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Pre-Service Teachers' Technology Literacy Skills for Blended Learning: Case of Four Universities in Baguio City and Benguet, Philippines

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Abstract

The study aimed to determine the level of technology literacy skills of pre-service teachers necessary for blended learning. The study employed the descriptive comparative design. Respondents of the project included 467 pre-service teachers from four public and private universities in Baguio and Benguet, Philippines. Descriptive and inferential statistics were used to treat the data gathered. Findings revealed that pre-service teachers are moderately capable in their technology literacy skills necessary for blended learning. There is no difference in the technology literacy skills regardless of the pre-service teachers' degree program. However, those from private teacher education institutions (TEIs) manifested higher technology literacy skills than their public TEI counterpart.

Introduction

Information and communications technology (ICT) has become an imperative tool in learning and teaching. ICT offers engaging and fast-evolving learning environments, blurs the boundaries between formal and informal education, and prompts teachers to discover new ways of teaching and facilitating students to learn. It entails education to re-think what skills and competencies students need to become active citizens and members of the workforce in a knowledge society (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2011). Teaching is becoming one of the most challenging professions in a society where knowledge is expanding uncontrollably and modern technologies are demanding teachers to learn how to use these technologies in their teaching. While new technologies escalate teachers' training needs, they also offer part of the solution. ICT can provide more flexible and effective ways for professional development for teachers, improve pre- and in-service teacher training, and connect teachers to the global teacher community (Jung, 2005). Modern developments of innovative technologies have provided new possibilities to teaching professions, but at the same time have placed more demands on teachers to learn how to use these new technologies in their teaching (Robinson & Latchem, 2003).

One of the growing approaches in teaching is the use of blended learning. Yerasimou (2010) mentioned that numerous educational institutions and training organizations use a blend of learning approaches to more efficiently serve their learners by combining face-to-face and online strategies, as well as technological means. Schools are now

getting interested in blending the traditional approach with web-based learning. In a study conducted by Marquis (2004), a great majority of higher-education faculty believe that a combination of online and classroom-based teaching is more effective than classroom teaching alone.

The county's Teacher Education and Development Program (TEDP) conceptualizes a teacher's career path as a continuum that starts with entry to a teacher education program and concludes with the teacher's retirement from formal service. Pre-service teachers' entry to the teacher education programs initials their teacher education development program. This teacher education initiation continues when they go into the real world of teaching. The experiences encountered by the students in their pre-service training contribute a lot to shaping the would-be teachers. One of the skills future teachers need to develop is their ICT-pedagogy skills. Education students should not only know how to use ICTs but they should gain competence and confidence in using them in learning and teaching. With the above scenario, exploring possibilities in training would-be teachers to better develop their skills in using ICTs in facilitating learning is needed. Teacher education institutions need to explore these possibilities to unveil more efficient ways of preparing future teachers to be more competent and efficient teachers in the 21st century.

With the development of alternative modes of teaching and learning, particularly blended learning, this study has been conceptualized to evaluate the readiness of future teachers in applying this mode. The study, generally, aimed to determine the level of pre-service teachers' technology literacy skills capability for blended learning. In particular, this study was directed to determine the level of pre-service teachers' technology literacy skills capability for blended learning in terms of a) technological literacy, b) knowledge deepening, and c) knowledge creation. Furthermore, this study compared the level of pre-service teachers' technology literacy skills capability for blended learning according to the degree program and nature of the school.

ICT Integration in Learning

The way ICT is used in lessons is influenced by the teacher's knowledge of their subject and how ICT is related to it. Some teachers choose ICT resources that relate to a particular topic, while others use ICT to present the students' work innovatively, without any direct application to the topic. As mentioned by Cox et al. (2003), evidence shows that when teachers use their knowledge of both the subject and the way students understood the subject; their use of ICT has a more direct effect on students' attainment.

Norton and Sprague (2001) said that contemporary education has sustained an interest in the use of educational technology as a means to design more efficient learning opportunities for students. Research also has indicated that the use of ICT can support new instructional approaches and make hard-to-implement instructional methods such as simulation or cooperative learning more feasible. Moreover, as discussed by Wang and Woo (2007), educators commonly agree that ICT has the potential to improve student learning outcomes and effectiveness if it is used properly.

