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ICT-Pedagogy Integration in Elementary Classrooms: Unpacking the Pre-service Teachers' TPACK

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Abstract

This study aimed to investigate the Technological Pedagogical Content Knowledge (TPACK) self-efficacy and ICT integration skills of elementary pre-service teachers in elementary classrooms. The respondents were fifty-two (52) elementary pre-service teachers enrolled in the student teaching program at the Central Luzon State University. Results revealed that most of respondents perceived themselves to be highly proficient in all domains of TPACK framework: Technology 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 (TPCK). Most of them were found to be good in integrating ICT in classroom instruction, particularly in terms of planning and implementation.Respondents' GPA in Educational Technology and ICT-related courses was found to have negative significant relationship with their planning and implementation of ICT-Integrated instruction. Their TPACK self-efficacy had a highly significant relationship with their planning and implementation of ICT-integrated instruction.

Keywords

Information communication technology, self-efficacy, teacher education, technology integration, TPACK

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Introduction

As modern technology paved its way to classrooms, there had been an increased interest in the development of technology integration in instruction to provide better quality education among the students. As Adcock (2008) emphasized, "the evolution of teaching and learning through technology integration is apparent to all levels of education which has changed the classroom as well as the roles of the teachers and students". This inspired a new conceptual reform in delivering quality and effective instruction and the need for individuals to be involved in technological change and development had arisen (Kazu & Erten, 2014). Recognizing the possible significant benefits of technology in the field of education, various researchers tested and evaluated the effects of modern technology in teaching and learning (Sife, Lwoga, & Sanga, 2007; Walters & Lydiatt, 2004). They concluded that properly designed learning materials inspired and delivered by modern technology could add more value to the teaching and learning environment (Walters & Lydiatt, 2004). In developing countries (like the Philippines), information and communications technology (ICT) had been considered as a key factor to improve teaching and learning processes (Sife, Lwoga, & Sanga, 2007).

Though the utilization of modern technology in classrooms yielded positive effect on teaching and student learning, researchers pointed out that it was important to have the right competency and literacy in utilizing these technologies to really improve learning. The proper use of available modern technology [rather than the presence of that technology] could advance student learning and could improve the efficiency and effectiveness of teaching (Walters & Lydiatt, 2004). Thus, teachers should have technical competence and literacy to properly use technologies in classroom instruction. Kereluik, Mishra, and Koehler (2011) explained that technical competence and technical literacy required having knowledge and skills on knowing how to use the technologies which would provide comprehensive learning and effective teaching.

The responsibility of training prospective teachers to gain technical competence and literacy, which was vital for a successful classroom technology integration, laid on the hands of institutions offering teacher education program. The need for pre-service teachers to be involved in technological change had ascended demanding teacher education programs to strengthen courses integrating technology in classroom teaching.

In the Asia-Pacific Region, various efforts and practices (Sife, Lwoga, & Sanga, 2007; UNESCO, 2013) were undertaken by different institutions to strengthen the use of ICT for teaching and learning. The United Nations, Educational, Scientific, and Cultural Organization (UNESCO) Bangkok collected and documented case studies from different institutions offering Educational Technology and ICT-related courses in different countries including the Philippines. The reviewers concluded that the cases demonstrated the viability of tweaking existing Education Technology courses to be more adaptive to the needs of the current realities towards better integration of contents with ICT and their subsequent application in real world environments (UNESCO, 2013).

The Commission on Higher Education (CHED) also recognized the importance of gearing quality prospective teachers who could be capable of integrating technology in classroom teaching. Through CMO Order 30, series of 2004, the CHED mandated all Teacher Education Institutions (TEIs) to strictly follow the set of program specifications and embraced the new teacher education curriculum. This curriculum included two (2) Educational Technology courses to prepare teachers with technological competence and skills to facilitate and evaluate learning in diverse types of students in a variety of learning environment.

It was in this light that this study was conceptualized. With the acquired knowledge and experiences from various content, theories, methods/ strategies, and field study courses, pre-service teachers were expected to have acquired technological, pedagogical and content knowledge which were important in establishing technology integrated instruction. The advancement of technology in our classrooms had increased the interest of Teacher Education Institutions (TEIs) to develop prospective teachers who could be capable of integrating technology in classroom teaching. However, some researchers suggested that many teacher education programs had not been preparing teacher candidates adequately to integrate technology, and many teachers in schools were reluctant to use technology for teaching and learning (Walters & Lydiatt, 2004; Zhao, Pugh, & Sheldon, 2002) Supporting the results of research conducted by Vannatta and Beyerbach (2000), Hew and Brush (2007) recognized that student teachers had very little knowledge about effective technology integration, even after completing courses about instructional technology.

Though technology courses had offered a variety of technological tools and had provided opportunities to learn and practice technical skills, it had been emphasized that mere exposure to a number of ICT tools would not necessarily mean that pre-service teachers can develop abilities to design successful, technology integrated lessons(Hyo-Jeong & Bosung, 2009). These mentioned setbacks in foreign context prompted the researchers to investigate the current condition of ICT integration among elementary pre-service teachers.

In this regard, this study aimed to investigate the pre-service teachers' ICT integration in classroom teaching in elementary classrooms during the student teaching program and determine the relationship between pre-service teachers' socio-demographic characteristics, Technological Pedagogical Content Knowledge (TPACK) self-efficacy and their preparation and implementation of ICT-integrated lessons. Moreover, it was also conducted to determine the problems or challenges that might impede successful technology integration in classroom instruction. Specifically, it aimed to:

1. describe the socio-demographic characteristics of the respondents in terms of age, sex, major/ specialization, grade level handled, subject taught, ICT-related trainings attended, personal ICT equipment, and GPA in Educational Technology and ICT-related courses;
2. determine the respondents' TPACK self-efficacy;
3. describe the ICT program of the cooperating schools in terms of administration, facilities and equipment, and problems encountered;

4. find out respondents' ICT integration in classroom instruction in terms of planning (curriculum goals and technologies, instructional strategies and technologies, technology selections, and fit) and implementation (instructional use and technology logistics);
5. determine whether pre-service teachers' socio-demographic characteristics and TPACK self-efficacy are related to ICT integration in classroom instruction; and
6. identify problems of pre-service teachers in integrating ICT in classroom instruction.

