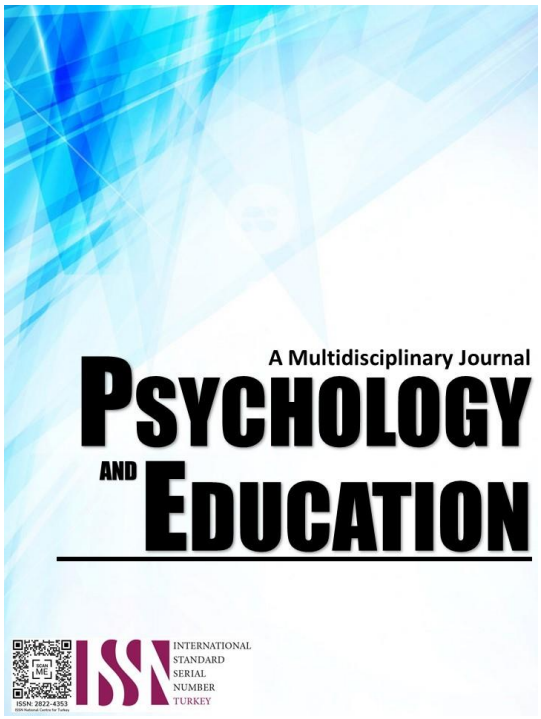
TECHNOLOGICAL PEDAGOGICAL AND CONTENT KNOWLEDGE OF COLLEGE TEACHERS AND ITS INFLUENCE ON THE ACADEMIC PERFORMANCE OF PRE-SERVICE TEACHERS



PSYCHOLOGY AND EDUCATION: A MULTIDISCIPLINARY JOURNAL

2023
Volume: 6
Pages: 720-737
Document ID: 2022PEMJ479
DOI: 10.5281/zenodo.7503515
Manuscript Accepted: 2023-3-1

Psych Educ,2023, **6**: 720-737, Document ID: PEMJ479, doi:10.5281/zenodo.7503515, ISSN 2822-4353

Research Article

Technological Pedagogical and Content Knowledge of College Teachers and Its Influence on the Academic Performance of Pre-service Teachers

Ronel D. Nugal*, Jessica P. Morales, Rodney Soreen A. Dayday, Gabrele D. Cubero
For affiliations and correspondence, see the last page.

Abstract

This study anchored by TPACK framework and the three theories which are the self-determination theory of Ryan and Deci, the theory of constructivism and the theory of Connectivism by Seiemen and Downes. To confirm this, the researchers made a self-administered questionnaire on the extent of influence of TPACK and its influence on the respondents' academic performance. The PSTs were chosen to participate in the study using a purposive random sampling method because they were assumed to have the highest level of influence to the technology towards their academic performance. The study employed a descriptive-correlational method of the quantitative approach to determine the relationship of the two variables. The mean scores of the holistic development of students were analyzed according to the performance survey of the PSTs. The study revealed that technology did not fully influence the academic performance of the pre-service teachers. The study also revealed that there were no significant results between technologies towards the PSTs performance in academics, as the survey has been through that we've got the clear results with the use of self-administered questionnaires. On the other hand, when the respondents' performance was analyzed, it was concluded that the respondents have a greater level of their academics than utilizing technology to their school performances. Among the recommendations made was to motivate teachers to always provide opportunities where students can have good experiences and develop positive outcomes by integrating in their lessons in academics with the role of technology.

Keywords: *Philippines, TPACK, academic performance,pre-service teachers*

Introduction

One of the major problems of the colleges and universities is the student achievement or performance of the students. The students' performance (academic achievement) plays a vital role in producing the best quality graduates who will become great leaders and manpower for the country, thus responsible for the country's economic and social development (Ali et al., 2009). Students' performance in universities should be a concern not only to the administrators and educators but also to corporations in the labor market. Academic achievement is one of the main factors considered by the employer in recruiting workers, especially fresh graduates. Thus, students have to place the greatest effort to obtain a good grade to fulfill the employer's demand.

Students' performance in universities should be a concern not only to the administrators and educators but also to corporations in the labor market. Academic achievement is one of the main factors considered by the employer in recruiting workers, especially fresh graduates. Thus, students have to place the greatest effort in their study to obtain a good grade to fulfill the employer's demand (Ali et al., 2009). School systems are not responsible for meeting all these needs; however, when these directly affect learning, schools must meet the challenges as the goal of teaching is attained only when they have addressed these needs that interfere with their students' learning (Ramsey, 2000).

Integration of technology in education refers to the use of technology to enhance the student learning experience. The integration of technology also creates pathways for differentiated instruction to meet the unique needs of students as individual learners within a broader classroom climate. At present, we need exemplary teachers who know how to effectively use all the tools at their disposal to benefit students (Pierson, 2001). As eloquently stated by Murtala (2019) that there is a body of evidence suggesting that instead of concentrating only on teaching and learning (the education task), teachers believe that their tasks are to care for their students social, emotional, and physical needs (the caring task), and to raise them to be and become functional members of society (the socialization task).

One study revealed that there was a statistically significant increase in Technology Content, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge scores of PSTs of English from the beginning to the end of the study (Kurt et al., 2013). The findings of this study were in

parallel to the results of similar studies conducted by Cavirn (2007), Koh and Divaharan (2011), and Hofer and Grandgenett (2012). In their studies, PSTs were provided with some coursework and the opportunity of designing their lessons, which caused an increase in their TPACK. In the present study, learning about the TPACK framework explicitly, developing technological materials, designing technology-integrated lessons, and teaching them in a real classroom setting might also have helped PSTs of English develop their TPACK concerning EFL teaching. These findings contribute to understanding the nature and development of TPACK-based instruction among pre-service English teachers, suggesting that the integration of content, pedagogy, and technological knowledge into the existing teacher education paradigm and fostering a technologically rich environment for language learners will contribute to quality learning and teaching (Öz, 2015).

In the Philippine context, one study revealed that pre-service teachers have *'strong knowledge'* in the seven elements. This study evaluated the application of TPACK of pre-service teachers in different public schools around Bulacan. The pre-service teachers of the university received enough knowledge and skills to apply their learning in terms of TPACK to their cooperating schools. Moreover, it was evident the PSTs had a positive attitude towards TPACK and welcomed the opportunity to further develop their knowledge and skills for technology integration. They came to understand how purposeful integration of technology enhances student learning experiences. With that said, PSTs also appreciated the need for ongoing professional development to support their ability to effectively implement TPACK in their practice (Redmond & Lock, 2019).

Students value the use of technology in the classrooms. Moreover, teachers seemed to appreciate that technology is available to them to enhance education and make it more authentic for the students (Ruggiero & Mong, 2015). In this era where students are exposed to the advancement of technology, they find it not just a tool for teaching but a help for them to learn. Teachers are another benefactor of the advancement of technology in the teaching-learning process. This advancement makes their preparation of learning materials easier. But, judicious use of technology is a must in every class setting. It must be used to enhance the students' learning and thus improve their achievement.

