domains

In order to ascertain the relationship between the three TPACK domains a correlation analysis was performed and the results are displayed in Table 3.

Table 3: Correlation between the various TPACK elements

Correlation		TK	PK	CK
TK	Pearson Correlation	1	.314*	.741*
	Sig. (2-tailed)		.007	.000
	N	44	44	44
PK	Pearson Correlation	.314*	1	.387
	Sig. (2-tailed)	.007		.319
	N	44	44	44
CK	Pearson Correlation	.741*	.387	1
	Sig. (2-tailed)	.000	.319	
	N	44	44	44

*. Correlation is significant at the 0.05 level (2-tailed)

Table 3 suggested a significant positive relationship between technological knowledge and the following; pedagogical knowledge and content knowledge with p-values of 0.007 and 0.000 respectively. However, the relationship between technological knowledge and pedagogical knowledge was moderate(r=.314) while the relationship between technological knowledge and content knowledge was high(r=.741).

Meanwhile, the results further show that there was approximately 10% variability in technological knowledge and content knowledge while the variability of technological and pedagogical knowledge was approximately 55%. There was also a positive relationship between teachers' content knowledge and pedagogical knowledge, however, that relationship was moderate(r=.387) and not significant at p-value of .319. The variability in pedagogical knowledge and content knowledge was approximately 15%.

Hypothesis

H_0: statistically there is no significant difference between the teachers TPACK in teaching ICT
H_1: statistically there is a significant difference between the teachers TPACK in teaching ICT

To analyse these hypotheses, a one-way between-groups analysis of variance (ANOVA) was conducted to explore the difference in teachers' technology, content and pedagogical knowledge. The result is displayed in Table 4.

Table 4: One-way analysis of variance (ANOVA) for the relation among the three knowledge

Source of Variation	Sum of Square	df	Means Square	F	Sig.
Between Groups	3.244348	2	1.622174	21.85484	9.99E-05
Within Groups	0.890699	12	0.074225		
Total	**4.135047**	**14**			

From Table 4, the ANOVA reveal that the p-value = 9.99E-05 < .05 = α. The effect size, calculated using eta squared, was.07. According to Cohen 0.1 = Minor effect, 0.6 = average effect and 1.4 = great effect.[34]

The formula is Eta squared = Sum of squares between groups divided by Total sum of squares / Eta squared = 3.244348/4.135047= 0.78

In order to determine the specific variable whose means are statistically different after the ANOVA. A one-way between-group analysis of variance was conducted to analyse the difference in the knowledge of JHS ICT teachers. The three knowledge levels that were analysed were technological, content and pedagogical and the results are displayed in Table 5.

[34] Jacob Cohen, *Statistical Power Analysis for the Behavioral Sciences*. (New York, NY: Routledge Academic, 1988).

Table 5: Post Hoc Tukey HSD test for TPACK of teachers in relation to the three domains

(I)CSE I	(J)CSE2	M(1-J)	Standard error	p-value Sig.	95% confidence interval	
					Lower bound	Upper bound
Technological knowledge	Content knowledge	0.819	0.12518	.007	-0.32661	0.470127
	Pedagogical knowledge	1.0952	0.119335	.000	-0.15138	0.608168
Content knowledge	Technological knowledge	-0.819	0.12518	.007	-0.470127	0.32661
	Pedagogical knowledge	0.2762	0.717962	.319	-2.80719	1.762561
Pedagogical knowledge	Technological knowledge	-1.0952	0.119335	.000	-0.608168	0.15138
	Content knowledge	-0.2762	0.717962	.319	-1.762561	2.80719

*.The means difference is significant at 0.05 level

Analysis of Table 5 shows that there was a statistically significant difference at the $p < .005$ of teacher's ICT knowledge in the three domains $F(2,12) = 21.85$, $p < 0.005$. Post-hoc comparisons using the Tukey HSD test point out that the mean score of teachers Technological knowledge (M=3.5619, SD=1.15) was significantly different from Content knowledge (M=2.7429, SD=1.01) and Pedagogical knowledge (M=2.4667, SD=0.96). However, there was no statistically significant difference between the teachers Content knowledge (M=2.7429, SD=1.01) and Pedagogical knowledge (M=2.4667, SD=0.96).

DISCUSSIONS

On the level of TPACK of teachers, the result reveals that the teachers' technological knowledge is high, while pedagogical and content knowledge is moderate. These results disagree with the findings that teachers have more pedagogical and content knowledge than in technology.[35] The results show that ICT teachers in the Abuakwa South Municipality have moderate TPACK. This can be related to their background of specialisation. The result of the teachers' qualifications suggests that the majority of the teachers (77.7%) have no specialisation in ICT.

On the relationship among the various knowledge domains, the study revealed a significant positive relationship between technological and pedagogical knowledge and technological and content knowledge. But, the relationship between technological knowledge and pedagogical knowledge is moderate. While the relationship between technological and content knowledge is high. Furthermore, there is a moderate positive association between teachers' content and pedagogical knowledge but that relation is not significant. Nevertheless this finding is at variance with findings that portray that the relation between Pedagogical and Content Knowledge was stronger than the relationship between Technological and Pedagogical or Content Knowledge.[36]

The outcome of the hypothesis analysis from the ANOVA discloses that the p-value = 9.99E-05 < .05 = α, and this gives reason for the rejection of the null hypothesis and the acceptance of the alternate hypothesis. Consequently, this suggests that statistically, there is a significant difference between the various TPACK domains.

RECOMMENDATIONS

Based on the study outcomes it is recommended that the Municipal Educational Directorate should take steps to organise regularly teachers' professional learning sessions in the application of TPACK to bridge the ICT knowledge gap of the teachers teaching ICT in the Municipality. Secondly, Teachers teaching ICT in Abuakwa South Municipality should be encouraged to take advantage of the three-semester and five-semester sandwich programmes offered by the University of Cape Coast to upgrade their qualification in teaching the subject.

CONCLUSIONS

The study reveals that the majority of teachers (77.7%) teaching ICT in the Abuakwa South Municipality have no specialization in ICT-related courses. In terms of their TPACK, the teachers have high technological knowledge but moderate PK and CK. From the findings, a lot needs to be done to improve the TPACK of the teachers' teaching ICT

[35] Roig-Vila et al., "Primary Teachers ' Technological, Pedagogical and Content Knowledge," 151.
[36] Depaepea et al.,"Pedagogical Content Knowledge," 12.

in the Abuakwa South municipality since their overall TPACK is moderate. This has implications on the performance of the students in ICT. Although the study focused on the Abuakwa South Municipality, teachers in other parts of the country can also be considered as facing similar challenges. Therefore, stakeholders in the Ghanaian Educational sector need to consider the recommendations made to improve ICT literacy amongst teachers nationwide.

ABOUT AUTHOR

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