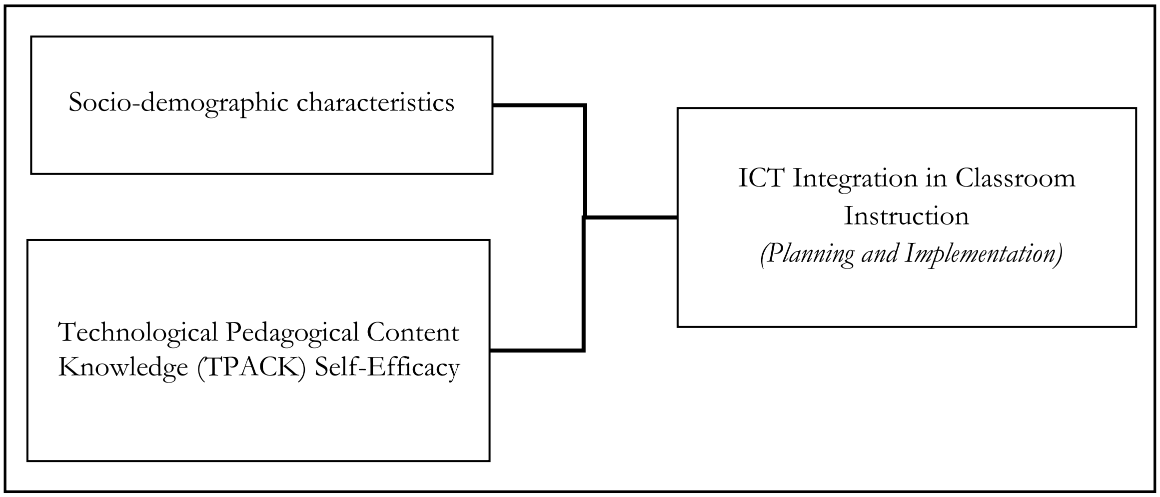
Literature Review

Theoretical and conceptual framework

This study was anchored on the TPACK framework developed by Mishra and Koehler (2006) and Self-Efficacy Theory proposed by Bandura (1977). This study also used TPACK-Based Evaluation model suggested by Abbit (2011).TPACK framework was introduced to the field of educational research for understanding teacher knowledge required for effective technology integration (Mishra & Koehler, 2006). This framework arises from multiple interactions among content, pedagogical, and technology knowledge. It encompassed understanding the representations of concepts using technologies; pedagogical techniques that may apply technologies in constructive ways to teach content in differentiated ways according to students' learning needs; knowledge of what could make concepts difficult or easy to learn and how technology can help redress conceptual challenges; knowledge of students' prior content-related understanding and epistemological assumptions; and knowledge of how technologies can be used to build on existing understanding to develop new epistemologies or strengthen old ones (Mishra & Koehler, 2008). It was composed of seven domains: Technology 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 (TPCK).

Self-efficacy referred to an individual's perception dealing with different challenges, the ability to accomplish an activity, and his/her belief in his/her own capacity (Senemoğlu, 2010). It was described as an individual's perception of personal ability to assume a task and complete it, thereby enabling an individual to accomplish his goals amidst the challenges or difficulties. Furthermore, Bandura (1997) claimed that self-efficacy could predict positive motivational and achievement outcomes across contexts, including persistence and performance. Pre-service teachers' self-efficacy oriented on TPACK framework was necessary to understand their perceived knowledge of different domains under the TPACK framework. Abbitt (2011) examined the development of the TPACK framework with a particular focus on assessing TPACK in the context of pre-service teacher preparation programs. In his review of different existing methods, he suggested the combination of different valid and reliable instruments to properly assess pre-service teachers' development of TPACK and technology integration in classroom instruction. He recommended the utilization of [a]survey of pre-service teachers' knowledge of teaching and technology (Schmidt, et al., 2009) and [b]technology integration assessment rubric (Harris, Grandgenett, & Hofer, 2010). He further explained that these instruments were highly complementary in their current form and appropriate to elementary education or early childhood education programs due to the design of the survey of pre-service teachers' knowledge. Based on the framework, theories, and model presented above, the researcher was able to design the conceptual paradigm of this study.

Figure 1. *The conceptual framework showing the relationship between the independent and dependent variables*



Methodology

Research design

This study employed a mixed method design quantitatively and qualitatively. For the quantitative part, the researchers used a correlation design and for the qualitative part, interviews with selected participants were used. This study was likewise correlational for it aimed to determine whether the respondents' socio-demographic characteristics and TPACK self-efficacy were related with classroom integration of ICT.

Sampling procedure

Since the aim of this study was to investigate the integration of ICT in classroom instruction among elementary pre-service teachers, the researcher employed purposive sampling method. Purposive sampling as defined by Black (2010) is a non-probability sampling method and it occurs when "elements selected for the sample are chosen by the judgment of the researcher. Elementary pre-service teachers who were [a] enrolled in the student teaching program this Second Semester 2016-2017; and [b] deployed in Muñoz

South Central School, DepEd-CLSU (Lab.) Elementary School, San Jose West Central School, and San Jose East Central School were selected as respondents of the study. These cooperating schools were chosen over other schools with the assumption that these schools had established ICT programs and had more facilities to support ICT integration in classroom instruction. The initial plan of the researchers was to have a total enumeration of the pre-service teachers who fitted to the abovementioned criteria. As each of them was given a copy of the research questionnaire, not all of them positively responded to the request. Fifty-two (75.4%) pre-service teachers participated in the study.

Instrumentation

Four (4) instruments were used in this study. The first instrument was developed by the researchers covering respondents' socio-demographic characteristics (age, sex, major/ specialization, grade level handled, subjects taught, ICT-related trainings attended, personal ICT equipment, and GPA in ICT-related and Educational Technology courses).The second instrument was based on the *"Survey of Pre-service Teachers' Knowledge of Teaching and Technology"* developed by Schmidt et al. (2009). It consisted of seven sub domains under TPACK framework (TK, CK, PK, PCK, TCK, TPK, and TPCK). These sub-domains included4-10 survey items measuring multiple knowledge domains represented in the framework. Respondents were asked to indicate the degree of their proficiency to the survey items of the instrument on a scale of: 1 – Strongly Disagree, 2 – Disagree, 3 – Agree and 4 –Strongly Agree. A pre-testing was also conducted to pre-service teachers at the Muñoz North Central School to test the reliability of the instrument. To measure internal consistency, alpha reliability coefficient was calculated. The result was 0.951 indicating that the survey questionnaire was reliable considering 0.70 or higher could be considered *"acceptable"* in most social science research situations (Mishra & Koehler, 2006).

The third instrument was utilized to determine pre-service teachers' planning and implemenation by analyzing lesson plans and observing actual demonstrations. Technology Integration Observation Instrument, developed by Hofer et al. (2011),was found to be highly reliable with a computed internal consistency of 0.914 (Cronbach's Alpha). Because of its validity evaluations, it was offered to other researchers for research purposes. Thirty (30) respondents were interviewed during classroom visitations and observations, and analysis of lesson plans. Coding of responses was applied to analyze data for emergent themes. The last instrument was also developed by the researcher and designed to describe ICT program of the cooperating schools in terms of administration, facilities, equipment, and problems relative to teaching and learning.

Methods of data analysis

Based on the objectives and hypotheses of the study, the data were analyzed by using the different statistical methods in Statistical Package for Social Science (SPSS). Descriptive statistics like mean, standard deviation, percentages, ranks and frequency counts were utilized to describe the socio-demographic characteristics, TPACK self-efficacy, and planning and implementation of the respondents. Pearson Product Moment Correlation was used to identify the relationship between the independent and dependent variables. On the qualitative part, coding was applied to analyze data gathered from the thirty respondents for emergent themes (Wolcott, 1990). After repeated readings, overlap shown among codes was reduced when similar codes were clustered together and were combined into a number of broad categories or themes. To provide more detailed background information of the data, the themes were tallied to reveal frequency of responses and were converted to percentage for easier view of the data summary.

