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Research Article

Pre-service Teachers' Characteristics Predict their Technological Knowledge: An Exploratory Multiple-Regression Design

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Abstract: Academic discourse has highlighted the influence of pre-service teachers' technological knowledge as a cord linking their pedagogy and content integration. However, pre-service teachers' demographic characteristics play a crucial role in their technological knowledge development. As a result, this study examined how prospective teachers' demographic variables predict their technological knowledge. A census survey with an exploratory multiple-regression design was adopted to test the relationship of the predictive variables (programme of study, gender, central area of specialization, and minor area of specialization) of Abetifi Presbyterian College of Education pre-service teachers. A census technique was used to include all the 379 level 400 pre-service teachers pursuing Bachelor of Education (Primary Education) and Bachelor of Education (Junior High School Education) for the 2021/2022 academic year. A five-point closed-ended questionnaire with a Cronbach alpha coefficient of 0.758 was used as the primary data collection instrument. The study's findings indicated that prospective teachers were technologically knowledgeable in recognizing, accepting, adapting, exploring and advancing technological resources. The study's findings established that demographic variables were statistically significant predictors of pre-service technological knowledge. For teacher training institutions to address the technological challenges of prospective teachers, technological resources applicable within their subject areas of specialization should be used during instruction. Teacher educators should consider the background characteristics of prospective teachers in order to select and adjust technological resources to whip prospective teachers' interest in the use of innovative resources during instruction.

Keywords: pre-service teachers, demographic characteristics, technological knowledge, technological pedagogical content knowledge, self-efficacy belief

1. Introduction

Teachers' possession of technological knowledge, proficiency and competency convey progression, enhancement, and improvement in integrating innovative resources toward delivering quality education. The lack of such technological knowledge and proficiency makes it practically impossible for teachers to use available technological resources to improve the representation of subject matter and facilitate teaching and learning (Amedzo, 2007; Jarvis et al., 2003). It is bestowed on teacher education institutions to educate prospective teachers on the requisite disciplinary knowledge, a strong command of learning theories, corresponding application of learning theories for pedagogical

purposes and technological knowledge. Through these mediums, pre-service teachers become more knowledgeable in specific content areas, competent in instructional practices and technologically knowledgeable (Shulman, 1986). The possession of technological knowledge by prospective teachers lends support to the fulfilment of the national policy and implementation plan for technology in education (Ghana ICT4AD Policy, 2003), Ministry of Education (2002) and the use of ICT as a pedagogical tool for effective instructional delivery (National Council for Curriculum and Assessment (NaCCA), 2019). These ICT-related policies highlight the need to integrate technologies into education, specifically in curriculum content delivery. The justification for technological resource integration into education is to stimulate motivation, desire, interest, self-esteem, confidence, creativity, interactivity, and critical thinking among students (Papaioannou & Charalambous, 2011).

To ensure the effective integration of information technology communication resources in education, a significant number of teachers feel unprepared to integrate technology into the subject matter as well as techniques for meaningful representation of lessons to meet the diverse learning needs of the student (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hutchison & Reinking, 2011). The lack of professional development and rapid changes in technological resources accounts for the unpreparedness of teachers (Agyei, 2012; Agyei & Voogt, 2011a; Hutchison & Reinking, 2011; Matherson et al., 2014; Ottevanger et al., 2007). Again, the didactic teaching method employed by tutors within the teacher training institutions limits pre-service teachers' exposure to how ICT resources are utilized for educational purposes (Agyei & Voogt, 2011a; 2011b; Mouza et al., 2014). Moreover, Cuhadar (2018) confirmed that pre-service teachers need adequate knowledge, training and support in using ICT resources in education during their course of study at teacher training institutions. The contextual implication of these studies (Agyei, 2012; Cuhadar, 2018; Ertmer & Ottenbreit-Leftwich, 2010; Hutchison & Reinking, 2011; Koc & Bakir, 2010) establishes discrepancies in the expectant use of technological resources towards the delivery of quality education.