The study has relevance to the Compostela Valley State College on sustainable institutions, particularly in the college instructors' student achievements and quality instructions. Some college students have low performance on campus during the current pandemic. For many, the so-called "campus life" feeds their sense of academic performance and even their overall well-being. The virtual classes are oftentimes confusing and contain an overload of information to keep track of. Deadlines are full of uncertainty, assignments are misleading, and exams are extremely difficult for students to study for. Hence, on this premise, the researcher wishes to find out the rationale of these problems that may contribute to the planning for effective programs that will help the teachers develop more effective strategies and approaches in school and guide the students towards their success. Due to the given circumstances, the researchers investigate the significant relationship between the knowledge of the teachers on technological pedagogical and content knowledge and the academic performance of the PSTs.

Research Questions

The study primarily focused on the influence of the knowledge of the teachers on Technology- Integration to the Academic Performance of Pre-Service Teachers of Compostela Valley State College New Bataan Campus, New Bataan, Davao de Oro from the school year 2020-2021. Specifically, it sought to answer the following questions:

1. What is the level of the teachers on the technological pedagogical and content knowledge as assessed by the Pre-Service Teachers in terms of:
   1.1. Pedagogical knowledge;
   1.2. Technology knowledge;
   1.3. Content Knowledge
   1.4. Pedagogical content knowledge;
   1.5. Technological pedagogical knowledge;
   1.6. Technological content knowledge; and
   1.7. Technological Pedagogical Content Knowledge?
2. Is there a significant relationship between the knowledge of the teachers on technological pedagogical and content knowledge and the academic performance of the PSTs?
3. Which domain of the IV significantly influences or is significant to the academic performance of the PSTs?

Literature Review

The subsequent related literature and studies were considered to support and validate this study's findings.

Pedagogical knowledge. Kong et al. (2020) stated that the declarative general pedagogical knowledge of adaptively (assessed via a standardized test) is a significant predictor for the situation-specific skill of pedagogical adaptively in written lesson plans especially to the education students, and the latter affects pre-service teachers' self-reported instructional practice of teaching that lesson. This means that the pre-service teachers of CVSC support it, New Bataan supports student learning to a higher degree due to a better fit between learning prerequisites of students and activities assigned to students. Differentiation of tasks for students' different learning needs is a typical element of constructive support (Fauth et al., 2014). In addition, the study showed how pedagogical knowledge practices may be linked to student outcomes (knowledge, understanding, demonstration of skills, and values and attitudes) for the pre-service education teachers in CVSC. For instance, "planning" involved devising a student booklet as a resource for students to understand the tasks required of them for constructing and teaching practice. The mathematics and science concepts were embedded in the planned resources to aid students' understandings of the pre-service teacher's activity (Hudson et al., 2015).

Probing the Amalgam: the relationship between science teachers' content, pedagogical and pedagogical content knowledge. We review the five papers (Sorge et al; Gess-Newsome et al; Kind; Pitjeng-Mosabala and Rollnick; and Liepertz and Bronowski) by discussing evidence these present regarding the relationships between content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK); the development, of CK, PK and PCK in novice and experienced secondary science teachers and how CK, PK and/or PCK impact students' learning. In conclusion, we draw these findings together in offering proposals for future research via reconsideration of Shulman's amalgam. This includes a post-doc examination of a PCK model known as 'the Consensus Model' (Gess-Newsome, 2015).

It has been suggested that, if pedagogical and learning theories are integrated into lesson and learning study, systematic construction of pedagogical knowledge is possible (Elliott, 2012). In this Special Issue, it is reported how theory and theoretical concepts can add value to the lesson and learning study. The purpose of this paper is to introduce the Special Issue and explore the above concepts. In addition, this study refers to the pre-service teachers of Compostela Valley State College, New Bataan.

Technology knowledge. One study revealed that ICT integration has great effectiveness for both teachers and the students, and it is a big help for the pre-service teachers. Findings indicated that teachers' well-equipped preparation with ICT tools and facilities is one of the main factors in technology-based teaching and learning success. It was also found that professional development training programs for teachers also played a key role in enhancing students' quality learning (Ghavifekr et al., 2015). This study is a big help for the pre-service teacher's especially in CVSC

Hermans, Tondeur, Van-Braak, and Valcke (2008) have identified three main stages for ICT to be highly valued and regarded by the teachers; integration, enhancement, and complementary. The integration approach is about implementing the right use of ICT in particular subject areas that involve complex concepts and skills to improve student's achievement and attainment. This approach allows students to be more organized and efficient in which they can obtain the notes from the computer, submit their works by email from home as long as they meet the deadline, and look for information from various sources provided online to fulfill the task given to them (Hermans et al., 2008). In addition, the Integration of ICT obtained and can provide information of the pre-service teachers in CVSC, New Bataan to fulfill the given tasks.

Previous research proved that ICT use in teaching will enhance the learning process and maximize the students' abilities in active learning (Finger & Trinidad, 2002; Jorge et al., 2003; Young, 2003; Jamieson-Procter et al., 2013).

According to Meyer and Sinani (2009), local firms view FDI as both competition and a source of advanced technologies and managerial knowledge. It is a fundamental concern to scholars investigating how firms and local (and national) economies grow in terms of technological knowledge, which functions as a base for developing sustainable competitive advantage.

Technology can be defined in many ways, but researchers usually refer to the words 'technology' or 'technological knowledge' as 'a way of doing something' and 'a collection of physical processes that transform inputs into outputs and knowledge and skills that structure the activities involved in carrying out these transformations in CVSC, New Bataan.

Pre-service teachers can also consider their TK in terms of the broad developments of technology and how new kinds of ICT tools can be used to support the 21CL dimensions that they have chosen. Essentially,

this process describes how pre-service teachers can draw upon their general understanding of TK. Angeli and Valanides (2009) emphasize that ICT integration needs to address learner difficulties. Therefore, when designing 21CL, pre-service teachers need to consider how its associated dimensions can be exploited to address specific learning issues as well as to enhance students' understanding.

Most of the previous convergence studies have taken a retrospective view in measuring the degree of convergence and monitoring the converging trends. This paper proposes a quantitative future-oriented approach to technological opportunity discovery for convergence using patent information. In a future-oriented approach, technological opportunities for convergence are suggested by predicting potential technological knowledge flows (TKFs) between heterogeneous fields. The potential TKFs are predicted by a link prediction method in a directed network, which is suggested in this paper to represent the direction of the predicted TKFs by adapting the concept of bibliographic coupling and edge-betweenness centrality.

Rapid developments in technology in the present age have made it necessary for communities to follow technological developments and adapt themselves to these developments. One of the fields that are most rapidly affected by these developments is undoubtedly education. Determination of the attitudes of pre-service teachers, who live in an age of technology and get ready to raise future individuals, is of paramount importance both educationally and professionally (Crano, & Prislin, 2006).

Technological innovations that have entered into education systems are new to teachers (pre-service teachers), what is important in this regard is that teachers should develop positive attitudes towards these innovations of ICT integration, adopt, and put them into practice. Attitudes of teachers and pre-service teachers towards technology were investigated extensively in several studies in the past. Researchers stated that teachers' attitudes towards technology significantly influence the integration of technology into learning and teaching environments as well as the success of teaching processes.

Content Knowledge. Accordingly, content knowledge refers to the amount and organization of experience in the mind of the education which it helps the pre-service to attain the following (Zhang, Liu & Cai, 2019). It describes the pre-service teachers' knowledge of the subject matter (Malik, Rohendi, & Widiaty, 2019; Kurt, 2019). It includes facts, concepts, structures, and rules that incorporate those facts and ideas (Ozudogru & Ozudogru, 2019) as well as the field's best practices and established approaches to communicating information to students in the field of education (Kurt, 2019).