Results and Discussion

Socio-demographic characteristics

Age. The age of the respondents ranged from 19 to 32 years old with a mean of 20.06 (SD=2.26). Almost half (48.1%) of the respondents were 19 years old while 40.4 percent of the respondents aged 20 years old. A very small number of respondents (11.5%) was 21 years old and above. This indicated that almost all of the respondents were in the age bracket that could be expected from typical enrollees for this fourth year level of college.

Sex. Based on gathered data, most of the respondents were females (88.5%). This confirmed the typical condition in our educational system where teaching positions were predominated by female.

Major/specialization. Most of the respondents (86.5%) were taking generalist as their specialization while only seven respondents (13.5%) were taking pre-school education. According to the official enrolment report of the Office of Admissions for the school year 2016-2017, the number of Bachelor of Elementary Education (BEEd) students taking Generalist as their specialization was greater than those who were specializing in Pre-school Education.

Grade Level. Findings also indicated that the respondents were widely spread on different grade levels in the cooperating schools. Respondents who handled Grade 5 pupils obtained the highest number (12 or 23.1%), followed by respondents assigned to Grade 3 (9 or 17.3%). The least number (5 or 9.6%) was obtained by respondents who were handling Grade 1 and 2.

Subject taught. Respondents who handled Science obtained the highest frequency (19 or 36.5%), followed by respondents assigned to Mathematics (13 or 25.0%), and Language arts – Filipino and English (11 or 21.2%).

ICT-related trainings attended. More than half of the respondents (53.8%) indicated that they had attended ICT-related trainings and/ or seminars. All of the indicated seminars were categorized as local and primarily provided by the institution. Meanwhile, almost half of the respondents (46.2%) indicated that they had not attended any ICT-related trainings and/or seminar. Probably, the college provided seminars/ trainings but not all pre-service teachers were involved.

Personal ICT equipment. Table 1 also revealed that most of the respondents owned three to four ICT equipment (46.2%). It was followed by respondents with one to two ICT equipment (34.6%). Meanwhile, only three respondents indicated that they owned seven and more number of ICT equipment (5.8%). When asked about the ICT equipment possessed, almost all of the respondents (96.2%) owned cellular/ mobile phone, forty-seven respondents (90.3%) owned personal computers (laptop, desktop, netbook, or notebook). Only four (2.38%) respondents had their own router/ switch/ hub installed with internet connection.

Table 1a. *Socio-demographic characteristics of the respondents*

Characteristics	**Frequency (N=52)**	**Percentage**
Age		
19 years old	25	48.1
20 years old	21	40.4
21 years old and above	6	11.5
Mean ($\bar{x}$) =	*20.06*	*SD= 2.26*
Sex		
Male	6	11.5
Female	46	88.5
Major/ Specialization		
Generalist	45	86.5
Pre-School Education	7	13.5
Grade Level Handled		
Kindergarten/ Pre-elementary	7	13.5
Grade I	5	9.6
Grade II	5	9.6
Grade III	9	17.3
Grade IV	7	13.5
Grade V	12	23.1
Grade VI	7	13.5
Subject Taught		
Mathematics	13	25.0
Science	19	36.5
Language Arts (English/MT/ Filipino)	11	21.2
Araling Panlipunan/Social Science	4	7.7
MAPEH	4	7.7
Values Education	1	1.9

ICT-related trainings and seminars attended		
Attended 1 seminar related to ICT	28	53.8
Did not attend any ICT-related training/ seminar	24	46.2
Number of personal ICT equipment owned		
with 1-2 ICT equipment	18	34.6
with 3-4 ICT equipment	24	46.2
with 5-6 ICT equipment	7	13.5
with 7 and more number of ICT equipment	3	5.8

GPA in educational technology and ICT-related courses. Respondents' academic performance in subjects related to the use of technology in teaching obtained an overall mean of 2.13 which could be verbally interpreted as *"Good"* in the standpoint of CLSU grading scheme. It can also be noticed that the mean of grades obtained by the respondents in Educ 120 (ICT in Education) was 2.15 (Good), in Educ 120a (Educational Technology I was 2.18 (Good) and in Educ 120b (Educational Technology II) was 2.08 (Good). Only eight respondents obtained a grade of 1.00 – 1.50 (Excellent) in all ICT-related courses taken.

Table 1b. *GPA in educational technology and ICT-related courses*

Grade Range	Frequency (N=52)			Descriptive Rating
	ICT in Education (Educ 120)	Educational Technology I (Educ 120a)	Educational Technology II (Educ 120b)	
1.00-1.50	3.0	1.0	4.0	Excellent
1.51-2.00	26.0	22.0	30.0	Very Good
2.01-2.50	16.0	25.0	14.0	Good
2.51-2.75	1.0	4.0	1.0	Fair
2.76-3.00	6.0	0.0	3.0	Passing
Mean=	*2.15*	*2.18*	*2.08*	
SD=	*0.41*	*0.29*	*0.37*	
Overall Mean		**2.13**	**Good**	

Legend:
1.00-1.50 Excellent
1.51-2.00 Very Good
2.01-2.50 Good
2.51-2.75 Fair
2.76-3.00 Passing

TPACK self-efficacy

Table 2 presents the TPACK self-efficacy of the respondents. Analyzing the data presented, they posted an overall TPACK self-efficacy mean of 3.03 which determined that their TPACK self-efficacy levels were at the level of "*High proficiency*". Also, the overall standard deviation was 0.31 indicating a narrow distribution of responses. These findings could be possibly attributed to the prior experiences of the respondents in using technology in teaching as all of them underwent ICT-related courses such as ICT in education, Educational Technology I, and Educational Technology II. Among the domains in the TPACK framework, TCK and TPK obtained the highest means($\bar{x}$ =3.20, 3.13 respectively). Meanwhile, TK obtained the lowest mean($\bar{x}$ =2.87).It can also be noticed that respondents were found to be highly proficiency in all items except for item "*I can explain advantages of using technology in a content area"* which had a descriptive rating of *Very high proficiency* ($\bar{x}$ =3.31).

Technology knowledge (TK). TK of the respondents had an overall mean of 2.87 which indicated that respondents were found to be highly proficient in this domain. All items under this domain received a descriptive rating of *"Agree"*. The overall standard deviation of 0.27 indicated that respondents' answers were narrowly dispersed in terms of TK. It can be implied that elementary pre-service teachers perceived themselves that they had sufficient knowledge to learn technologies easily and technical skills needed to use technology. These findings supported the results determined by Kazu and Erten (2014) in testing TPACK self-efficacies of preservice teachers in Turkey.

Content knowledge (CK). By looking at the respondents' self-efficacy under CK, it was indicated that respondents were highly proficient on matters concerning content based on the overall mean obtained ($\bar{x}$ =2.97). These finding supported the study of Kazu and Erten (2014) that pre-service teachers perceived themselves as proficient in various lesson contents. These results could also be related to the respondents' degree program (Bachelor of Elementary Education) where different content areas were included in their curriculum. Also, interdisciplinary integration was included in professional subjects allowing them to relate two subject contents in one lesson.