Furthermore, the acceptability of Information Communication Technology (ICT) resource implementation in education to address the technological knowledge gap of prospective teachers has caused African countries to lag behind Western and Asian countries (Hew & Brush, 2007; Kiboro, 2018). Teachers' need for more technological knowledge, ICT-related skills and competence are significant hindrances to the effective implementation and utilization of innovative resources in schools. Pre-service teachers' ability to integrate technological resources depends on their knowledge of technology. According to Mishra and Koehler (2006), a teacher's knowledge of educational technologies is known as technological knowledge (TK). Technological knowledge is used when teachers use technological resources to deliver information in the classroom (Archambault & Barnett, 2010). The technological resources are classified as low and high technologies (Archambault & Barnett, 2010; Cox, 2008). To oscillate between low and high technologies, pre-service teachers must exhibit technical flexibility, instructional interactivity, organizational feasibility, ethical acceptance and feedback progressivity (Georgakellos, 2005; Simkins & Allen, 2000). Prospective teachers' integration of technology into content and pedagogy becomes functional when the requisite technical knowledge and competence are gained, reflected in their instructional practices. Interactive and participatory lessons stimulate the student's interest and ensure performance-based assessment opportunities, which contribute to the development of technological literacy among teachers and students.

Studies have established intersections and relationships among independent variables of technological pedagogical content knowledge (TPACK) (Wilson et al., 2020; Chai et al., 2013). Irrespective of pre-service teachers' technological knowledge contribution to their TPACK, there exist contradictions in the contribution of prospective teachers' demographic variables to their technological knowledge and utilization. As Prensky (2001) attests that prospective teachers' demographic variable "age" relates to teachers' teaching competence in integrating innovative technologies, Chai et al. (2013) posited that there exist gender differences in teachers' technological and content knowledge. However, Jang and Tsai (2012) indicated no statistically significant gender differences in the TPACK of prospective primary-school Mathematics and Science teachers. In addition, Jimoyiannis and Komis (2007) established a strong relationship between the teaching experience of pre-service teachers and technology-related teaching activities. Furthermore, studies indicate that the experience, qualification, age, TK, and PK of prospective teachers influence their usage of technological resources in education (Chai et al., 2010; Lee & Tsai, 2010; Pierson, 2001). Age, gender, and teaching experience are mostly investigated in studies focusing on knowledge, adaptation and usage of technological resources while the specific programme of study, areas of subject concentration and minor are less researched. Studies on the integration of technology in education (Arkorful et al., 2021; Essel et al., 2021; Amanamah et al., 2018; Lam et al., 2008) have

concentrated on university students as their target population as a result there is a paucity of studies highlighting how prospective teachers' demographic variables (gender, programme of study, major and minor areas of specialization) influence their technological knowledge in the Colleges of Education in Ghana. Lam et al. (2008), and Tsourela and Roumeliotis (2015) attest that demographic variables of students have a predictive role in studies on technology usage which reflects in the unified theory of acceptance and use of technology (UTAUT) model (Venkatesh et al., 2012). It is against this backdrop this study sought to use the exploratory multiple-regression design to investigate how pre-service teachers' characteristics predict their technological knowledge in the Abetifi Presbyterian College of Education.

The study's findings aim to orient teacher educators and the Principals of Colleges of Education on technological shock among prospective teachers establishing how specific technological resources are applicable within their subject areas of specialization and background experiences. This enables teacher educators to diagnose pre-service teachers' entry behaviour and knowledge to plan, adjust and restructure learning materials to suit pre-service teachers' learning styles and technological knowledge gaps. To improve pre-service teachers' proficiency and competency in integrating technology, pedagogy, and content, Principals of the College of Education must ensure the development of positive effort expectancy and informed performance expectancy, enabling facilitating conditions within pre-service teachers. This will stimulate their desire to integrate technological resources during instruction.