The primary factor that influences the effectiveness of learning is not the availability of technology, but the pedagogical design for the effective use of ICT (Mandell et al., 2002). As agreed by Earle (2002), the computer should be fitted into the curriculum, not the curriculum into the computer. This principle indicates that computers are to be used by teachers to enhance student learning and not the other way around. Effective ICT integration should focus on pedagogy design by justifying how the technology is used in such a way and why. With the appropriate ICT integration into the teaching-learning process, students will be well-engaged in learning. For instance, using multimedia to present authentic and ill-structured problems in problem-based learning can motivate and challenge students and hence develop their problem-solving skills (Boud & Felleti, 1991; Savery & Duffy, 1995, Wang & Woo, 2007).

Blended Learning Environment

Blended learning is the thoughtful integration of face-to-face and online learning (Garrison & Vaughan, 2007). Correspondingly, Rossett and Frazee (2006) describe blended learning (BL) as the integration of opposite approaches, such as formal and informal learning, face-to-face and online experiences, directed paths and reliance on self-direction, and digital references and

collegial connections, to achieve individual and organizational goals. Bailey et al. (2013) underscore that blended learning is not just a different district initiative. It is a fundamental redesign of instructional models to accelerate learning.

According to Vaughan (2007) and Dziuban et al. (2004), as stated by Felea (2013), blended learning, also -known as hybrid learning and mixed-mode instruction, has been going on for a long while due to the complex nature of teaching/learning. However, at the beginning of the new millennium, the development of technology especially the rapid expansion of the Internet and the increased accessibility of personal computers and mobile devices, the adoption of online/distance learning programs, and the research in and development of new learning theories brought forth practices and discussions on the notable shift going on in pedagogical approaches from the teacher-centered into a student-centered and the disruptions in the social, political and cultural aspects of education.

Methodology

The study employed the descriptive comparative research design. Specifically, a survey questionnaire was used to determine the level of technology literacy skills of pre-service teachers necessary for blended learning. The descriptive comparative design was utilized to compare the level of technology literacy skills between two groups of respondents.

The respondents of the study were graduating pre-service teachers in the various university TEIs in Baguio and Benguet. Total enumeration sampling was used as the study considered the entire population as respondents. There were 26 graduating pre-service teachers from Baguio Central University, 103 from Saint Louis University, 43 from the University of Baguio, and 295 from Benguet State University. Thus, the total number of graduating pre-service teachers who served as respondents is 467. The survey was conducted from 2017 to 2018.

A questionnaire adapted from the UNESCO ICT Competency Framework for Teachers (version 2) was used to gather the data needed for the study. Cronbach's Alpha was used to test the reliability of the data-gathering instrument. The data gathering tool for the study on ICT instructional skills and capabilities for blended learning has a Cronbach's Alpha result of 0.96, which means that the items for the questionnaire were consistent.

Data were analyzed using descriptive and inferential statistics. Descriptive statistics included the weighted means while inferential statistics t-test for independent samples was used to compare if there are significant differences in the overall results according to the degree program (Bachelor in Elementary Education or Bachelor in Secondary Education) and nature of the school (public or private).

The interpretation of the level of skills, capabilities, and needs was based on an interval scale. This study used the following four-point scale with the corresponding descriptive equivalent.

3.26-4.00	Highly Capable (HC)	I can do the task confidently without assistance
2.51-3.25	Moderately Capable (MC)	I can do the task with little assistance
1.76-2.50	Slightly Capable (SC)	I can do the task but I need much assistance
1.00-1.75	Not Capable (NC)	I cannot do the task

Results and Discussion

Level of Pre-service Teachers' Technology Literacy Skills Capability for Blended Learning

In Terms of Technology Literacy

Table 1 shows the level of technology instructional skills and capabilities of the pre-service teachers in terms of technology literacy. The overall average weighted mean is 3.24 which means that the pre-service teachers are moderately capable of enabling themselves to use ICT to learn more efficiently. Nonetheless, in some of the skills under technology literacy, the pre-service teachers demonstrate high capabilities like sending and receiving messages. This is evident as it relates to sending and receiving messages through calls and text

Table 1

Level of Technology Literacy of Benguet and Baguio Teacher Education Schools' Pre-Service Teachers, 2018