Initially, pre-service teachers in CVSC, New Bataan must have an in-depth knowledge of the subject matter to teach content in logical and organized ways before mastering other aspects of teaching. It is one of the key components of pre-service teacher competence that affect student progress (Kleickmann, 2013). Simpson (2008) concluded that successful teaching depends on a real understanding of the teaching context. In this very context, the Chinese teachers in the study by Ma, An et al, and Wang and Paine cultivated their knowledge for teaching. It is essential to note that Pompea and Walker (2017) emphasized the value of content knowledge for the development of the curriculum. Accordingly, the pre-service teachers of CVSC, New Bataan emphasized the value of content knowledge for the development of the new curriculum.

On the same note, SEI-DOST & MATHTED (2011) concluded that the amount and depth of mathematics the pre-service teachers learned were essential for teaching proper and correct mathematics to students. By having a deep understanding of mathematics, pre-service teachers can guide students in learning mathematics well. However, the results revealed that respondents only had 80-84% sufficiency of knowledge on mathematics content.

Pre-service teacher's understanding helped students understand the specific subject matter. It includes knowledge of how particular subject matter topics, problems, and issues can be organized, represented, and adapted to the diverse interests and abilities of learners, and then presented for instruction. Content knowledge has been shown to affect pre-service teachers' instructional practice as well as student learning in the domain of mathematics (Baumert et al., 2010; Hill, Rowan, & Ball, 2005).

Historically, researchers have focused on many aspects of teaching, but often scant attention has been given to how pre-service teachers need to understand the subjects they teach. Further, when researchers, educators, and policymakers have turned attention to pre-service teacher subject-matter knowledge the assumption has often been that advanced study in the subject is what matters. Debates have focused on how much preparation teachers need in the content strands rather than on what type of content they need to learn.

Given the crucial role of subject matter knowledge for student progress, this means a severe social inequality of learning opportunities. The quantity of the learning opportunities for CK available in different pre-service teacher education programs (BEED, BSD, etc.). Further research is needed to investigate the impact of differences in the quality of those learning opportunities (Baumert et al., 2010).

Given the importance of pre-service teacher knowledge for student progress, pre-service teacher education can be regarded as a key target and lever of educational reform. However, understanding how teacher education programs affect the development of professional knowledge remains limited (Cochran-Smith & Zeichner, 2005). One of the main challenges for research on pre-service teacher education lies in the assessment of teacher knowledge. Only recently, test instruments have been developed to proximally assess components of teacher knowledge—primarily, in the domain of mathematics (Hill et al., 2005; Krauss, Brunner, et al., 2008; Schmidt et al., 2007; Tatto & Senk, 2011).

Pedagogical Content Knowledge. Pedagogical content knowledge (PCK) is an academic construct that represents an intriguing idea. It is an idea rooted in the belief that teaching requires considerably more than delivering subject content knowledge to students, and that student learning is considerably more than absorbing information for later accurate regurgitation. PCK is the knowledge that teachers develop over time, and through experience, about how to teach particular content in particular ways to lead to enhanced student understanding (Van Driel, 2010). Pedagogical content knowledge (PCK) is generally accepted as positively impacting teaching quality and student learning. Therefore, research on PCK development in (prospective) teachers is highly relevant (Evens, 2015).

Aydin and Boz (2013) utilized the strategy of mapping, enumerating, and then comparing PCK maps. They observed two experienced chemistry teachers' teaching of electrochemical cells and redox reactions. Aydin and Boz (2013) enumerated interplays by developing a scoring rubric in which interplays were graded based on their quality and usefulness for students' learning. Analysis of data revealed new features of interplays, in addition to those stated by Park and Chen (2012). First, the nature of interplays differed based on their complexity. Second, the least frequent connection was observed between knowledge of curriculum and assessment. Lastly, interplays are composed of many diverse components, including understanding, decision-making, enactment, and reflection. In terms of understanding, teachers used their knowledge of the learner and curriculum to diagnose learners' difficulties. Science teaching orientation directs teachers while they are making their decisions on how to remedy learners' difficulties in the decision-making component. During enactment, knowledge of instructional strategy and assessment were contributors. Finally, teachers reflect on the instructional decisions that they made.

Hanuscin (2013) noted that by using scenarios that are rooted in-classroom experience, student teachers' learning of how to teach is fostered through discussion and reflection on critical incidents: 'Growth in one's knowledge for teaching comes about when reflection on critical incidents involves a challenge to and critique of one's self and professional values, which in turn can lead to changes in practice' (p. 937). Amade-Escot (2005) argued that focusing on critical incidents when teaching a specific subject matter, demonstrating failure or success, is a tool that invites us to take the development of content more into consideration and to better understand the functioning of a teaching and learning activity.

According to Niess, subject matter knowledge is important as it defines and develops the teacher's content of instruction. In the modern method of instruction, technology has become an integral component for learning across subject matter areas—an intersection of technology-based subject matter knowledge with pedagogical content knowledge as it requires a thorough understanding of the methods of the integration process. Therefore, science and mathematics teachers must develop pedagogical content knowledge with the integration of technology-based approaches. In the study conducted by Barak and Dori, ICT-supported learning environments could significantly enhance students' ability to traverse chemistry understanding levels and their understanding of chemical concepts, theories, and the structure of molecules. In addition, other researchers claim that the PCK-guided lesson study was an effective method to improve teacher's competence and student achievement in terms of conceptual understanding and problem-solving skills in chemistry (Lucenario et al 2019).

Pedagogical content knowledge for 21CL (PCK-21CL) knowledge of teaching methods concerning subject matter content to support 21CL dimensions without using technology. It is most effective in the case of separate content and pedagogical content courses or whether both pieces of

training should be integrated into one course remains an important question for future research.

The gaps in prospective teachers' knowledge base not only demonstrate the need to strengthen the pre-service CK- and PCK training, but also point to the need for lifelong professional training. To meet this requirement, educational policy should initiate and support professional development initiatives that aim at coaching beginning teachers in the acquisition and application of appropriate CK and PCK when teaching rational numbers, the more since a review of educational practices has revealed that a systematic and embedded approach to in-service teacher training remains scarce (e.g., European Commission, 2007).

Pre-service teacher training should aim at developing in prospective teachers a thorough mathematical content and mathematical pedagogical content knowledge base, which will hopefully result in e in the long run e in increased student learning outcomes. Courses on mathematical content should address prospective teachers' conceptual and procedural knowledge of rational numbers.

In line with our finding that prospective teachers mainly struggle with operations implying fractions e.g., in transforming more complex word problems into an appropriate mathematical model e the training should certainly address these particular contents. Furthermore, mathematical pedagogical content training should aim at enhancing prospective teachers' knowledge of students' (miss) conceptions and learning difficulties with rational numbers. In particular, we think of research evidence from the natural number bias (Vamvakoussi et al., 2012).

In the elementary and secondary school curriculum, teaching them requires an appropriate knowledge base of teachers to properly deal with students' difficulties. We investigated prospective teachers' content knowledge (CK) and pedagogical content knowledge (PCK) on rational numbers, the relationship between CK and PCK, and differences in CK and PCK among prospective elementary teachers (trained as general classroom teachers) and lower secondary teachers (trained as subject-specific classroom teachers). The results revealed gaps in prospective teachers' CK and PCK, a positive correlation between CK and PCK, and a better CK but not PCK for secondary compared to elementary school teachers.