Pedagogical knowledge (PK). The domain PK had an overall mean of 3.00 and standard deviation of 0.25, which means that respondents' knowledge on teaching was sufficient. It also showed that all items under PK received a descriptive rating of *"Agree"*. The same result was obtained by Kazu and Erten (2014) where pre-service teachers viewed themselves as efficacious when it came to assessing student performance. These findings suggested that pre-service teachers had sufficient self-efficacies on classroom management, learning and teaching methods, learning and teaching processes and practices.

Pedagogical content knowledge (PCK). The overall mean of the items was 2.99 with a descriptive rating of *"High proficiency"* and the standard deviation was 0.27.These findings implied that respondents' perceived knowledge of the pedagogies and teaching practices was sufficient. As suggested by Aquino (2015), this can also be attributed to having professional subjects which covered the preparation, utilization of different methods and strategies to teach a specific content area. Moreover, respondents were exposed to lesson plan development and demonstrations aligned to different subject matters during their student teaching program.

Technological content knowledge (TCK). Respondents suggested that their knowledge in this domain was sufficient. With an overall mean of 3.20 and standard deviation of 0.36, respondents were found to be highly proficient in this domain. These findings coincided with the findings of Aquino (2015) where she found out that science pre-service teachers' high TCK can be attributed to their personal ICT equipment or devices. Most of the respondents had possession of mobile phones and computers which can be used to gather and analyze data or information about a specific content.

Technological pedagogical knowledge (TPK). On the aspect of TPK, respondents revealed that they had sufficient understanding of how teaching and learning changed when particular technologies were used. With an overall mean of 3.13 and standard deviation of 0.37, respondents were found to be highly proficient in this domain. This entailed that respondents had confidence on their use of technologies to improve teaching and learning. Respondents' adaptation and use of technology to different teaching activities can be associated with their possessed ICT devices. This was observed by the researcher and the cooperating teacher during their implementation of the lesson. Majority of them used computer as in various ways to support different teaching activities (e.g. using the computer for drill, review, motivation, and application).

Technological pedagogical content knowledge (TPCK). This domain was seen as the intersection of all three bodies of knowledge. Understanding of this knowledge could go above and beyond understanding technology, content, or pedagogy in isolation, but rather as an emergent form that understands how these forms of knowledge interact with each other (Koehler and Mishra, 2008). TPCK obtained an overall mean of 3.07 with a descriptive rating of *"Agree (High proficiency)"*and standard deviation of 0.42. All of the items under this domain also got a descriptive rating of *"Agree"* which revealed that respondents had confidence that they were highly proficient in this domain. As argued by Aquino (2015), the way pre-service teachers viewed the interrelationship of content, pedagogy and technology resulted to their confidence in choosing and utilizing technologies that would enhance their teaching and learning of a specific content or topic. This can be associated with their learning experiences while they were attending classes in college and performing demonstration teaching inside and outside the campus.

Table 2. *Summary of respondents' TPACK self-efficacy*

Domains	Mean	SD	Descriptive Rating
Technology Knowledge (TK)	2.87	0.27	Agree
Content Knowledge (CK)	2.97	0.24	Agree
Pedagogical Knowledge (PK)	3.00	0.25	Agree
Pedagogical Content Knowledge (PCK)	2.99	0.27	Agree
Technological Content Knowledge (TCK)	3.20	0.36	Agree

Technological Pedagogical Knowledge (TPK)	3.13	0.37	Agree
Technological Pedagogical Content Knowledge (TPCK)	3.07	0.42	Agree
Overall TPACK Self-efficacy	3.03	0.31	Agree

Legend:
3.26-4.00 Strongly Agree (Very high proficiency)
2.51-3.25 Agree (High proficiency)
1.76-2.50 Disagree (Low proficiency)
1.00-1.75 Strongly Disagree (Very low proficiency)

ICT integration in classroom instruction

Table 3 presents the results of classroom observations and analysis of lesson artifacts during the student teaching program. To generate quantitative data from observations, the researcher utilized the *"Technology Integration Observation Instrument"* developed by Hofer et al. (2011) during actual demonstration. It can be observed that pre-service teachers' ICT integration in classroom instruction obtained an overall mean of 3.06 and standard deviation of 0.36 which implied that most of the observed lessons were rated as *"good"*.

Based on the gathered data, most of the respondents were observed to have selected technologies aligned with one or more curriculum goals set on their lesson plans. With a mean of 3.18, the alignment of curriculum goals and technologies was described to be *"good*". Most of the respondents were also observed to have used technologies to support instructional strategies ($\bar{x}$ =3.10) and had their content, instructional strategies, and technology fitted together within their lesson plans ($\bar{x}$ =2.85). Technology selections of the respondents were also considered appropriate and *"good*" based on the observed lesson plan ($\bar{x}$ =3.10). Most of the respondents were also considered *"good*" and effective in using technologies in instruction ($\bar{x}$ =3.11). Teachers and students were able to use and operate the technologies presented in the class ($\bar{x}$ =2.94).These findings indicated that most of the respondents were *"good*" in planning and implementing technology-integrated lesson in the classroom.

Planning. When asked about what encouraged the respondents to select a topic or concept for integration of technology, majority of the respondents disclosed that the improvement of pupils' learning was their priority (17 or 32.7%) Increasing pupils' motivation (12 or 23.1%) and ease of introducing a topic (10 or 19.2%) were also considered in the selection of topic and technology to be integrated. These findings can be attributed to their confidence level in TPK and TPCK domains which indicated that they were highly proficient in explaining the advantages of using technology in a content area and selecting technologies to use that would enhance their teaching and support students' learning.

Moreover, all of the respondents indicated that learning a lesson integrated with technology was a good idea. One respondent claimed: "*I incorporated technology in this lesson because it helped my students to understand our lesson by listening to the audio recorder. Other than that, it's a way to motivate them to listen and participate in our discussion*." It was also worth mentioning that majority of the respondents revealed that the materials (e.g., pictures used in the presentation, video presentation) they used in the implemented lesson were obtained from other sources (e.g., internet-based materials, downloaded files).

Table 3. *Results of classroom observation and analysis of lesson plans*

Criteria	Mean	SD	Descriptive Rating	
Planning				
Curriculum Goals and Technologies (Curriculum-based technology use)	3.18	0.49	Good	Technologies selected for use in the instructional plan are aligned with one or more curriculum goals.
Instructional Strategies and Technologies (Using technology in teaching/ learning)	3.10	0.53	Good	Technology use supports instructional strategies.
Technology Selection(s) (Compatibility with curriculum goals &instructional strategies)	2.85	0.35	Good	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.
Fit(Content, pedagogy and technology together)	3.10	0.51	Good	Content, instructional strategies and technology fit together within the instructional plan.
Overall Mean	**3.06**	**0.30**	**Good**	
Implementation				
Instructional Use (Using technologies effectively for instruction)	3.11	0.49	Good	Instructional use of technologies is effective in the observed lesson.
Technology Logistics (Operating technologies effectively)	2.94	0.40	Good	Teacher and/or students operate(s) technologies well in the observed lesson
Overall Mean	**2.96**	**0.31**	**Good**	
Overall ICT Integration	**3.06**	**0.31**	**Good**	

Legend:
- 3.26-4.00 Best
- 2.51-3.25 Good
- 1.76-2.50 Fair
- 1.00-1.75 Poor

Other respondents used self-created materials while other used a combination of self-created materials and materials obtained from other materials. Some respondents modified and customized materials obtained from other sources. One respondent shared*: "I searched for a video in YouTube and edited it a little*". Another participant commented: "*Audio clips are downloaded from YouTube".* Respondents were also asked about the activities or exercises they prepared for teaching their lesson with technology. Most of the respondents used technology for presentation and illustration (22 or 42.3%), interactive activities (9 or 17.3%), and listening activities involving audio materials (6 or 11.5 %).