Item	Technology Instrcutional Skills and Capabilities of Pre-Service Teachers	Average Weighted Mean	Descriptive Equivalent
1	Demonstrate the use of common hardware (such as desktop computers, laptops, and hand-held devices)	3.28	HC
2	Demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing	3.33	HC
3	Demonstrate the purpose and basic features of presentation software and other digital resources	3.17	MC
4	Use of graphics software package to create a simple graphic display	3.19	MC
5	Use the internet/World Wide Web/URL to access a website	3.40	HC
6	Create an email account and use it for a sustained series of email correspondence	3.32	HC
7	Use tutorial and drill and practice software	3.12	MC
8	Locate off-the-shelf educational software packages and web resources, evaluate them for their accuracy	3.03	MC
9	Evaluate off-the-shelf educational software packages and web resources for their accuracy	2.97	MC
10	Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments	3.07	MC
11	Use ICT resources to enhance their productivity	3.28	HC
12	Use ICT resources to support their own acquisition of subject matter and pedagogical knowledge	3.24	MC
13	Identify and manage Internet safety issues	3.24	MC
14	Use ICT skills to create and share information	3.31	HC
15	Search, sift, scan, and sort information	3.34	HC
16	Navigate through screens of information	3.20	MC
17	Use ICT to research and solve problems	3.27	HC
18	Make multimedia presentations	3.34	HC
19	Retrieve, organize, manage, and create information	3.26	MC
20	Send and receive messages	3.41	HC
	Category Weighted Mean	3.24	MC

$t_{stat} = 0.0565 < t_{crit} = 1.725$ *Not Significant*

messaging on mobile phones and the internet. Most students, if not all, use mobile phones in their daily communications with other people allowing them to acquire basic skills in sending and receiving messages. Novak (2019) believed that the incorporation of technology into different types of communication has made it easier to share information. She said that even though there are many gadgets, software, and tools related to communication technology, the modern-day communicator doesn't need to be an expert at them all.

The next technology literacy the pre-service teachers are highly capable of doing is using the internet/World Wide Web/URL to access a

website. It is becoming a trend that students, nowadays, use the internet as a source of information more often than going to the library. Consequently, if the students are highly capable of accessing the websites, it follows that they are also able to search, sift, scan and sort information. On why students tend to be highly capable in using the internet, the Florida Center for Instructional Technology believes that the Internet is a researcher's dream come true. By browsing the Internet, much as students would browse the shelves in the library, they can access information on limitless topics. Moreover, web-based catalogs are available in many libraries to assist researchers in locating printed books, journals, and other materials. Another technology literacy skill the pre-service teachers can highly perform is demonstrating the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing. The abovementioned technology literacy skills, indeed, are the skills expected for pre-service teachers to possess to be able to face the challenges of teaching in the 21st century. Technohella (2011) concurred that a balanced technology program combines a wide range of ICT skills such as word processing, presentation, spreadsheet, Internet, database, graphics, and desktop publishing. Among these skills, word processing is certainly the most extensive and important for students to master.

Other technology literacy skills that pre-service teachers are highly capable of doing are: creating an email account and using it for a sustained series of email correspondence, using ICT skills to create and share information, demonstrating the use of common hardware, using ICT skills to enhance their productivity, and using ICT to search and solve problems.

In terms of technology literacy skills involving the use of graphic software packages, presentation software, and other digital resources, the skill levels of the pre-service teachers are described as moderately capable. The primary reason is that most of the skills are quite specialized. Hence, pre-service teachers need more training to acquire these skills.

Table 1 further shows the comparison of indicators for the pre-service teachers' technology literacy skills capability for blended learning in terms of technology literacy. The computed t-value at 1.451 is less than the critical value at 1.725. The result means that there is no significant difference among the different indicators as compared to the desired level of technology literacy skills capability.

Since the overall result indicates moderate capability among the pre-service teachers, UNESCO highly encourages that competencies related to technology literacy include basic digital literacy skills and digital citizenship. It must also include the ability to select and use appropriate educational tutorials, games, drills software, and web content in computer laboratories. In such manner, pre-service teachers will be able to use ICT to manage the classroom and support their own professional learning.

In Terms of Knowledge-Deepening Skills

The next category, knowledge deepening, emphasizes the depth of understanding over coverage of content and assessments that give attention to the application of understanding to real-world problems. Table 2 showed that the pre-service teachers are moderately capable of performing the technology instructional skills and capabilities in terms of knowledge-deepening. Among the knowledge-deepening skills, pre-service teachers are reasonably capable of using search engines, online databases, and email to find people and resources for collaborative projects. The capability level conforms with the study of Humes (2015) on the Effects of Online Collaborative Learning on Student Engagement and Academic Success. The study has shown that collaborative learning projects through online warrant increases in student engagement leading to deeper understanding and higher-level thinking. The ability of the pre-service teachers to utilize online resources is a skill that they should acquire to develop their higher-level thinking. Another skill that the pre-service teachers are moderately but reasonably capable of doing is accessing and sharing resources to support their activities and their own professional learning. This skill is related to or an extension of the previous skill. The next three skills--using the network to support student collaboration within and beyond the classroom; using ICT to communicate and collaborate with students, peers, parents, and the large community in order to nurture student learning; and implementing collaborative, project-based plans and classroom activities, while guiding students towards the successful