1.1 *Research questions*

From the empirical review, these research questions guided the study:

1. What is the level of pre-service teachers' technological knowledge (TK) at the Abetifi College of Education, Ghana?

2. What is the influence of pre-service teachers' demographic variables (programme of study, major and minor areas of specialization, and gender) on their technological knowledge?

2. Material and methods

A non-experimental census survey with an exploratory multiple-regression design was adopted to discover and report relationships among different aspects of an issue. This explanatory multiple-regression design aimed to examine whether pre-service teachers' demographic variables influence their technological knowledge. Again, it allowed the researchers to test the relationship of the predictive variables of pre-service teachers (programme of study, gender, central area of specialization, and minor area of specialization) as they influence the dependent variable (technological knowledge). Again, the explanatory multiple-regression design enabled the researchers to identify the strength of the effect that the predictors (demographic variables of pre-service teachers) have on a criterion (technological knowledge). The study adopted the positivism paradigm to empirically test hypotheses on how the demographic variables of pre-service teachers predict their technological knowledge. The hypothesis testing enabled the researchers to gain variable insight into the current status of the phenomenon concerning the variables (demographic variables and TK) of pre-service teachers at the Abetifi Presbyterian College of Education.

Pre-service teachers at the College of Education formed the target population of the study. However, the study focused on all the level 400 pre-service teachers pursuing a Bachelor of Education (Primary Education) and a Bachelor of Education (Junior High School Education) for the 2021/2022 academic year. These Level 400 were 379. In order to increase pre-service teachers' participation and return rate of the questionnaire, pre-service teachers undertaking their on-campus teaching practice were used for the study. As a result, the census technique was used to include the respondents. The primary data collection instrument was a closed-ended questionnaire on a five-point Likert scale (Strongly Disagree = 1; Disagree = 2; Undecided = 3; Agree = 4 and Strongly Agree = 5). The seven-item questionnaire was adapted from Schmidt et al. (2009a) and Yalley's (2016) questionnaire. Schmidt et al. (2009a) and Yalley's (2016) questionnaire provided content and construct validity to examine the TPACK of pre-service teachers and Senior High School Social Studies teachers in Ghana respectively. The seven-item questionnaire was pilot-tested due to the changes in respondents and geographical settings. The closed-ended questionnaire was pilot-tested among pre-service teachers at the Ola College of Education and yielded a Cronbach alpha reliability coefficient of 0.758. According to Wallen and Fraenkel (2013), a Cronbach alpha coefficient of 0.6 to 0.9 is considered very respectful to determine the

appropriateness of the instrument. By implication, the closed-ended questionnaire Cronbach alpha reliability coefficient of 0.758 has the potential to elicit reliable data to answer the research question. The face and content validity of the instrument was established by scholars in the field of educational technologies and Curriculum and Instruction at the University of Cape Coast. The researchers administered the close-ended questionnaires to the respondents and adhered to ethical considerations such as guaranteed anonymity, concealment and confidentiality of information provided, and volunteering participation. The entire data collection exercise took two weeks (14 days). Frequencies and percentages were used to analyze the demographic data while mean, standard deviation, and multiple linear regression were used to analyze research questions 1 and 2 respectively.

3. Results

3.1 *Demographic variables of respondents*

This section presents the demographic variables of the respondents. This includes their programme of study, the central area of specialization, minor area of specialization and gender. Figure 1 represents the result of the programme of study of respondents.
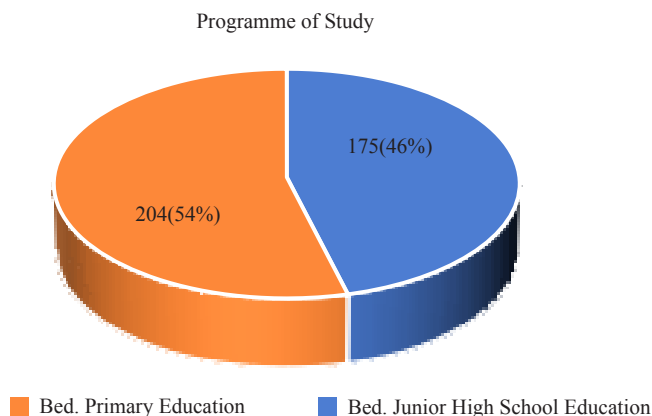