Preparations made by the respondents were also affected by the use of technology. Almost all of them felt prepared to teach the lesson using technology. When asked about how the incorporation of technology affected their preparations, half of the participants revealed that the use of technology made their preparations faster and easier. However, twenty-five per cent of the respondents said that it required time and effort to finish the materials of the lesson. Mixed perceptions of the respondents can be explained by how they obtained materials appropriate for their lesson and how they used ICT tools for the preparation of their materials.

Almost half of the respondents indicated that they had obtained their materials from other sources (which materials were commonly downloaded from the internet, e.g. video clip). Correspondingly, almost half of them disclosed that they used these materials for presentation/ illustration. Obtaining readily available materials, which were compatible with their set lesson objectives and aligned with their teaching strategies, positively impacted their preparation for their lessons by making them cost and time efficient. When interviewed, one respondent said, "*In preparing my lesson, technology helped me save time and effort; and my expenses decreased".* Another respondent commented: *"Well, I prepared differently because incorporating technology in the preparation of my lesson made everything a lot easier than preparing using traditional materials."*

On the other hand, there was a likely possibility that respondents who had indicated that they had put more effort and time in the preparation of their lesson may be those whose prepared materials were self-created. It can also be related to the teaching activities they were trying to implement and accessibility of needed equipment/ tools. As one respondent said, *"The incorporation of technology was not easy because it took time to prepare the presentation and [there is] lack of equipment to be used."* Respondents' motivation relative to technology integration jived with their expectations. Most of them had expectations that because of technology integration, their students would learn the lesson easily (38 or 73.1%). Further, they also expected that their students did the activities in the lesson actively (6 or 11.5%) and appreciated the use of technology in learning (6 or 11.5%).

Implementation. Respondents, during implementation of the lesson, were rated as "good" in terms of instructional use of technology and operation of technology inside the classroom (see Table 3).When observed, they were comfortable in using the technology in teaching the lesson. When asked about what aspect of technology-integrated lesson went well and supported student learning, most of the respondents disclosed that the use of technology in developmental activities (20 or 38.5%) and abstraction (11 or 21.2%) helped the students in learning the content or topic of the lesson. Moreover, the operation of the technology was thought to be helpful in supporting the students. They also described their students as more engaged and active during the lesson. Students' attention to the content was also sustained.

Some of the respondents believed that they needed to improve their activities in application (9 or 17.3%), utilization of technology inside the classroom (8 or 15.4%), classroom management (6 or 11.5%), communication skills (5 or 9.6%), and motivational activities (5 or 9.6%).When asked about what were the difficulties they had in guiding the students to use technology, they disclosed that students were not behaving properly (14 or 26.9%), too focused on the technology use and did not listen to their instructions (13 or 25.0%), and did not use the technology properly (7 or 13.5%).

Contextual factors affecting technology integration. During observation, contextual factors that affected the planning and implementation of technology-integrated lesson were also considered. These were used to help scorers analyze the observed lesson objectively in relation to the content objectives and teaching approaches/ methods employed by the respondents. Based onTable **4**, there were contextual factors that positively and negatively affected the observed lesson. Among the positive contextual factors noted during observation, the suitability of technology used for instruction (41 or 78.8%) was the most observable. This indicated that respondents were able to use the technology to support teaching learning during the progress of the lesson. It was followed by respondents' methods, strategies, and techniques used inside the class (39 or 75.0%); and students' attitude towards learning (9 or 17.3%). On the other hand, frequent contextual factors that negatively affected the observed lesson were the following: availability of needed technology (22 or 42.3%), medium of instruction (20 or 38.5%), and behavior of students (11 or 21.2%).

Table 4. *List of factors that affected the observed lesson*

Contextual Factors	Frequency (N=52)	Percentage	Rank
Positive contextual factors			
Suitability of technology used for instruction	41	78.8	1
Method, strategy, and techniques	39	75.0	2
Attitude of students towards learning	9	17.3	3
Negative contextual factors			
Availability of needed technology	22	42.3	1
Medium of instruction	20	38.5	2
Behaviour of students	11	21.2	3
Classroom management	6	11.5	4
Large class size	5	9.6	5.5
Diversity of students	5	9.6	5.5

List of materials used during the observed lesson. Following the modified guidelines set for the use of Technology Integration Observation Instrument, the researcher recorded all ICT Tools/ Equipment used in the lesson implementation for the purpose of discussion. Among the ICT Tools used in the observed lessons as shown in Table 5, computer (42 or 80.8%) was the most frequent ICT material used by the respondents. Most of these computers (laptop, netbook, and notebook) were personally owned by the respondents. It was followed by television (8 or 15.4%), projector (7 or 13.5%) and speaker (7 or 13.5%).

Table 5. *List of ICT equipment/ tools used during lesson*

ICT Equipment/ Tools Used	Frequency (N=52)	Percentage	Rank
Computer	42	80.8	1
Television	8	15.4	2
Projector	7	13.5	3.5
Speaker	7	13.5	3.5
Audio recorder and player	2	3.8	5.5
DVD/ CD player	2	3.8	5.5

ICT program of cooperating schools

Cooperating Schools are very important in the culmination of prospective teachers. They are said to be key partner institutions providing real-world experience to practicing student teachers.

Administration. All schools had ICT coordinators (9 or 100.0%) and more than half (5 or 55.6%) had designated ICT teachers. While it was true that there were ICT coordinators as mandated by the Department of Education, it was worthy to mention that none of the participating schools had ICT technician which was vital in maintaining the equipment in the school. Less than half of the schools (4 or 44.4%) had budget for the implementation of the school ICT program plan.

Facilities and equipment. Seven schools (77.8%) had ICT building/ room. All of the schools with ICT building/ room had computer tables, chairs, and proper electrical wirings. It can also be observed that only three schools (33.3%) indicated that they had ICT building/ room with at least ten networked personal computers and air-conditioning units. All schools were using Windows Operating System. Four schools (44.4%) stated that their internet service provider was Globe Telecom while three schools (33.3%) indicated PLDT.

It was indicated that all schools had available LCD projectors, desktop computers, and printers. Based on the gathered data, LCD projector obtained the highest total number of available units (72), followed by desktop computer (67), and television (51). Meanwhile, Telephone (7), Interactive whiteboard (7) and digital camera (5) garnered the least total number of available units. It was worth mentioning that among the schools with LCD projectors; only one cooperating school indicated a total number of fifty available units which was relatively larger than other schools with 1-5 projector units. Moreover, only three schools stated that the total number of their available desktop computers units were more than ten.