Table 2

Level of Knowledge-Deepening Skills of Benguet and Baguio Teacher Education Schools' Pre-Service Teachers, 2018

Item	Technology Instrcutional Skills and Capabilities of Pre-Service Teachers	Average Weighted Mean	Descriptive Equivalent
1	Design complex, real-world problems and structure them in a way that incorporates key subject matter concepts and serves as the basis for student projects.	2.98	MC
2	Design online materials that support students' deep understanding of key concepts and their application to real-world problems.	2.90	MC
3	Design plans and classroom activities so that students engage in reasoning with, talking about, and using key subject matter concepts while they collaborate to understand, represent, and solve complex real-world problems, as well as to reflect	3.03	MC
4	Structure classroom active so that open-ended tools and subject-specific applications will support students in their reasoning with, talking about, and use of key subject matter concepts and processes while they collaborate to solve complex problems.	3.03	MC
5	Implement collaborative, project-based plans and classroom activities, while providing guidance to students toward the successful completion of their projects and attainment of a deep understanding of key concepts.	3.08	MC
6	Operate open-ended/instructional software appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.	2.96	MC
7	Evaluate the accuracy and usefulness of web resources in support of project-based learning in a subject area.	2.98	MC
8	Use authoring environment or tools to design online materials.	2.91	MC
9	Use a network and appropriate software to manage, monitor, and assess progress of various student projects.	2.98	MC
10	Use ICT to communicate and collaborate with students, peers, parents, and the large community in order to nurture student learning.	3.11	MC
11	Use the network to support student collaboration within and beyond the classroom.	3.12	MC
12	Use search engines, online databases, and email to find people and resources for collaborative projects	3.15	MC
13	Place and organize computers and other digital resources within the classroom so as to support and reinforce learning activities and social interactions	3.07	MC
14	Manage student project-based learning activities in a technology-enhanced environment	3.04	MC
15	Use ICT to access and share resources to support their activities and their own professional learning	3.13	MC
16	Use ICT to access outside experts and learning communities to support their activities and their own professional learning	3.06	MC
17	Use ICT to search for, manage, analyze, integrate and evaluate information that can be used to support their professional learning	3.06	MC
	Category Weighted Mean	3.03	MC

$t_{statr} = 0.261 < t_{crit} = 1.740$ *Not Significant*

completion of their projects and attainment of deep understanding of key concepts— are similar to the previous skills, which use ICT in collaborative activities. The rest of the knowledge-deepening skills involve structuring the classroom, designing instructional software and online materials, and operating instructional software. These skills, likewise, are quite specialized and need more training and constant practice.

Table 2 further shows the comparison of indicators for the pre-service teachers' technology literacy skills capability for blended learning in terms of knowledge-deepening skills. The computed t-value at 0.261 is less than the critical value at 1.740. The result means that there is no significant difference among the different items or indicators as compared to the desired level of technology skills capability.

With the results, UNESCO encouraged pre-service teachers to enhance their ability to manage information, structure problem tasks, and integrate online tools. Pre-service teachers are also advised to prepare student-centered teaching methods and collaborative projects in support of students' in-depth understanding of key concepts and their application to complex and practical problems. To support collaborative projects, pre-service teachers should use web-based resources to help students collaborate, access information, and communicate with experts to analyze and solve their chosen problems. Pre-service teachers should also be able to use ICT to construct and monitor individual and group student projects, as well as to access information and collaborate with experts and other stakeholders to support their professional learning.

In Terms of Knowledge-Creation Skills

The last category of the technology instructional skills and capabilities of pre-service teachers is knowledge creation. Knowledge creation aims to increase productivity by establishing students that will continually be engaged in, and benefits from, knowledge creation, innovation, and life-long learning. Table 3 indicates that the pre-service teachers are moderately capable of executing technology instructional skills that can lead to knowledge creation. The result coincides with the article published online by the National Center for Biotechnology (2021) that the interactivity and presence of digital technologies are exerting a significant impact on knowledge creation wherein the critical relevance is highly associated with digital innovation. The research found that there is a gap between knowledge creation on information technology and digital innovation. In the case of the pre-service teachers, they lack exposure to the higher-level application of ICT. It was noted that the respondents, especially the pre-service teachers, have taken only three units of Information Technology course and six units of Educational Technology subject. This result shows that pre-service teachers have learned the basic Information Technology and technology-pedagogy concepts but can only demonstrate a few ICT skills.