Programme of Study

175(46%)

204(54%)

🟧 Bed. Primary Education   🟦 Bed. Junior High School Education

Figure 1. Programme of Study of Respondents
(Source: Field Data, 2022)

Figure 1 shows that out of 379 pre-service teachers for the Bachelor of Education in Basic Education at the Abetifi Presbyterian College of Education, 204 (54%) pursue Bachelor of Education in Primary Education, whiles 175 (46%) pursue Bachelor of Education in Junior High School (JHS) Education. This implies that 29 (8%) pre-service teachers were pursuing a Bachelor of Education in Primary Education than pre-service teachers pursuing a Bachelor of Education in JHS Education. Irrespective of the programme of study, respondents pursued a major and a minor area of specialization. Figure 2 presents the results in major and minor areas of specialization, respectively.

With respondents' significant areas of specialization, Figure 2 shows that 52 (14%) of the respondents majored in the English Language, 75 (20%) majored in Social Studies, 77 (20%) majored in Mathematics, 75 (20%) majored in Religious and Moral Education, 32 (8%) specialized in ICT while 68 (18%) specialized in Ghanaian Language. Again, respondents had a minor area of specialization. 68 (18%) of the respondents minored in the English language, 32 (8%) minored in Mathematics, 48 (12%) minored in Ghanaian Language, and 77 (20%) minored in Religious and Moral Education, ICT and Music, respectively. Except for Social Studies, which was not a minor area of specialization and Music, not a central area of specialization, all respondents had a major and a minor area of specialization irrespective of the programme of study.
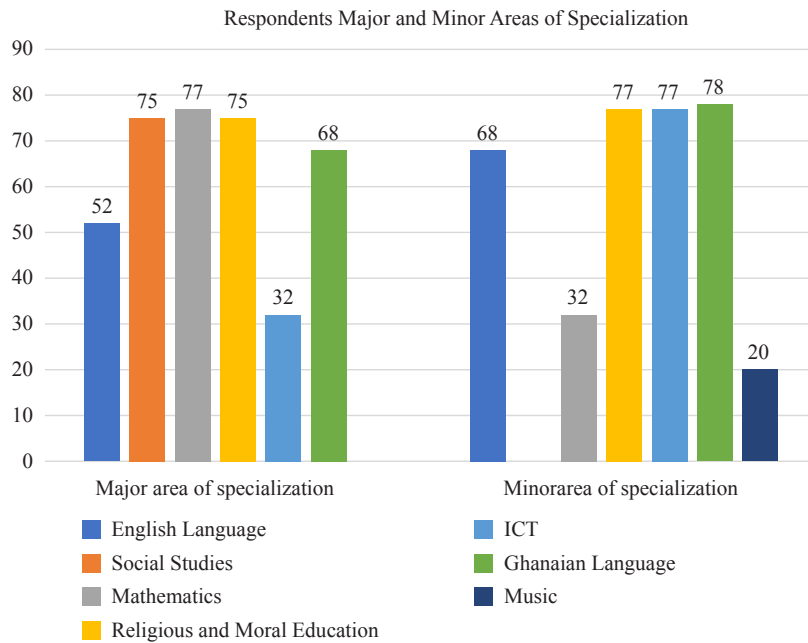
Respondents Major and Minor Areas of Specialization

Figure 2. Respondents' Major and Minor Areas of Specialization
(Source: Field Data, 2022)