Table 6. *List of equipment available in cooperating schools*

List of Equipment	Frequency (N=9)	%	Total No. of Units
LCD Projector	9	100.0	72
Desktop Computer	9	100.0	67
Television (connected to cable)	7	77.8	51
Laptop/ Netbook/ Notebook Computer	8	88.9	44
Printer	9	100.0	35
Scanner	6	66.7	14
CD/ DVD Player	7	77.8	12
Telephone	6	66.7	7
Interactive whiteboard	7	77.8	7
Digital/ Video Camera	4	44.4	5

Problems relative to ICT integration in teaching and learning. The researcher also asked common problems relative to ICT integration teaching and learning in cooperating schools. Coding of answers was done to categorize the themes of the answers expressed by the respondents. As shown in Table 7, insufficient number of computer units (3 or 33.3%); lack of ICT teacher/ technician in the school (3 or 33.3%); and lack of trainings to enhance teachers' knowledge of ICT (3 or 33.3%) tied in the first rank. These were followed by Poor network connection (2 or 22.0%); lack of budget to implement the program (1 or 11.0%); and defective computer units (1 or 11.0%).

Table 7. *Problems relative to ICT integration in teaching and learning*

Problems	Frequency (N=9)	Percentage	Rank
Insufficient number of computer units	3	33.0	2
Lack of ICT teacher/ technician in the school	3	33.0	2
Lack of trainings to enhance teachers' knowledge of ICT	3	33.0	2
Poor internet connection	2	22.0	4
Lack of budget to implement the program	1	11.0	5.5
Defective computer units	1	11.0	5.5

Relationship between elementary pre-service teachers' socio-demographic characteristics and ICT integration in classroom instruction

Based on the result shown in Table 8, GPA in Educational Technology and ICT-related courses was found to have highly negative significant relationship with pre-service teachers' planning of instructional strategies and technologies (*r*=-0.623) while the rest of the variables were found to have no relationship with their ICT integration in classroom instruction.

GPA and instructional strategies and technologies. It was found that GPA in Educational Technology and ICT-related courses obtained a highly negative significant relationship with pre-service teachers' planning of instructional strategies and technologies (*r*=-0.623). The negative correlation can be explained as the mean grade of respondents in subjects related to technology integration which was set to 1.00 as the highest number value while 3.00 as the lowest . The researcher based this order from the grading scheme of Central Luzon State University where the highest possible passing grade that can be given to an individual is 1.00 (excellent) while the lowest possible passing grade is 3.00 (Passing).

Table 8. *Relationship between respondents' socio-demographic profile and ICT integration*

	Planning				Implementation	
	Curriculum Goals and Technologies	Instructional Strategies and Technologies	Technology Selection(s)	Fit	Instructional Use	Technology Logistics
Age	-0.144	-0.05	-0.05	0.004	-0.139	0.004
Sex	-0.137	0.159	0.068	-0.009	0.108	0.096
Major/ Specialization	-0.091	-0.239	0.087	-0.019	-0.028	0.135
Grade level handled	0.002	0.191	-0.003	0.077	-0.024	-0.144
Subject taught	-0.052	0.055	0.038	0.081	-0.118	0.146
ICT-related trainings and seminars attended	0.25	0.08	0.146	0.015	0.156	0.172
Number of personal ICT equipment owned	0.146	0.133	0.148	0.033	0.056	0.085
GPA in Educational Technology courses	-0.086	-0.623**	-0.144	0.004	-0.217	0.101

**Correlation is significant at p<0.01.
*Correlation is significant at p<0.05.

Thus, this relationship indicated that higher academic performance of respondents in technology-related courses positively affected their integration of technology in classroom instruction, particularly their planning of instructional strategies and technologies to be utilized. It was also supported by the data gathered through interview. In the summary of coded responses from the result of interview conducted after the observation, respondents suggested that because of the educational technology courses they had attended, they became prepared and knowledgeable on how to integrate ICT in their lessons. Furthermore, these courses also helped them create lessons that were easier to discuss and understand; helped them create good presentations; and helped them gain confidence in using technology inside the classroom.

It was worth mentioning that when respondents were asked about their preparation in their educational technology courses, they had indicated that their professors/ instructors helped and prepared them to successfully integrate technology in their lessons. On the other hand, other variables were found to have no relationship with pre-service teachers' ICT integration in classroom instruction. These findings could have been affected by the homogeneity of the samples. Meanwhile, numerous studies found similar results where these factors were not significantly correlated with technology integration (Berry, 2011; Brunk, 2008; Chen, 1986; Inan & Lowther, 2010; Karakaya & Avgin, 2016; Schulze, 2014). Age, for instance, was found to have no direct relationship with teachers' integration of technology in instruction. As disclosed by Schulze(2014) in his study to determine relationship between teacher characteristics and educational technology, technology integration and respondent age did not seem to have a dominate age group for integration. This result was also supported by technology experiments conducted by Berry (2011), Brunk (2008), and Inan and Lowther (2010). As cited by Schulze (2014), they found that age did not seem to play a role in determining the amount of technology integration.

Sex, which was considered one of the limitations of this study, had found to be not correlated with technology integration and TPACK. The fact that gender might affect teachers' attitudes toward ICT was firstly rejected in Chen's (1986) study, where he found no correlation between gender and teachers' attitudes in integrating technology in instruction. On a study conducted by Karakaya and Avgin (2016), it was understood that there was no statistical logical difference between male and female respondents' TPACKSCS and other sub-dimensions of TPACK (TCK, TK). This confirmed the results that there were no statistically significant differences among pre-service teachers' self-efficacy perception levels towards technology integration based on gender (Keser, Yilmaz, & Yilmaz, 2015). In other words, it can be explained that being male or female did not have an impact on self-efficacy perception level towards technology integration and actual integration of technology in classroom instruction. However, this assumption was not statistically proven given the uneven number of respondents in this study.

Moreover, ICT-related trainings and seminars attended and number of personal ICT equipment owned by the respondents were found to be not significantly related to their integration of technology. Although more than half of the respondents indicated that they had attended one seminar related to ICT, the results showed that this did not have any relationship with their performance in integrating technology in the classroom. This can be interpreted in a way that while trainings and seminars may positively affect an individual's knowledge about technology, it may have limited impact on classroom practice.

Relationship between elementary pre-service teachers' TPACK self-efficacy and ICT integration in classroom instruction

Table 9 shows the relationship between the respondents' TPACK self-efficacy and ICT integration in classroom instruction. It was found that all TPACK sub-domains were significantly related to technology integration.

Technology knowledge (TK) and ICT integration. It was found that respondents' perceived TK had highly significant relationship with technology selections (r=0.526) and technology logistics (r=0.542).Based on the data presented, the subdomain TK had a highly significantly relationship with technology selections (r=0.526). This indicated that respondents' perceived knowledge about various digital technologies, such as the internet, digital video, interactive whiteboards, and software programs, was significantly related to their planning and selection of technology appropriate to the curriculum goals of their lesson and instructional strategies to be employed. It also revealed that respondents' TK was highly correlated to technology logistics (r=0.542) which indicated that their perceived knowledge on various digital technologies greatly affected their use and operation of technologies during implementation of the lesson.