The first among the list of technology skills that the pre-service teachers can engage to create knowledge is to help students reflect on their own learning. Gerstein (2016) concurs that critical reflection is a very important part of any learning process. Without reflection, learning can only become like viewing a reality TV show which was never meant to have sense but was only intended to spend time. Pre-service teachers are encouraged to design class activities that call for students to reflect on their own learning. The second technology skill is to use ICT resources to share and discuss best practices in teaching. Educators believe that teaching expertise is a powerful gift, especially when shared. The remaining technology skills are focused on using ICT production tools and resources and designing materials and activities to support students' innovation and knowledge creation.

Table 3 further shows the comparison of indicators for the pre-service teachers' technology literacy skills capability for blended learning in terms of knowledge-creation skills. The computed t-value at 0.105 is less than the critical value at 1.860. The result means that there is no significant difference among the different indicators as compared to the desired level of technology skills capability.

For pre-service teachers to become fully competent in imparting knowledge creation to students, UNESCO (n.d.) recommends that they must be able to design ICT-based learning resources and environments. They must use ICT to support the development of the critical thinking skills of the students. The pre-service teachers support students' continuous, reflective learning, and create knowledge communities for students and peers.

Table 3

Level of Knowledge-Creation Skills of Benguet and Baguio Teacher Education Schools' Pre-Service Teachers, 2018

Item	Technology Instrcutional Skills and Capabilities of Pre-Service Teachers	Average Weighted Mean	Descriptive Equivalent
1	Explicitly model reasoning, problem-solving, and knowledge creation while teaching students	3.06	MC
2	Design online materials and activities that engage students in collaborative problem-solving, research, or creating art	3.01	MC
3	Help students incorporate multimedia production, web production, and publishing technologies into their projects in ways that support their ongoing knowledge production and communication with other audiences	3.08	MC
4	Help students reflect on their own learning	3.20	MC
5	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation)	3.09	MC
6	Describe the function and purpose of virtual environments and knowledge-building environments, and use them to increase knowledge and understanding of subjects in the curriculum and to develop online and face-to-face learning communities	2.99	MC
7	Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning	3.03	MC
8	Use ICT resources to share and discuss best practices in teaching	3.12	MC
	Category Weighted Mean	3.07	MC

$t_{stat} = 0.105 < t_{crit} = 1.860$ *Not Significant*

Level of Technology Literacy Skills of Pre-Service Teachers According to Degree Program

Table 4 compares the technology instructional skills and capabilities of Bachelor of Secondary Education and Bachelor of Elementary Education pre-service teachers. The overall weighted means of both groups are almost equal. The BSE pre-service teachers tallied 3.12 while the BEE pre-service teachers registered 3.11. Both groups demonstrate moderate capabilities. The computed t-value is 1.30 which is less than the critical value of 2.02. This result means that there is no significant difference in the technology instructional skills and capabilities of the Bachelor of Secondary Education and the Bachelor of Elementary Education pre-service teachers. Regardless of the degree program, the BSE and BEE pre-service teachers demonstrate the same level of technological skills and capabilities. Both degree program features the same instructional technology components that include competencies in the use of technology in teaching and training (Commission on Higher Education, 2004). The BSE and BEE are designed so that the components are integrated. In the plan of courses, both programs offer the same basic subjects for ICT and educational technology.

The similarity in technology literacy skills of the pre-service teachers can be associated with other indicators such as the performance in the Licensure Examination for Teachers (LET). A study was conducted to compare the performance of BSE and BEE graduates in the LET. Delos

Angeles (2019) revealed in her study that there is no significant difference in the performance between BSE and BEE graduates. While passing the LET is the result of many contributing factors, being a BSE or BEE graduate does not necessarily influence their performance in the LET.

Bhattacharjee and Deb (2016) listed in their study the roles of ICT in 21st Century's Teacher Education. Regardless of whether the teachers are assigned to the elementary or secondary, the researchers believe that the knowledge of ICT is very much essential for both practicing teachers as well as pre-service teachers. This will help teachers know how to integrate technology with classroom teaching. ICT allows teachers to update new knowledge and skills to use new digital tools and resources. By applying the acquired knowledge of ICT, pre-service teachers will become effective teachers. ICT is one of the primary reasons for generating rapid changes in our society. ICT can change the landscape of education and roles of teachers in the teaching learning process. Higher Education Institutions, therefore, are encouraged to monitor and implement necessary improvements or development on their ICT program.