In addition to the programme of study, major and minor areas, Abetifi Presbyterian College of Education is a mixed institution. Therefore, Figure 3 presents the gender distribution of the respondents.
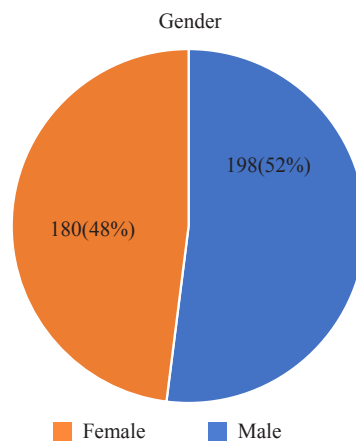
Gender

Figure 3. Gender representation of Respondents
(Source: Field Data, 2022)

The result from Figure 3 indicates that 198 (52%) pre-service male teacher trainees and 180 (48%) female pre-service teacher trainees at the Abetifi Presbyterian College of Education. The result indicates that there were 18 (4%) more male respondents than females in level 400 pursuing Bachelor of Education, Basic Education. In the process of learning, the environment and cognitive factors play a crucial role in determining the extent of knowledge, experience and competencies of an individual. Teacher training institutions must consider prospective teachers' demographic variables to provide intervention, guidance, and training needed to enhance prospective teachers' technological

knowledge. Therefore, it is imperative to determine pre-service teachers' technological knowledge (TK) at the Abetifi Presbyterian College of Education. The Likert scale weights were added to get the average mean value for decision-making (1 + 2 + 3 + 4 + 5 = 15; 15/5 = 3). Therefore, a mean score of 3.00 and below indicates respondents are not knowledgeable, while a mean value of 3.10 and above indicate respondents possess TK. Table 1 shows the results that were collected.

3.1.1 Research Question 1: What is the technological knowledge (TK) of pre-service teachers at the Abetifi College of Education, Ghana

Table 1. Technological knowledge (TK) of pre-service teachers at the Abetifi College of Education

Technological Knowledge	SA + A	U	D + SD	M	SD.	Decision
	№ (%)	№ (%)	№ (%)			
Technology is how humans modify nature to meet their needs and wants and make life easier and better.	347 (92)	13 (3)	19 (5)	4.31	0.72	Knowledgeable
I have a positive attitude towards the use of technology	335 (88)	25 (7)	19 (5)	4.26	0.82	Knowledgeable
I know of standard technologies such as books, dry-erase boards and chalkboards.	323 (85)	27 (7)	28 (7)	4.18	0.68	Knowledgeable
I know of modern/advanced technologies such as computers, the internet, interactive whiteboard, digital video and overhead projectors.	311 (82)	29 (8)	39 (10)	4.07	0.86	Knowledgeable
I can use computer software within the educational context.	297 (78)	31 (8)	31 (8)	3.87	0.92	Knowledgeable
I possess the knowledge and skills to monitor students by using a technological resource for non-education activities	246 (65)	71 (19)	62 (16)	3.53	0.90	Knowledgeable
I possess the technical skills needed to use innovative resources.	279 (74)	59 (16)	41 (11)	3.77	0.95	Knowledgeable
Mean of Means				3.99	0.84	Knowledgeable

M = Mean SD = Standard Deviation
Source: (Field Data, 2022)

Table 1 shows that 347 (92%) of the respondents agreed that technology is the process humans modify to meet their needs and wants, and 279 (74%) of the respondents agreed that they possess the technical skills needed to use innovative resources. Moreover, 335 (88%) and 311 (82%) of the respondents agreed they have a positive attitude towards using technology ranging from standard to modern. On respondents' possession of TK, the overall mean of means scores (M = 3.99; SD = 0.84) indicates that pre-service teachers at the Abetifi College of Education were technologically knowledgeable along all the seven constructs of TK.

3.1.2 Research Question 2: What is the influence of pre-service teachers' demographic variables (programme of study, major and minor areas of specialization, and gender) on their technological knowledge?