Technological Pedagogical Knowledge. Technological pedagogical knowledge is an understanding of how teaching and learning change when particular technologies are used. This includes knowing the pedagogical affordances and constraints of a range of technological tools and resources as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies. Pre-service teachers in CVSC New Bataan must have the knowledge and skills that allow them to appropriate technologies for pedagogical purposes, so that they can use Excel, for example, to help the children to organize and analyze data, and they can create podcasts as ways to share constructed knowledge with others. Thus, TPK must include a forward-looking, creative, and open-minded seeking of technological application, not for its own sake, but the sake of advancing student learning and understanding (Harris 2019). Additionally, the pre-service teachers in CVSC New Bataan will be able to prepare themselves to work in their field someday in a very nice organization as they know using technology in the field of teaching.

This is supported by Heitink et al. (2017) argued that teachers' reasoning about pedagogy elicits their technological pedagogical knowledge (TPK). Data from 29 video cases show how elementary teachers used ICT to facilitate specific pedagogical strategies (e.g., activating learning, classroom management, dealing with diversity, fostering learning strategies). Findings indicate that teachers used ICT mostly to promote the activation of learning. Equally important, teachers who strive to survive in the era of cloud pedagogy, which provides more affordable technology than before, are advised to acquire knowledge on technology, pedagogy, and content. When teaching, instructors are responsible for reviewing their practices at any time with appropriate and effective tools to improve upon their weaknesses and strengthen their professional abilities. By doing so, teachers enhance their teaching efficiency and provide students with a better quality of teaching and learning (Hsu & Chen, 2019). In the future, the pre-service teachers in CVSC New Bataan will no longer struggle in applying their knowledge of using those ICT tools in their field someday, since they already have the background of using them.

According to Simons (2002), most teachers do not automatically develop the required technological-pedagogical knowledge, and Owston (2007) emphasized that pedagogical innovation using ICT requires specific teacher support 'for without this [support] the innovation simply cannot occur' (p. 69). A well-respected model that portrays the professional knowledge teachers should possess.

Research has shown that these pedagogical strategies

can be ordered from very basic (providing a safe learning climate and classroom management) to more complex (adaptive teaching and teaching-learning strategies) (Van de Grift et al., 2014; Van de Grift et al., 2011; Van der Lans, van de Grift, van Veen, 2015).

Regarding ICT and pedagogy, the lion's share of the research addressed integrated support for the advancement of teachers' technological-pedagogical knowledge. In a typical study, Chai et al. (2010) presented several pedagogical approaches to promote meaningful learning and simultaneously introduced ICT as a way to enhance student-centered instruction. The integrated technological and pedagogical support has a positive effect on pre-service teachers' in CVSC New Bataan of having the integration of ICT and pedagogy in lesson planning justifications. It engages pre-service teachers in thinking about both ICT and pedagogy when considering the use of ICT in class. However, to ensure that ICT is used effectively, extended or further support is needed on how and why ICT could advance pedagogical strategies.

Technological Content Knowledge. This is explained by Harris, 2019 that technological content knowledge (TCK) includes an understanding of how technology and content influence and constrains one another. In planning for instruction, content, and technology are often considered separately. For the same reason, the pre-service teachers of CVSC New Bataan must understand which technologies are best suited for addressing which types of subject matter, and how content dictates or shapes specific educational technological uses, and vice versa. Furthermore, the pre-service teachers need to master more than the subject matter they're going to teach, they must also have a deep understanding of how the subject matter (or the kinds of representations that can be constructed) can be changed by the application of technology. The pre-service teachers must understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology—or vice versa (Mishra & Koehler, 2007).

According to Çapuk, 2015 stated that to prepare students with the skills and knowledge that are necessary for the information society, ICT should be integrated into all levels and all subject matter curriculum in an appropriate way. In this matter, the pre-service teachers are necessary to be prepared with the skills and knowledge of academic areas especially in ICT, and in pedagogies for both integration. Teaching merely ICT, should not be the goal of education. ICT should provide opportunities for all learners to learn better and faster in an enjoyable environment. It is believed that these models will increase the understanding of ICT integration into teaching and learning of middle and high school subject matters. One study showed that both the teachers and pupils had positive perceptions towards ICT as an examinable curriculum subject as the majority of the participants strongly felt that the current times demanded ICT knowledge for people to fit well in the modern world of technology (Moono, S, 2017).

Technological Pedagogical Content Knowledge. Recent research in the subjects pointed towards teachers' technological pedagogical content knowledge (TPCK) as one of the most influential factors contributing to students' learning and achievement (Gess-Newsome, 2013). Keller et. al (2017) concluded that teacher technological pedagogical content knowledge mainly influences student learning whereas teacher motivation mainly influences students' interests.

Delgado (2016) asserted that the use of technology in learning provides opportunities for all students to build their skills, and the various levels of tasks that all students could do with technology, allow the students to work by themselves at their own pace. As the lessons designed with technology integration are essentially more interesting and engaging for both teachers and students, it is proven that students' learning could be fostered, students can learn better and more effectively (Ghavifekr & Wan Athirah, 2016). Furthermore, technology has allowed students to internalize and explore more by themselves, and it helps them to develop and be more resourceful than before. Therefore, teachers need to be more creative and shift their roles in teaching, since they are no longer the sole provider of information. It was found that teachers today are more motivated and interested to learn about technology integration, due to its flexibility and autonomy (Delgado, 2016).

Concerning students' learning, there is substantial evidence that teachers' technological pedagogical content knowledge (TPCK) as the knowledge to make the subject matter accessible to all students (Krauss et al., 2008) is a key element explaining student learning and achievement (Baumert et al., 2010). Particularly, teachers with a high level of TPCK can provide creative instruction in a way that is challenging but also supportive (Baumert et al., 2010), a feature of instruction which is called cognitive activation (Lipowsky et al., 2009; Praetorius et al., 2012).

Therefore, in the present study, the impact of supportive teachers' TPCK on students' achievement is addressed as well as whether this effect is mediated by cognitive activation as the explanatory instructional feature.

To explain this matter, the researchers want to pursue a study to know how technology integration of knowledge of CVSC teachers influences the academic performance of the Pre-service teachers in CVSC New Bataan.

Methodology

This section presents the research design, research locale, respondents, research instrument, and validation of the instrument, data gathering procedure, statistical treatment of data, and other information and data treatment.

Research Design

This quantitative, non-experimental, correlational study involved utilizing two Likert-type scale survey instruments to describe and measure the degree of association or relationship between or among the variables. It provides an accurate picture of the status or characteristics of a situation or phenomenon and it focuses on describing the variables and how well the two variables are correlated (Christensen & Johnson, 2008). In correlation research, this determines the strength of a relationship between variables and how well the variables are correlated.

Research Locale

For this study, the Compostela Valley State College, New Bataan district was selected as a site of interest as it was the only state college. New Bataan is located in the province of Davao de Oro, Philippines. For this Academic Year 2020-2021, as of this year, the total number of enrolled students is 943, comprising three departments (Bachelor of Elementary Education, Bachelor of Secondary Education, and Bachelor of Science and Entrepreneurship). The school is being selected for this study, as it is the only college in that municipality.