Table 4

Level of Technology Literacy Skills of Pre-Service Teachers in Benguet and Baguio Teacher Education Schools According to Degree Program, 2018

Item	Technology Instructional Skills and Capabilities of Pre-Service Teachers	Average Weighted Mean	Descriptive Equivalent
A. Technology Literacy			
1	Demonstrate the use of common hardware (such as desktop computers, laptops, and hand-held devices)	3.25	3.32
2	Demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing	3.29	3.40
3	Demonstrate the purpose and basic features of presentation software and other digital resources	3.18	3.16
4	Use of graphics software package to create a simple graphic display	3.24	3.12
5	Use the internet/World Wide Web/URL to access a website	3.39	3.42
6	Create an email account and use it for a sustained series of email correspondence	3.30	3.35
7	Use tutorial and drill and practice software	3.17	3.03
8	Locate off-the-shelf educational software packages and web resources, evaluate them for their accuracy	3.11	2.92
9	Evaluate off-the-shelf educational software packages and web resources for their accuracy	3.07	2.80
10	Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments	3.22	2.85
11	Use ICT resources to enhance their productivity	3.28	3.29
12	Use ICT resources to support their own acquisition of subject matter and pedagogical knowledge	3.25	3.22
13	Identify and manage Internet safety issues	3.26	3.20
14	Use ICT skills to create and share information	3.28	3.34
15	Search, sift, scan, and sort information	3.34	3.33
16	Navigate through screens of information	3.20	3.20
17	Use ICT to research and solve problems	3.25	3.30

Table 4 *continuation...*

Item	Technology Instructional Skills and Capabilities of Pre-Service Teachers	Average Weighted Mean	Descriptive Equivalent
18	Make multimedia presentations	3.29	3.42
19	Retrieve, organize, manage, and create information	3.32	3.17
20	Send and receive messages	3.36	3.47
	Category Weighted Mean	3.25	3.22
B. Knowledge Deepening			
1	Design complex, real-world problems and structure them in a way that incorporates key subject matter concepts and serves as the basis for student projects.	2.96	3.01
2	Design online materials that support students' deep understanding of key concepts and their application to real-world problems.	2.93	2.85
3	Design plans and classroom activities so that students engage in reasoning with, talking about, and using key subject matter concepts while they collaborate to understand, represent, and solve complex real-world problems, as well as to reflect	3.00	3.07
4	Structure classroom active so that open-ended tools and subject-specific applications will support students in their reasoning with, talking about, and use of key subject matter concepts and processes while they collaborate to solve complex problems.	3.04	3.01
5	Implement collaborative, project-based plans and classroom activities, while providing guidance to students toward the successful completion of their projects and attainment of a deep understanding of key concepts.	3.12	3.02
6	Operate open-ended/instructional software appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.	2.96	2.97
7	Evaluate the accuracy and usefulness of web resources in support of project-based learning in a subject area.	3.00	2.96
8	Use an authoring environment or tools to design online materials.	2.91	2.90
9	Use a network and appropriate software to manage, monitor, and assess the progress of various student projects.	3.01	2.93
10	Use ICT to communicate and collaborate with students, peers, parents, and the large community in order to nurture student learning.	3.08	3.15
11	Use the network to support student collaboration within and beyond the classroom.	3.12	3.13
12	Use search engines, online databases, and email to find people and resources for collaborative projects	3.17	3.11
13	Place and organize computers and other digital resources within the classroom so as to support and reinforce learning activities and social interactions	3.07	3.08
14	Manage student project-based learning activities in a technology-enhanced environment	3.06	3.02
15	Use ICT to access and share resources to support their activities and their own professional learning	3.17	3.08
16	Use ICT to access outside experts and learning communities to support their activities and their own professional learning	3.03	3.09
17	Use ICT to search for, manage, analyze, integrate and evaluate information that can be used to support their professional learning	3.04	3.10
	Category Weighted Mean	3.04	3.03

Table 4 *continuation...*

Item	Technology Instructional Skills and Capabilities of Pre-Service Teachers	Average Weighted Mean	Descriptive Equivalent
C. Knowledge Creation			
1	Explicitly model reasoning, problem-solving, and knowledge creation while teaching students	3.08	3.03
2	Design online materials and activities that engage students in collaborative problem-solving, research, or creating art	3.00	3.02
3	Help students incorporate multimedia production, web production, and publishing technologies into their projects in ways that support their ongoing knowledge production and communication with other audiences	3.11	3.03
4	Help students reflect on their own learning	3.18	3.23
5	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation)	3.08	3.11
6	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation)	3.00	2.98
7	Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning	3.04	3.02
8	Use ICT resources to share and discuss best practices in teaching	3.07	3.20
	Category Weighted Mean	3.07	3.08
	OVERALL WEIGHTED MEAN	3.12	3.11