These findings can be explained by the respondents' self-efficacy in selection and utilization of technologies to be used appropriate in teaching and learning content. This coincided with the results found by Mustafina (2016) that the level of confidence and knowledge that the respondents possessed played a significant role in their attitudes toward technology. These aspects predetermined the teachers' acceptance of this technology and their *"likelihood"* to use ICT in pedagogical/teaching practices.

Respondents reported that they were highly proficient when it came to knowledge related to technology. This was verified when respondents disclosed that they chose appropriate technologies for the improvement of pupils learning of the topic and they were comfortable in using technology inside the classroom. Their high confidence in perceived TK and actual use of technology in lesson implementation can also be related to the exposure to available technologies. Based on the given data in Table 5, almost all of them used computers as ICT tool in teaching and learning a subject content which was one of the common ICT tool they were exposed to. Therefore, it also supported this relationship between having technical skills in using technologies and gaining technical competency in using ICT tools in teaching and learning.

Content knowledge (CK) and ICT integration. As shown in Table 9, perceived CK of the respondents was found to have significant relationship with Technology Selection, Fit, and Technology Logistics. Though the significance of the correlation was not high, the data still suggested that respondents' perceived CK was related to their selection of appropriate technology in relation to curriculum content and instructional strategies

(r=0.306). Respondents' perceived CK was also found to be significantly correlated to the fitness of curriculum goals, instructional strategies, and technologies used in the instructional plan (r=0.285). It was also indicated that their perceived CK had a significant relationship with their utilization of technologies during implementation of a lesson (r=0.316). This suggested that their knowledge about various subjects/ topics can affect the way they used a particular technology inside the classroom.

Subject matter/content was a thought to be a major factor that a teacher should consider when it comes to planning teaching and learning activities and selecting appropriate technologies. Respondents' understanding of the content to be taught (having sufficient knowledge about various content areas; explaining various concepts in a specific content area; having various ways and strategies of developing understanding of a specific content area; and making appropriate connections to other content areas) had a direct effect on their selection and use of appropriate technologies to be used. This clearly supported Shulman's(1986) claim that teachers must know and understand the subject they teach before they present to the students. Otherwise, teachers who did not have these understandings can misrepresent those subjects to their students as argued by Ball and McDiarmid (1990).

Table 9. *Relationship between respondents' TPACK self-efficacy and ICT integration*

	PLANNING				IMPLEMENTATION	
	Curriculum Goals and Technologies	Instructional Strategies and Technologies	Technology Selection(s)	Fit	Instructional Use	Technology Logistics
Technology Knowledge (TK)	0.13	0.055	0.526**	0.173	0.062	0.542**
Content Knowledge (CK)	0.213	0.147	0.306*	0.285*	0.214	0.316*
Pedagogical Knowledge (PK)	0.280*	0.049	0.175	0.169	0.107	0.462**
Pedagogical Content Knowledge (PCK)	0.213	0.279*	0.303*	0.028	0.176	0.420**
Technological Content Knowledge (TCK)	0.415**	0.459**	0.292*	0.045	0.388**	0.162
Technological Pedagogical Knowledge (TPK)	0.384**	0.547**	0.449**	0.171	0.388**	0.342*
Technological Pedagogical Content Knowledge (TCPK)	0.553**	0.451**	0.355**	0.389**	0.532**	0.313*

**Correlation is significant at $p<0.01$.
*Correlation is significant at

Pedagogical knowledge (PK) and ICT integration. The table shows that respondents' PK had a significant relationship with their use of curriculum-based technologies and had a highly significant relationship with the operation of these technologies inside the classroom. The data revealed that respondents' perceived knowledge of different teaching strategies was significantly correlated with curriculum goals and technologies (*r*=0.280). As shown in Table 9, respondents' perceived PK had been found to have highly significant relationship with technology logistics (*r*=0.462). Argued by Mishra and Koehler (2008) in their paper about technology integration, this domain pertained to deep knowledge about the processes and practices or methods of teaching and learning and how it encompassed (among other things) overall educational purposes, values and aims. Respondents reported that they had understanding of different teaching methods and strategies which could be helpful in improving students' learning.

This knowledge had been their selection of technology to achieve the set objectives (curriculum goals) because it required them to have an understanding of cognitive, social and developmental theories of learning and how they applied to students in their classroom (Mishra & Koehler, 2008). Thus, appropriate use of technology should be based on a teacher's devised teaching and learning activities.

Pedagogical content knowledge (PCK) and ICT integration. It was found out that this domain was significantly related to instructional strategies and technologies, technology selections, and technology logistics. As Table 9shows, respondents' PCK had a significant relationship with their planning of instructional strategies and technologies (*r*=0.279). Respondents' perceived PCK was also found to be significantly correlated with technology selections (*r*=0.303). The data also revealed that their perceived knowledge under this domain had a significant relationship with technology logistics (*r*=0.420).

PCK was actually based on the concept of Shulman (1986) about the intersection of pedagogy and content in education which includedrepresentation and formulation of concepts,pedagogical techniques, knowledge of what madeconcepts difficult or easy to learn, knowledge of students' prior knowledge and theories of epistemology. However, Donald (2002) claimed that different disciplines emphasized certain processes and under-emphasized others. For example, verification in Science subject would be pragmatic, while in English subject, verification would be a search for interpretive coherence.

The knowledge of evaluating what technological tools should be used to support teaching and learning of the concept was clearly demonstrated by most of the respondents during the observed lesson. Developmental strategies and abstraction were found to be the key aspects which helped students fully understand the lesson. In relation to this, students were also found to be more engaged and active during the lesson and their focus on the content was sustained.

Technological Content Knowledge (TCK) and ICT Integration. TCK of the respondents was found to be highly correlated with their curriculum-based use of technology, instructional strategies and technologies, and instructional use during implementation of the lesson. Respondents' perceived TCK had a significant relationship with Curriculum Goals and Technologies (*r*=0.415). It was also revealed that their perceived

TCK was highly associated with instructional strategies and technologies (*r*=0.459). Table 9 also reveals that respondents' knowledge of this sub domain had a significant relationship with their use of technology for instruction during implementation of the lesson (*r*=0.388).

Understanding the manner in which technology and content influenced and constrained one another was the focus of this domain. These findings supported the study of Mishra and Koehler (2008) that teachers needed to master more than the subject matter they taught, they must also have a deep understanding of the manner in which the subject matter (or the kinds of representations that can be constructed) can be changed by the application of technology. Based on respondents' performance and self-efficacy under this domain, it can be concluded that their TCK had a direct relationship with their preparation of technologies aligned with curriculum goals. As Mishra and Koehler (2008) claimed, teachers should understand which specific technologies were best suited for addressing subject-matter learning in their domains and how the content dictated or perhaps even changed the technology - or vice versa.