Research Respondent/s

The researcher employed purposive random sampling to arrive at having one hundred ten student-respondents. This sampling technique was used to randomize sampling strategy, even when identifying a small sample, can increase credibility to get the exact result of respondents in which the largest sub-population comprised the largest part of the sample size while the smallest sub-population comprised the smallest part of the sample size.

Fourth Year College students of the school year 2020-2021 from the school of CVSC were the respondents of this study. Considered to be in the highest grade level in the college curriculum, Fourth Year College students were the primary participants of this study because they were considered as the learners who possess the highest level of experience and sample judgment among all students at the college level.

The inclusion criteria of our study were the following: respondents are enrolled in Compostela Valley State College New Bataan Branch; respondents were selected only from the education department which is the Pre-service teachers, and respondents can be male and female of any age. Respondents in any status (single, widow. Married). In addition, the exclusion criteria of our study are the following: students who are First-Year, Second-Year, and Third-Year Students Education Departments; Students who are enrolled in Science Entrepreneurship.

Table 1. *Distribution of Respondents*

Class Categories	*n Sample Size*	*Percentage*
BEED	76	69.09%
Male	26	23.63%
Female	50	45.45%
BSED	34	30.630%
Male	8	7.207%
Female	26	23.423%
Total	110	99.999%

Our respondents are 110 pre-service teachers from CVSC, New Bataan, who are divided into two programs (BEED & BSED). There are 26 male respondents with a total percentage of 23.63 percent and 50 female respondents with a total percentage of 45.045 percent in the BEED category. In BEED, there were a total of 76 respondents, with a total percentage of 69.09 percent. In the BSED group, there were a total of 34 respondents with a total percentage of 30.630 percent, with 8 male respondents with a total percentage of 7.207 percent and 26 female respondents with a total percentage of 23.423 percent. The total

number of people who took part in the survey was 110, with a response rate of 99.999 percent.

Research Instrument

The quantitative design involved the self-administered questionnaire using the TPACK-21 instrument. The study adopted the TPACK-21 instrument proposed by Valtonen et al. (2017) with some items being re-worded to suit the context of the study. The respondents were asked to respond to the 36-item questionnaire, hence there are 7 indicators in the TRACK 21 instruments.

Likewise, the academic performance of the students as part of the data of which their 1st Semester grades were taken. The data was taken from 110 pre-service teachers of Compostela Valley State College who were selected through simple random sampling. The instrument's validity and reliability were assessed using Pearson Product Moment Correlation and Cronbach's Alpha test. The result of the validity test through Pearson Correlation showed that all the items are valid. To test the questionnaire reliability through Cronbach's Alpha test, 0.975 was obtained. The data of this study were analyzed descriptively. The data were collected concerning respondents' consent.

Data Gathering Procedures

The following steps were followed in the gathering of data:

Asking Permission to Conduct the Study. After the researcher-made questionnaire was checked by the adviser and validated by the panel of examiners, the researcher conducted pilot testing to ensure validity. After a few revisions of the questionnaire, the researcher made a letter of request to the School President branch and faculty of Compostela Valley State College to conduct a study on the Technological Pedagogical and Content Knowledge of College Teachers and Its Influence on the Academic Performance of Pre-service Teachers. After receiving approval from the school president branch, the researcher asks the permission of the respondent to conduct and start the study and orient the respondents that they must apply those health protocols (were facemask and face shield, social distancing, and hand sanitizer) if they can't access the online interview.

From the total population of one hundred eleven-fourth-year education students of Compostela Valley State College, the researcher used the purposive random sampling randomized sampling strategy, to get the exact result of respondents.

Administration and Retrieval of the Research Instrument. The administration of the questionnaires to the student-respondents of CVSC New Bataan followed the scheduled date and time of appointment with the researcher. The data were collected over five days in April. This was administered by the researchers. Moreover, instructions were given to ensure an honest, clear, and complete answer before answering the questionnaires. After which, questionnaires were retrieved immediately. Before the respondents answer the questions, the researcher orients the respondents that they must apply those health protocols (were facemask and face shield, social distancing, and hand sanitizer) if they can't access the online interview. All responses of the respondents were checked, collated, and consolidated in the Microsoft Excel File. The said file was submitted to the statistician for statistical analysis to seek answers to the problems raised in the first chapter of this research.

Collation and Tabulation of Data. After the collection of the survey questionnaire, after the collection of data, the researcher carefully tallied and submitted them to the statistician for statistical treatment. After which, the data were subjected to analyses and interpretations using the three-point scale as indicated in the research instrument.

Results and Discussion

Table 1. *Content Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
Has enough experience creating material for the subjects he teaches.	3.89	Good	Much Extensive
Has a solid understanding of the fundamental theories and principles of the subjects he teaches.	3.94	Good	Much Extensive
In the subjects he teaches, he is well-versed in the history and advancement of essential theories.	3.86	Good	Much Extensive
Has a good understanding of current studies in the subjects he teaches.	3.94	Good	Much Extensive
Overall mean	3.91	Good	Much Extensive

It can be gleaned that the overall mean is 3.91 to a good extent. This means that the influence of Content Knowledge (CK) of the pre-service teachers has a major impact when it comes to content.

Data revealed that the highest score obtained has the mean of 3.94 in which there has a solid understanding of the fundamental theories and principles of the subjects he teaches and has a good understanding of current studies in the subjects he teaches. It is followed by there has enough experience creating material for the subjects he teaches with a mean score of 3.89 and lastly, in the subjects he teaches, he is well-versed in the history and advancement of essential theories. The remarks imply that the extent of Content Knowledge is much extensive.

The result implies that the pre-service teachers have the facts, concepts, structures, and rules that incorporate those facts and ideas as well as the field's best practices and established approaches to communicating information to students in the field of education. This finding conforms to Content Knowledge refers to the amount and organization of experience in the mind of the education in which it helps the pre-service to attain the following (Zhang, Liu teacher & Cai, 2019). It describes the pre-service teachers' knowledge of the subject matter (Malik, Rohendi, & Widiaty, 2019; Kurt, 2019). It includes facts, concepts, structures, and rules that incorporate those facts and ideas (Ozudogru & Ozudogru, 2019) as well as the field's best practices and established approaches to communicating information to students in the field of education (Kurt, 2019). Displayed in Table 2 are the data on Pedagogical Knowledge that influences the pre-service teachers.

It is reflected on Table 2 that the overall mean is 4.00 to a good extent. This means that the influence of Pedagogical Knowledge (PK) of the pre-service teacher has a major impact in adapting for the situation-specific skill of pedagogical adaptively.

Data revealed that the highest score obtained has the mean of 4.08 in which during the teaching process, followed by can assist students in developing their learning plans, and during the teaching process, students' critical thinking can be supported has the mean score of 4.03. Then during the teaching process, students' problem-solving skills may be supported with a mean score of 3.98, followed by during the teaching process, students' innovative thinking can be supported 3.96, lastly, during group work, you will be able to lead students' discussions (2-5 students) with a mean score of 3.94. The remarks imply that the extent of Pedagogical Knowledge is much extensive.