The research question sought to ascertain if there is a statistically significant influence of pre-service teachers' demographic variable on their technological knowledge. A multivariate technique was used to predict the regress (technological knowledge) variable and a combination of regressors (programme of study, central area of specialization, minor area of specialization and gender) variables. The researchers used the enter design method of multiple regression to analyze the data. In conducting a multiple linear regression, the residuals should be normally distributed

and independent as a result, the Durbin-Watson test statistic varying from 0 to 4 with a value around 2, indicating the existence of no autocorrelation was used. In this research, the Durbin-Watson test statistic is 1.700, which is approximately 2, thereby meeting the no autocorrelation assumption of the multiple regression analysis (Rogerson, 2001; Hair et al., 2017). Moreover, the Pearson Moment correlation was calculated among the predictive variables, and none of the correlations reached the 0.86 threshold. The analysis showed that no two variables are closely related. Again, the predictive variables' tolerance levels and the Variance Inflation Factor (VIF) was calculated. The Tolerance levels are approximately above 0.1, while the VIF scores are below 10. This indicates that the predictive variables do not excessively influence each other; hence, the multicollinearity assumption was not violated. Table 2 presents the result of the predictive variables in the enter design method of multiple regression analysis.

Table 2. Regression analysis of pre-service teachers' demographic variables to their technological knowledge.

Modal Summary

			Change Statistics				
Model	R	Adjusted R Squared	R Square Change	F Change	df1	Df2	Sig. F Change
1	0.302[a]	0.069	0.091	4.115	9	386	0.000

Coefficients

Variables	Unstandardized coefficients B	Standardized coefficients Beta	t	Sig
Constant	28.224		33.161	0.000
Bachelor of Education (Primary Education)	0.466	0.041	0.797	0.426
English Language (Major)	-2.167	-0.130	-0.507	0.613
Social Studies (Major)	-5.381	-0.374	-1.266	0.206
Male	2.102	0.183	3.385	0.001[*]
English Language (Minor)	-3.162	-0.212	-3.310	0.001[*]
Mathematics (Minor)	-2.331	-0.113	-1.987	0.048[*]
Religious and Moral Education (Minor)	2.916	0.205	0.675	0.500
Ghanaian Language (Minor)	0.910	0.053	0.206	0.837

a. Predictor: (Constant), mMUS, Male, P1, ENG, mMATH, mRME, mE, mGHA& SST
b. Dependent Variable: TK (This indicate the dependent variable used in the running of the regression.)
(Source: Field Data, 2022)

It is evident from Table 2 that the demographic variables are statistically significant predictors of pre-service teachers at the Abetifi Presbyterian College of Education technological knowledge, $F_{(4.115)} = 5.536$, $p < 0.001$, R = 0.302 with $R^2 = 0.069$. This explains that all the eight independent variables (Bachelor of Education (Primary Education), major subject (English Language, Social Studies), male, minor subject (English Language, Mathematics, Religious and Moral Education, Ghanaian Language, Music) significantly contribute to the dependent variable (technological knowledge) of pre-service teachers. The R-value of 0.302 represents the multiple correlation coefficient which measures the quality of the prediction of the dependent variables (pre-service teachers' technological knowledge).

The R-square change (R^2) value of 0.069 was obtained, which is the coefficient of determination explaining about (6.9%) of the variance in the dependent variable. Furthermore, the regression model indicated that the constant was (B = 28.224, SE = 0.851, t = 33.161, p = 0.000). This implies that pre-service teachers' technological knowledge would be improved at 28.224 if pre-service teachers' demographic variables (Bachelor of Education (Primary Education), major subject (English Language, Social Studies), male, minor subject (English Language, Mathematics, Religious and Moral Education, Ghanaian Language, Music) are held constant at zero. From the model, pre-service teachers' demographic variable (male) (B = 2.102, SE = 0.621, t = 3.385, p = 0.001) is the highest significant and positive predictor of pre-service teachers' technological knowledge. The English language follows this as a minor subject area (B = -3.162, SE = 0.955, t = -3.310, p = 0.001), then Mathematics as a minor area of specialization (B = -2.331, SE = 1.173, t = -0.113, p = 0.001).