Technological pedagogical knowledge (TPK) and ICT integration. This part presents the results of relationship between respondents' perceived TPK and their actual integration of ICT in classroom instruction. As shown in Table 9, respondents' knowledge in this domain had a highly significant relationship with curriculum goals and technologies, instructional strategies and technologies, and technology selections. It also was significantly related to technology logistics. The data revealed that respondents' knowledge on the use of technology to effectively implement a teaching strategy had a highly significant relationship with curriculum goals and technologies (*r*=0.384). As shown in Table 9, respondents' TPK was found to have highly significant correlation with instructional strategies and technologies (*r*=0.547).Respondents' knowledge on this domain was also revealed to have a highly significant relationship with technology selections (*r*=0.449).

The data also revealed that their TPK had a significant relationship with technology logistics (*r*=0.342). Observation results showed that among the factors that positively affected the integration of ICT in the lesson, suitability of the technology used was the most highly observable. It was followed by methods and strategies. Aside from this, gathered data also revealed that developmental strategies and abstraction were the aspects of technology-integrated lesson that greatly impacted the students' learning. Along with these results, students were observed to have learned the content of the lesson. These clearly established a direct positive relationship between their perceived PCK and their actual integration of technology in classroom instruction. Respondents were observed to have deeper understanding of the constraints and affordances of technologies and the disciplinary contexts within which they functioned. Knowing these pedagogical affordances and technological constraints, they were able to plan disciplinarily and developmentally appropriate pedagogical designs and strategiesreporting similar results with Mishra and Koehler (2008).

Technological pedagogical content knowledge (TPCK) and ICT integration. TPCK of the respondents was found to have significant relationship with their planning and implementation during ICT integration in classroom instruction. It had been found to be significantly correlated with all the elements of planning: curriculum-based use of technology (r=0.553); planning and strategies (r=0.451); technology selections (r=0.355); and fitness of technology, content, and pedagogy (r=0.389). It was also found to have relationship with their instructional implementation: instructional use (r=0.532) and technology logistics (r=0.313).

TPCK was defined as the *"intersection of all three bodies of knowledge"* (Mishra & Koehler, 2008). Understanding of this knowledge could be above and beyond understanding technology, content, or pedagogy in isolation, but rather as an emergent form that understands how these forms of knowledge interact with each other. Respondents' TPACK self-efficacy was found to have direct relationship with ICT integration. Thus, it can be concluded that developing technological content knowledge among pre-service teachers could be very important to effectively integrate ICT in classroom instruction. As argued by numerous researchers, technology integration in teaching and learning required understanding the dynamic, transactional relationship among these three knowledge components (Abbitt, 2011; Bruce & Levin, 1997; Dewey & Bentley, 1949; Harris, Mishra, & Koehler, 2009; Mishra & Koehler, 2008; Rosenblatt, 1978).

Problems relative to integration of ICT in classroom instruction

Table 10 shows the problems encountered by respondents in integrating ICT in classroom instruction. It can be noticed that among the problems identified, *"lack of internet connection/ slow connectivity"* (27 or 51.9%) and *"lack of computers, equipment and devices"* (21 or 40.4%) obtained the highest frequency. These results could be associated with the problems identified by the cooperating schools: insufficient number of computer units and poor network connection (*see* Table 7). These problems affected the use of technology inside the classroom, limiting the possible ways of preparation and implementation of technology-integrated lesson.

Table 10. *Problems encountered by respondents in integrating ICT in classroom instruction*

Problems Relative to ICT Integration	Frequency (N=52)	Percentage	Rank
Lack of internet connection/ slow connectivity	27	51.9	1
Lack of computers, equipment and devices	21	40.4	2
Lack of technical knowledge in using various devices	5	9.6	3
Lack of electricity	2	3.8	4
Lack of preparations in creating videos and presentations	1	1.9	5.5
Insufficient learner's capacity in using the ICT equipment	1	1.9	5.5

Conclusions and Recommendations

Conclusions

Based on the results of the study, the conclusions were drawn. Most of them were female and taking generalists as their specialization. This implied that there was homogeneity when it came to the respondents who participated in the study. Further, only half of them attended a local ICT-related seminar conducted by the institution. Respondents reported that opportunities to work with different technologies were insufficient. It meant that most of the respondents were not able to use various technologies in the courses that they had attended .Most of the respondents were able to integrate ICT in classroom instruction. In terms of overall ICT integration, they were found to be *"good"* in all components of technology integration – planning and implementation. Most of their instructional materials were obtained from other sources and were commonly used for presentations/ illustrations. None of the cooperating schools had employed ICT technician which was found vital in maintaining ICT equipment in the school. The leading problems reported by schools relative to integrating ICT in teaching and learning were insufficient number of computer units, lack of ICT teacher/ technician in the school, and lack of trainings to enhance teachers' knowledge of ICT.

GPA of the respondents in Educational Technology and ICT-related courses had highly but negative significant relationship with their preparation and implementation of instruction integrated with technology. It implied that pre-service teachers with higher academic performance performed better in preparation and implementation of technology-integrated lessons. Pre-service teachers' TPACK self-efficacy had highly significant relationship with their preparation and implementation of technology-integrated instruction. This tended to suggest that the higher TPACK self-efficacy of pre-service teachers, the more effective they would be in integrating technology in classroom instruction.

Recommendations

In the light of the results and conclusions of this study, the following measures are strongly recommended:

1. Although age, sex, grade level handled, subject taught, ICT-related trainings attended, and personal ICT equipment were not found to be related to pre-service teachers' integration of ICT, these factors should still be considered by other researchers. Since homogeneity of samples affected the results of this study, future researchers should include good and large distribution of samples. Moreover, participation of pre-service teachers to various ICT-related seminars should be encouraged by the institution.

2. Since respondents reported that opportunities to work with different technologies were insufficient, professors/ instructors of Educational Technology and ICT-related courses should be encouraged to provide opportunities for pre-service teachers to use a wide range of technologies in classroom instruction.
3. While most of the respondents were able to integrate ICT in classroom instruction, the College of Education should provide more opportunities for the pre-service teachers to further develop their skills in using technology in classroom instruction. Pre-service teacher should also be trained in selecting and creating instructional materials; and utilization of these materials in various instructional techniques.
4. Cooperating schools should be encouraged to develop plans to improve their ICT program. Furthermore, concerned government units should also be advised about the problems encountered relative to ICT integration in classroom instruction (e.g. insufficient number of computer units, lack of ICT teacher/ technician in the school, and lack of trainings to enhance teachers' knowledge of ICT).
5. Since GPA of pre-service teachers in Educational Technology and ICT-related courses was found to be significantly related to their development of technology-integrated instruction, Teacher Education Institutions, particularly the College of Education, should strengthen Educational Technology and ICT-related courses by engaging students to various activities essential for the development of their ICT integration in classroom instruction.
6. Since pre-service teachers' TPACK self-efficacy was found to have significant relationship with their ICT integration in classroom, pre-service teachers should be encouraged to develop their TPACK. TPACK-oriented trainings should also be provided by the institution for them to fully understand the multidimensional aspects of technology integration.

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