Table 2. *Pedagogical Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
During group work, you will be able to lead students' discussions (2-5 students).	3.94	Good	Much Extensive
During the teaching process, it is possible to encourage students' critical thinking.	4.08	Good	Much Extensive
Can assist students in developing their learning plans.	4.03	Good	Much Extensive
During the teaching process, students' critical thinking can be supported.	4.03	Good	Much Extensive
During the teaching process, students' problem-solving skills may be supported	3.98	Good	Much Extensive
During the teaching process, students' innovative thinking can be supported.	3.96	Good	Much Extensive
Overall mean	4.00	Good	Much Extensive

The result implies that the influence of the declarative general pedagogical knowledge of (assessed via a standardized test) is a significant predictor for the situation-specific skill of pedagogical adaptively in written lesson plans especially to the education students, and the latter affects pre-service teachers' self-reported instructional practice of teaching that lesson.

This finding is the differentiation of tasks for the different learning needs of students is a typical element of constructive support (Fauth et al., 2014). In addition, the study showed how pedagogical knowledge practices may be linked to student outcomes (knowledge, understanding, demonstration of skills, and values and attitudes) for the pre-service education teachers in CVSC.

Table 3 shows the data regarding the perceptions on the Pedagogical Content Knowledge that influences the pre-service teachers.

Table 3. *Pedagogical Content Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
In the subjects he teaches, he knows how to lead students through content-related problem-solving in small groups (2-5 students).	3.87	Good	Much Extensive
In the subjects he teaches, he knows how to direct students' critical thought.	3.93	Good	Much Extensive
In the subjects he teaches, he knows how to instruct students in using each other's thoughts and ideas in group work (2-5 students).	3.94	Good	Much Extensive
In the subjects he teaches, he knows how to direct students' critical thinking.	3.89	Good	Much Extensive
In the subjects he teaches, he knows how to help students prepare for their learning.	4.00	Good	Much Extensive
Overall mean	3.92	Good	Much Extensive

It can be gleaned that the overall mean is 3.92 to a good extent. This means that the influence of Pedagogical Content Knowledge (PCK) of the pre-service teachers has a major impact on the academic construct that represents an intriguing idea. Data revealed that the highest mean score of 4.00 in which in the subjects he teaches, he knows how to help students prepare their learning, followed by in the subjects he teaches, he knows how to instruct students in using each other's thoughts and ideas in group work (2-5 students) has a mean score of 3.94. Next, in the subjects he teaches, he knows how to direct students' critical thought with a mean score of 3.93, then followed by the mean of 3.89 in which in the subjects he teaches, he knows how to direct students' critical thinking and lastly, in the subjects he teaches, he knows how to lead students through content-related problem-solving in small groups (2-5 students) with a mean score of 3.87. The remarks imply that the extent of Pedagogical Knowledge is much extensive.

The result connotes that Pedagogical content knowledge (PCK) is generally accepted as positively impacting teaching quality and student learning. Therefore, research on PCK development in (prospective) teachers is highly relevant (Evens, 2015). Moreover, PCK is the knowledge that teachers develop over time, and through experience, about how to teach particular content in particular ways to lead to enhanced student understanding (Van Driel, 2010).

Table 4 shows the data regarding the perceptions on the Technology Knowledge that influences the pre-service teachers.

Table 4. *Technology Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
When using ICT for teaching and learning, can solve problems related to it.	3.91	Good	Much Extensive
Is well-versed in a variety of emerging technology and their features?	3.95	Good	Much Extensive
New tools can be used to teach and learn.	4.08	Good	Much Extensive
In terms of emerging technologies, he is familiar with some blogs and social media networks.	3.93	Good	Much Extensive
Overall mean	3.97	Good	Much Extensive

It can be gleaned that the overall mean is 3.97 to a good extent. This means that the influence of Technology Knowledge (TK) of the pre-service teacher has a major impact in integrating great effectiveness for both teachers and students. Data shows that all of the items are much extensive. The pre-service teachers obtained the highest score with a mean of 4.08 in which new tools can be used to teach and learn, followed by is well-versed in a variety of emerging technology and their features with a mean score of 3.95. And it is followed by the mean of 3.93 in terms of emerging technologies, he is familiar with some blogs and social media networks, and lastly, when using ICT for teaching and learning, can solve problems related to it with a mean score of 3.91. The remarks imply that the extent of Pedagogical Content Knowledge is much extensive.

It was also found that professional development training programs for teachers also played a key role in enhancing students' quality learning (Ghavifekr et. al 2015). This study is a big help for the pre-service teachers, especially in CVSC. Moreover, according to Hermans, Tondeur, Van-Braak, and Valcke (2008)

have identified three main stages for ICT to be highly valued and regarded by the teachers; integration, enhancement, and complementary. The integration approach is about implementing the right use of ICT in particular subject areas that involve complex concepts and skills to improve student's achievement and attainment.

Table 5 shows the data regarding the perceptions of the Technological Pedagogical Knowledge that influences the pre-service teachers.

Table 5. *Technological Pedagogical Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
Knows how to use ICT as a platform for students' critical thinking in the classroom.	3.92	Good	Much Extensive
Knows how to incorporate ICT into the classroom as a guide for students to prepare for their education.	4.00	Good	Much Extensive
Knows how to use ICT in the classroom as a medium for exchanging thoughts and collaborative thought.	4.03	Good	Much Extensive
Knows how to use ICT as a platform for students' innovative thinking in the classroom.	3.94	Good	Much Extensive
Knows how to use ICT in the classroom as a method for community problem solving (2-5 students).	3.92	Good	Much Extensive
Knows how to use ICT in the classroom as a platform for critical thought interaction with students.	3.94	Good	Much Extensive
Overall mean	3.96	Good	Much Extensive

It can be gleaned that the overall mean is 3.96 to a good extent. This means that influence of Technological Pedagogical Knowledge (TPK) of the pre-service teacher has a major impact in understanding how teaching and learning change when particular technologies are used.

It relates with item 3 with the highest mean score of 4.03 in which they know how to use ICT in the classroom as a medium for exchanging thoughts and collaborative thought, to be followed by the mean of 4.00 in which they know how to incorporate ICT into the classroom as a guide for students to prepare their education, followed by knows how to use ICT as a platform for students' innovative thinking in the classroom and Knows how to use ICT in the classroom as a platform for critical thought interaction with students with a mean score of 3.94 and lastly they know how to use ICT as a platform for students' critical thinking in the classroom and knows how to use ICT in the classroom as a method for community problem solving (2-5 students). The remarks imply that the extent of Technology Pedagogical Knowledge is much extensive.

The result implies that the technologies helpful of the pre-service teachers were described as often influential. It engages pre-service teachers in thinking about both ICT and pedagogy when considering the use of ICT in class. However, to ensure that ICT is used effectively, extended or further support is needed on how and why ICT could advance pedagogical strategies.

In line with the statement of Chai et al. (2010) presented several pedagogical approaches to promote meaningful learning and simultaneously introduced ICT as a way to enhance student-centered instruction. Moreover, this is supported by Heitink et al., 2017 argued that teachers' reasoning about pedagogy elicits their technological pedagogical knowledge (TPK). Data from 29 video cases show how elementary teachers used ICT to facilitate specific pedagogical strategies (e.g., activating learning, classroom management, dealing with diversity, fostering learning strategies).

Table 6 shows the data regarding the perceptions of the Technological Content Knowledge that influences the pre-service teachers.