$t_{stat} = 1.30 < t_{crit} = 2.02$ *Not Significant*

Level of Technology Literacy Skills of Pre-Service Teachers According to Nature of School

Table 5 compares the technology instructional skills and capabilities of pre-service teachers enrolled in private and public schools. The overall weighted mean for the private schools at 3.33 is higher than for the public schools at 2.99. The computed t-value is 20.46 which is higher than the critical value of 2.02. This result means that there is a significant difference in the technology instructional skills and capabilities of pre-service teachers enrolled in private and in public schools. The result concurs with the research of Environmental Conscience (n.d.) that private colleges and universities can be better because of smaller class sizes. Smaller class sizes contribute to more individual treatment of students regarding their educational progress including their digital skills. Another reason is private schools have a higher level of flexibility regarding curriculum. Private schools may offer their students additional subjects or special additional classes. This freedom of private schools to offer enhancement subjects is supported by the study of Scheper (2013) where they will try out new research-based subjects and teaching strategies within the school. These private schools may adopt sparingly the curriculum of public schools and then it will be enhanced with the integration of research-based subjects.

The difference in the technology instructional skills and capabilities for private and public schools is also related to the research of Ali et al. (2020) on the trends in using digital skills. The researchers found that public and private sector institutions differ extensively regarding the use of their digital skills. The study disclosed that in using modern digital devices in their teaching and learning process, private sector institutions were more advanced and innovative.

Another reason for the difference in the technology instructional skills and capabilities of private and public schools is seen in the availability and accessibility of communication paraphernalia. Environmental Conscience (n.d.) noted that private schools have better technological equipment compared to public schools. Processing the procurement of equipment is faster in private schools, making them ahead in the use of the latest technologies.

Ali et al. (2020) discovered in their study that teachers in private schools are more experienced and well-trained in accessing digital media. Moreover, they possess greater basic information and are found to be digitally conscious in content arrangement, content development, and content evaluation as compared to public sector teachers. In contrast, public schools are better in the delivery of content, online processing, and record keeping. While the study covered only the teachers, it may also be extended to the pre-service teachers. One thing notable in the research is the case where the public and private sectors interchangeably perform better on some technology skills. The event of one sector performing better in terms of technology may lead to sharing of practices so that both sectors perform equally good.

Bernardo et al. (2014) also conducted a study comparing the private and public high schools in the Philippines in terms of the level of achievement. The study disclosed that public school students have lower levels of achievement compared to private school students. Statistical data from the research indicated that public school students reported less support for schooling from their social groups, lower academic-related self-concept, and lower achievement goals compared to private school students. This research by Bernardo et al. (2014) can be a good reference to validate if similar research results will occur in the technology skills capability of the students when subjected to public and private higher education institutions offering teacher education programs.

Summing up, while the level of technology instructional skills and capabilities of pre-service teachers enrolled in private schools is generally higher than in public schools, there can be other indicators at which public schools are higher. It is recommended that private and public schools share their best practices in terms of ICT integration.

Table 5

Level of Technology Literacy Skills of Pre-Service Teachers According to Nature of School

Item	Technology Instructional Skills and Capabilities of Pre-Service Teachers	Private	Public
A. Technology Literacy			
1	Demonstrate the use of common hardware (such as desktop computers, laptops, and hand-held devices)	3.43	3.19
2	Demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing	3.53	3.22
3	Demonstrate the purpose and basic features of presentation software and other digital resources	3.34	3.08
4	Use of graphics software package to create a simple graphic display	3.33	3.11
5	Use the internet/World Wide Web/URL to access a website	3.73	3.21
6	Create an email account and use it for a sustained series of email correspondence	3.62	3.15
7	Use tutorial and drill and practice software	3.30	3.01
8	Locate off-the-shelf educational software packages and web resources, evaluate them for their accuracy	3.04	3.03
9	Evaluate off-the-shelf educational software packages and web resources for their accuracy	2.99	2.95