The study confirms Markauskaite's (2006) findings that there exists a significant gender difference in the ICT capabilities of prospective teachers. Norris et al. (2003) have positioned the gender of prospective teachers as a determining factor in the integration of ICT in the education system. Based on the study's findings, equity of gender in the integration of ICT in the education system can easily be bridged through quality preparation. It was evident from Table 2 that pre-service teachers' demographic variable (male) (B = 2.102, SE = 0.621, t = 3.385, p = 0.001) is the highest significant and positive, English language as a minor subject area (B = -3.162, SE = 0.955, t = -3.310, p = 0.001). Mathematics as a minor area of specialization (B = -2.331, SE = 1.173, t = -0.113, p = 0.001) predicts pre-service teachers' technological knowledge. The findings confirm the assertion of Chai et al. (2010) that pre-service teachers' technological pedagogical content knowledge (TPACK) changes concerning their sex, age, period of service, faculty graduated from, branch access to the internet, the use of technology level and access. This highlights the significant influence of prospective teachers' demographic variables in their quest to use technological resources.

4. Discussion

The study findings indicated that respondents are prepared to become techno-savvy and technophiles within the educational and technological usage. The signal from the respondents implies that pre-service teachers at the Abetifi College of Education possess the needed technical knowledge to use innovative resources for instructional purposes. Pre-service teachers' technological knowledge becomes a skateboard for effectively integrating technology into content and pedagogy. By implication, it becomes easy for prospective teachers to adopt/adapt any innovative resource to enhance content representation to meet diverse learning needs. Representing content through technological means brings varied experiences, whips motivation and stimulates critical thinking among students. This process motivates prospective teachers to become conscious of emerging technological resources and their associated affordances to enhance subject matter transformation in the classroom. Prospective teachers' ability to use technological resources in an educational context ensures that these resources are screened to suit students' preferences, learning abilities and needs. A better understanding of the classroom, students, and the various cultural and socio-linguistic diversity presents a good classroom atmosphere for equity and inclusivity in transforming subject matter. As technological resources are emerging, prospective teachers must have a positive attitude toward using technology. Christensen and Knezek (2008) emphasized its pivotal role in continuously utilising technological resources for educational gains and purposes. By so doing, prospective teachers will appreciate and understand every standard and modern technological resource's technical, cognitive and ethical affordances before using them during instruction. This will reduce the rate of technical distraction and waste of instructional time.

In the era of technological advancement and its associated influence on education, teacher educators must understand the implications of each learning theory (behaviourism, cognitivism, and constructivism) on pre-service teacher technological knowledge formation. Pre-service teachers' understanding of technological resources will occur best under conditions aligned with their cognitive and social architecture (Taylor & Sobel, 2001). Given this, the demographic variable of pre-service teachers influences the technological knowledge and disposition to which they must continue to fine-tune their knowledge about technological resources to establish progressive equilibrium, adaption and organization to adequately make effective use of available and emerging innovative resources (Ho, 2004). Again, Vygotsky's social cognition learning depicts an interplay between the individual and society and how social interaction and language affect learning (Jarvis et al., 2003; Schunk, 2012). The principle that epitomizes the social learning theory

"Zone of Proximal Development (ZPD)" is the gap created for potential development residing within the socio-cultural background of individuals. The programme of study, area of specialization, area of second specialization and gender of pre-service teachers create a gap that needs consideration in training prospective teachers in the use of technology. This practice will allow pre-service teachers to construct their knowledge concerning the use of technological resources based on their gender, programme of student, and area of specialization. By implication, technological knowledge is not static but emerges as new resources (hardware and software) are developed and discovered. This presupposes that knowledge about the varied technological resources needs to be prepared and transferred to prospective teachers. However, spontaneous concepts emerging naturally from everyday experiences and interactions enable prospective teachers to re-adjust to the growing disposition of knowledge relating to ICT. This requires teacher education institutions to employ cognitive apprenticeship, reciprocal teaching, anchored instruction, inquiry-based learning, discovery learning and problem-based learning as practical pedagogical approaches to educate pre-service teachers to become technological literates.