Table 6. *Technology Content Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
Knows where to find online learning materials for the subjects he teaches.	4.10	Good	Much Extensive
ICT software used by practitioners in the subjects he teaches is familiar.	3.97	Good	Much Extensive
Knows how to use ICT to help him better understand the content of the subjects he teaches.	4.05	Good	Much Extensive
Knows how to use technology to help students understand difficult concepts in the subjects he teaches.	4.01	Good	Much Extensive
Overall mean	4.03	Good	Much Extensive

It can be gleaned that the overall mean is 4.03 to a good extent. This means that the influence of

Technology Content Knowledge (TCK) of the pre-service teachers has a major impact on understanding how technology and content influence and constrains one another.

Data revealed that the Technological Content Knowledge, the highest score obtained has a mean of 4.10 in which the pre-service teachers knows where to find online learning materials for the subjects he teaches, followed by the mean of 4.05 in which they know how to use ICT to help him better understand the content of the subjects he teaches. Next, knows how to use technology to help students understand difficult concepts in the subjects he teaches with a mean of 4.01, and lastly, ICT software used by practitioners in the subjects he teaches is familiar with a mean of 3.97. The remarks imply that the extent of Technology Content Knowledge is much extensive.

Furthermore, the pre-service teachers need to master more than the subject matter they're going to teach, they must also have a deep understanding of how the subject matter (or the kinds of representations that can be constructed) can be changed by the application of technology.

This finding supports that the pre-service teachers must understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates or perhaps even changes the technology—or vice versa (Mishra & Koehler,2007). In addition, Çapuk (2015) stated that to prepare students with the skills and knowledge that are necessary for the information society, ICT should be integrated into all levels and all subject matter curriculum in an appropriate way. In this matter, the pre-service teachers are necessary to be prepared with the skills and knowledge of academic areas especially in ICT, and in pedagogies for both integration. Teaching merely ICT, should not be the goal of education.

Table 7 shows the data regarding the perceptions of the Technological Pedagogical Content Knowledge that influences the pre-service teachers.

Table 7. *Technological Pedagogical Content Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
In the subjects he teaches, he knows how to use ICT as a medium for exchanging ideas and thinking together.	3.81	Good	Much Extensive
In the subjects he teaches, he understands how to use ICT as a medium for students' critical thinking.	4.03	Good	Much Extensive
In the subjects he teaches, he understands how to use ICT as a platform for students to prepare for their learning.	4.04	Good	Much Extensive
In the subjects he teaches, he knows how to use ICT as a medium for students' problem-solving in groups (2-5 students).	3.93	Good	Much Extensive
Knows how to use ICT to help students think creatively	4.08	Good	Much Extensive
In the subjects he teaches, he knows how to use ICT as a tool in group work (2-5 students).	3.99	Good	Much Extensive
In the subjects he teaches, he understands how to use ICT as a medium for students' critical thought.	3.97	Good	Much Extensive
Overall mean	3.98	Good	Much Extensive

It is reflected that the overall mean is 3.98 on the good level. This means that the use of Technological Pedagogical Content Knowledge (TPCK) of the pre-service teachers has a major impact on learning opportunities.

It is shown from the data that the pre-service teachers know how to use ICT to help students think creatively that obtain the highest mean of 4.08, followed by the mean of 4.04 in which in the subjects he teaches, he understands how to use ICT as a platform for students to prepare their learning, and followed by in the subjects he teaches, he understands how to use ICT as a medium for students' critical thinking with a mean of 4.03. Next, in the subjects he teaches, he knows how to use ICT as a tool in group work (2-5 students) with a mean of 3.99, and to be followed by the mean of 3.97 in which that in the subjects he teaches, he understands how to use ICT as a medium for students' critical thought, followed by in the subjects he teaches, he knows how to use ICT as a medium for students' problem-solving in groups (2-5 students) with a mean of 3.93, and lastly, in the subjects he teaches, he knows how to use ICT as a medium for exchanging ideas and thinking together with a mean of 3.81. The remarks imply that the extent of Technological Pedagogical Content Knowledge is much extensive.

The result implies that the influence of TPACK is the key element explaining student learning and achieving the knowledge to make the subject matter accessible to all students and able to provide creative instruction in a way that is challenging but also supportive, a feature of instruction which is called cognitive activation.

This finding confirms that teachers with a high level of TPCK can provide creative instruction in a way that is challenging but also supportive (Baumert et al., 2010), a feature of instruction which is called cognitive activation (Lipowsky et al., 2009; Praetorius et al., 2012). Therefore, in the present study, the impact of supportive teachers' TPCK on students' achievement is addressed as well as whether this effect is mediated by cognitive activation as the explanatory instructional feature. To explain this matter, the researchers want to pursue a study to know how technology integration of knowledge of CVSC teachers influences the academic performance of the Pre-service teachers in CVSC New Bataan.

Presented in Table 8 are the summary data regarding the perceptions of the academic performance of pre-service teachers.

It can be gleaned that the overall mean is 3.97 on the good level; this means that the results of these content knowledge, pedagogical knowledge, pedagogical content knowledge; technology knowledge, technological pedagogical knowledge, technology content knowledge, and technological pedagogical content knowledge has a major impact.

Data revealed that all items displayed a good extent and in much extensive. Technology Content Knowledge has the highest mean score of 4.03, followed by Pedagogical Knowledge with a mean of 4.00. It is followed by Technological Pedagogical Content Knowledge with a mean of 3.98 and to be followed by Technology Knowledge with a mean of 3.97. Next, Technological Pedagogical Knowledge with a mean of 3.96. It is then followed by Pedagogical Content Knowledge with a mean of 3.92 and lastly, Content Knowledge with a mean of 3.91.

Table 8. *Summary Table on the TPACK-Technological Pedagogical Content Knowledge*

Indicators	*Mean*	*Descriptive Equivalent*	*Remarks*
Content Knowledge	3.91	Good	Much Extensive
Pedagogical Knowledge	4.00	Good	Much Extensive
Pedagogical Content Knowledge	3.92	Good	Much Extensive
Technology Knowledge	3.97	Good	Much Extensive
Technological Pedagogical Knowledge	3.96	Good	Much Extensive
Technology Content Knowledge	4.03	Good	Much Extensive
Technological Pedagogical Content Knowledge	3.98	Good	Much Extensive
Overall mean	3.97	Good	Much Extensive

The results imply to the recent research in the subjects pointed towards teachers' technological pedagogical content knowledge (TPCK) as one of the most influential factors contributing to students' learning and achievement (Gess-Newsome, 2013). Keller et. al (2017) concluded that teacher technological pedagogical content knowledge mainly influences student learning whereas teacher motivation mainly influences students' interests.

The domain of the IV that Significantly Influences or Significant the Academic Performance of the PSTs

The domain of the IV that significantly influences or significantly of the academic performance of the PSTs was tested and presented in Table 9. The substantial influence of this study is to determine the two variables if there is a significant relationship among the variables; Technological Pedagogical Content Knowledge and the Academic Performance of the PSTs. The study was tested at a .05 level of significance using Pearson Correlation.