Table 5 *continuation...*

Item	Technology Instructional Skills and Capabilities of Pre-Service Teachers	Private	Public
10	Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments	3.39	2.89
11	Use ICT resources to enhance their productivity	3.46	3.18
12	Use ICT resources to support their own acquisition of subject matter and pedagogical knowledge	3.43	3.12
13	Identify and manage Internet safety issues	3.45	3.11
14	Use ICT skills to create and share information	3.51	3.19
15	Search, sift, scan, and sort information	3.51	3.24
16	Navigate through screens of information	3.38	3.1
17	Use ICT to research and solve problems	3.49	3.15
18	Make multimedia presentations	3.62	3.18
19	Retrieve, organize, manage, and create information	3.47	3.14
20	Send and receive messages	3.81	3.17
	Category Weighted Mean	3.44	3.12
B. Knowledge Deepening			
1	Design complex, real-world problems and structure them in a way that incorporates key subject matter concepts and serves as the basis for student projects.	3.10	2.91
2	Design online materials that support students' deep understanding of key concepts and their application to real-world problems.	3.07	2.8
3	Design plans and classroom activities so that students engage in reasoning with, talking about, and using key subject matter concepts while they collaborate to understand, represent, and solve complex real-world problems, as well as to reflect	3.27	2.89
4	Structure classroom active so that open-ended tools and subject-specific applications will support students in their reasoning with, talking about, and use of key subject matter concepts and processes while they collaborate to solve complex problems.	3.23	2.91
5	Implement collaborative, project-based plans and classroom activities, while providing guidance to students toward the successful completion of their projects and attainment of a deep understanding of key concepts.	3.27	2.97
6	Operate open-ended/instructional software appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.	3.19	2.83
7	Evaluate the accuracy and usefulness of web resources in support of project-based learning in a subject area.	3.16	2.88
8	Use an authoring environment or tools to design online materials.	3.16	2.76
9	Use a network and appropriate software to manage, monitor, and assess the progress of various student projects.	3.19	2.86
10	Use ICT to communicate and collaborate with students, peers, parents, and the large community in order to nurture student learning.	3.38	2.95
11	Use the network to support student collaboration within and beyond the classroom	3.32	3.01
12	Use search engines, online databases, and email to find people and resources for collaborative projects	3.42	2.99

Table 5 *continuation...*

Item	Technology Instructional Skills and Capabilities of Pre-Service Teachers	Private	Public
13	Place and organize computers and other digital resources within the classroom so as to support and reinforce learning activities and social interactions	3.28	2.95
14	Manage student project-based learning activities in a technology-enhanced environment	3.27	2.91
15	Use ICT to access and share resources to support their activities and their own professional learning	3.34	3.01
16	Use ICT to access outside experts and learning communities to support their activities and their own professional learning	3.30	2.91
17	Use ICT to search for, manage, analyze, integrate and evaluate information that can be used to support their professional learning	3.33	2.91
	Category Weighted Mean	3.25	2.91
C. Knowledge Creation			
1	Explicitly model reasoning, problem-solving, and knowledge creation while teaching students	3.25	2.95
2	Design online materials and activities that engage students in collaborative problem-solving, research, or creating art	3.20	2.89
3	Help students incorporate multimedia production, web production, and publishing technologies into their projects in ways that support their ongoing knowledge production and communication with other audiences	3.30	2.95
4	Help students reflect on their own learning	3.53	3.01
5	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation)	3.31	2.96
6	Describe the function and purpose of virtual environments and knowledge-building environments, and use them to increase knowledge and understanding of subjects in the curriculum and to develop online and face-to-face learning communities	3.19	2.87
7	Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning	3.24	2.91
8	Use ICT resources to share and discuss best practices in teaching	3.42	2.95
	Category Weighted Mean	3.31	2.94
	OVERALL WEIGHTED MEAN	3.33	2.99
$t_{stat} = 20.46 < t_{crit} = 2.02$			*Significant*

Conclusions

Pre-service teachers are moderately capable in their technology literacy skills necessary for blended learning in terms of technological literacy, knowledge deepening, and knowledge creation. With regards to degree programs, there is no significant difference in the technology literacy skills between pre-service teachers taking up Bachelor of Secondary Education and Bachelor of Elementary Education. However, pre-service teachers from private TEIs manifest higher technology literacy skills capability than their public school counterparts.

Recommendations

Based on the results of the study, the following are recommended: 1) Teacher Education Institutions are encouraged to review their curricular offerings for possible integration of ICT literacy framework to ensure the advancement of literacy skills development of pre-service teachers not only on basic ICT skills but to include knowledge creation and knowledge deepening; 2) Teacher Education Institutions may conduct seminars to pre-service teachers to continually enhance their ICT integration practices specifically along knowledge creation; 3) Teacher Education Institutions may invest more in ICT training of teachers and students, procurement of ICT equipment, and providing faster connectivity to the internet; and 4) strengthen partnerships and linkages between private and public schools to include sharing of best practices in terms of ICT integration.

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