Technology knowledge is ever-evolving; as a result, a teacher with a firm understanding and knowledge of technology can adapt new technologies to the classroom environment and understand how technology can enhance the subject matter. Again, the conceptualization of TK does not posit an "end state" but assumes TK is developmental, evolving over a lifetime of fruitful interactions with multiple technologies. By so doing, pre-service teachers need to recognize (knowledge), accept (persuasion), adapt (decision to use technology), explore (implementation), and advance (confirmation) in order to effectively make good use of their TKN (Nies, 2012; Staus et al., 2014). Through this development, pre-service teachers align technological resources to transform subject matter delivery and the technique of teaching in the classroom (Ryan & Cooper, 2006; Honey, 2001). This education and training process will enable prospective teachers to be proficient and competent in technological resource usage.

5. Conclusion

Prospective teachers within the various teacher training institutions should pay more attention to the training, education, orientation, programme of study and area of specialization of pre-service teachers to direct prospective students to the underlying technological knowledge (TK) within their subject area. TK cannot be seen as the end product but rather as a conveyor to effectively integrate two heterogeneous knowledge domains (content and pedagogy). From the study findings, it can be concluded that prospective teachers at the Abetifi Presbyterian College of Education are technologically knowledgeable in recognizing, accepting, adapting, exploring and advancing technological resources. Again, prospective teachers' demographic variables (male, English language and Mathematics as a minor subject) predict their technological knowledge. Therefore, teacher training institutions must adopt and adapt theoretical and practical approaches to optimize the degree of exposure, orientation, and training tailored towards each programme, area of specialization and gender.

6. Recommendations

Based on these conclusions, it is recommended that teacher training institutions in Ghana should present a conducive school and classroom environment/atmosphere to curb the technostress, fear and anxiety of prospective teachers to build their mastery of experience, vicarious experience, social persuasion, physiological and emotional state (self-efficacy belief). It is envisaged that through this means, pre-service teachers will develop a positive attitude and become conscious of the developmental and ever-emerging technological resources. Again, educators and tutors of the various teacher training institutions should consider the socio-cultural and personal background of prospective teachers to enable them to appreciate the unique nature and abilities of each pre-service teacher. This will enable educators to diagnose pre-service teachers' entry knowledge. This will help educators plan, adjust and restructure learning materials to suit their learning styles and technological knowledge gap. Pre-service teachers' global readiness and competitiveness depend on the enriched supportive learning environment and technical support for the successful use of technology in education. The resultant effect is the possibility of creating a positive effort expectancy and informed performance expectancy to improve pre-service teachers' knowledge, proficiency and competency in integrating technology,

pedagogy, and content (TPACK) during instructional delivery.

7. Delimitation and limitation of the study

The study adopted the theoretical framework, "Technological Pedagogical Content Knowledge (TPACK)" by Mishra and Koehler (2006) to examine prospective teachers' TK. The study was delimited to the pre-service teachers at the Abetifi College of Education for the 2021/2022 academic year. Furthermore, the position of the researchers in conducting this study was that knowing is objectively investigated. This limited the explanation of the criterion variables of prospective teachers as predictors of their technological knowledge. Based on this limitation, it is recommended that a qualitative study should be conducted for an in-depth meaning of the predictors of pre-service technological knowledge in Ghana.

8. Funding

The authors have received no funding or grant for this research.

Conflict of interest

The authors declare no competing financial interest.

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