Table 9. *The domain of the IV That Significantly Influences or Significant the Academic Performance ofthe PSTs*

Correlations				
		Academic performance of PST	*Tech. Ped. & Content Knowledge of CT*	*Remarks*
Academic performance of PST	Pearson Correlation	1	0.163	Not significant
	Sig. (2-tailed)		0.093	
	N	108	108	
Tech. Ped. & Content Knowledge of CT	Pearson Correlation	0.163	1	
	Sig. (2-tailed)	0.093		
	N	108	108	

As shown in the table, the two variables are at the level of 1 and have a 0.163 result in Pearson correlation which implies that the variables are in a low correlation. Furthermore, as indicated by the computed result of 0.093, the correlation coefficient is less than the average score of .05, indicating that the variables are not significant, implying that the relationship between the two variables which technological pedagogical content knowledge and PSTs' academic performance has its limitation like the difficulty of today's situation. Moreover, the PSTs' performance and achievement are unaffected by technology, and while the PSTs of CVSC New Bataan do refer to technology, they do so not always; at times, they are more concerned with their academic success.

The students' performance (academic achievement) plays a vital role in producing the best quality graduates who will become great leaders and manpower for the country thus responsible for the country's economic and social development (Ali et al, 2009). The performance of students in universities should be a concern not only to the administrators and educators but also to corporations in the labor market. Academic achievement is one of the main factors considered by the employer in recruiting workers especially fresh graduates. Thus, students have to place the greatest effort in their studies to obtain a good grade to fulfill the employer's demand. Academic achievement is one of the main factors considered by the employer in recruiting workers especially fresh graduates. Thus, students have to place the greatest effort in their study to obtain a good grade to fulfill the employer's demand (Ali et al, 2009). School systems are not responsible for meeting all these needs, however, when these directly affect learning, schools must meet the challenges as the goal of teaching is attained only when they have addressed these needs that interfere with their students' learning (Ramsey, 2000).

Conclusion

With the findings of the study, the following conclusions are drawn: The perception of the TPACK as perceived by the academic performance of the PSTs is to a good extent, indicating that the influence of TPACK on the academic performance of PSTs is much extensive. Seven indicators of TPACK which are Technology Knowledge, Pedagogical Knowledge, Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge, Pedagogical Content Knowledge, and Technological Pedagogical Content Knowledge implies that the result is much extensive. Moreover, the TPACK of college teachers and its influence on the pre-service teachers' academic performance have given positive and extensive experiences and opportunities to the pre-service teachers. Likewise, the pre-service teachers' performance based on this study is very much evident that technology is not significantly influential for the pre-service teachers' academic performance.

There is no significant relationship between the technological pedagogical and content knowledge of teachers and the academic performance of the PSTs and there is no domain in the IV that significantly influences/determines the academic performance of the PSTs.

It has been seen in the results that technology hasn't influenced their academics, it means that it is very clear in the pre-service teachers' performance that they are more focused on academics because they are committed to developing their studies, skills, and performance academically without the influence of technology.

The following recommendations are offered based on the drawn conclusions: (1) In the sphere of education, pre-service teachers at CVSC New Bataan should always provide opportunities for them to understand different practices and proven strategies of giving knowledge to pupils. (2) Teachers should play an important role in increasing and improving the students' quality of learning, demonstrating that they truly expose both teaching quality and personal learning to assist students in growing their capabilities. (3) When pre-service teachers understand how to aid students in planning their learning, they should be encouraged. (4) Teachers should encourage the pre-service teachers to use technology and some resources in the field of education to provide and establish techniques in delivering information. (5) Teachers and other facilitating personnel should give chances for

pre-service teachers and students to learn how to utilize technology in a way that benefits their capacity to teach and learn. (6) The teacher must know how to learn in terms of utilizing technology with regards to the interconnectedness of their academic learning since the advent of technology nowadays is very intimate. (7) Teachers should encourage students to use technology to support both the teaching and learning processes, as well as to broaden their learning experiences. (8) Technology should be acknowledged in school, to boost student performance. It entails taking a systematic approach to recognizing students' needs, incorporating technology into instruction, and tracking their progress. (9) Future researchers could employ an experimental study to describe the relationship between TPACK and the Academic Performance of PSTs to further their research. (10) For the next researchers, the scope of their study should be region-wide or division-wide and their respondents could be a minimum of five hundred respondents. (11) We guarantee that this study will serve as a foundation for future research and will be more valuable to future researchers.

References

Ali, N., Jusof, K., Ali, S., Mokhtar, N., & Salamat, A. S. A. (2009). THE FACTORS KEDAH, MALAYSIA. Management Science and Engineering, 3(4), 81- 90.Amade-Escot, C. (2005). Using the critical didactic incidents method to analyze the content taught. Journal of Teaching in Physical Education, 24, 127–148.DOI: 10.1123/jtpe.24.2.127[Crossref], [Web of Science ®], [Google Scholar]

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK:Advances in technological pedagogical content knowledge (TPCK). Computers & Education, 52(1), 154–168

Aydin, S., & Boz, Y. (2013). The nature of integration among PCK components: a case study of two experienced chemistry teachers. Chemistry Education: Research and Practice, 14, 615e624. http://dx.doi.org/10.1039/c3rp00095h.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special. Journal of teacher education, 59(5), 389-407.

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Tsai, Y.-M. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. American Educational Research Journal, 47(1), 133–180. DOI: 10.3102/0002831209345157

Çapuk, S. (2015). ICT integration models into middle and high school curriculum in the USA. Procedia-Social and Behavioral Sciences, 191, 1218-1224.

Cavin, R.M. (2007). Developing technological pedagogical content knowledge in preservice teachers through microteaching lesson study. (Unpublished doctoral dissertation). The Florida State University, the United States of America.

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2010). Facilitating preservice teachers' development of technological, pedagogical, and content knowledge (TPACK). Educational Technology and Society, 13(4), 63–73. Retrieved from http://www.jstor.org/stable/jeductechsoci.13.4.63

Cochran-Smith, M., & Zeichner, K. M. (2005). Teacher education. The report of the AERA Panel on Research and Teacher Education. Mahwah, NJ: Lawrence Erlbaum.

De Vries, M. J. (2005). The nature of technological knowledge: Philosophical reflections and educational consequences. International Journal of Technology and Design Education, 15(2), 149- 154.

Downes, S. (2010). New technology supporting informal learning. Journal of Emerging Technologies in Web Intelligence, 2(1), 27-33.

Elliott, J. (2012). Pedagogical and learning theories and the improvement and development of lesson and learning studies.:A systematic construction of pedagogical knowledge.

Ersanli, C. Y. (2016). Improving Technological Pedagogical Content Knowledge (TPACK) of Pre-Service English Language Teachers. International Education Studies, 9(5), 18-27.

European Commission. (2007). Improving the quality of teacher education. Communication from the commission to the Council and the European Parliament. Brussels: European Commission.

Evens, M., Elen, J., & Depaepe, F. (2015). Developing pedagogical content knowledge: Lessons learned from intervention studies. Education Research International, 2015.

Fauth, B., Decristan, J., Rieser, S., Klieme, E., & Büttner, G. (2014). Student ratings of teaching quality in primary school: Dimensions and prediction of student outcomes. Learning andInstruction, 29, 1–9. https://doi.org/10.1016/j.learninstruc.2013.07.001

Finger, G., & Trinidad, S. (2002). ICTs for learning: An overview of systemic initiatives in the Australian states and territories. Australian Educational Computing, 17(2), 3-14.

García-Pérez, R., Santos-Delgado, J. M., & Buzón-García, O. (2016). Virtual empathy as digital competence in education 3.0. International Journal of Educational Technology in Higher Education, 13(1), 1-10.

Gess-Newsome, J. (2013). Pedagogical content knowledge. In J. Hattie, & E. M. Anderman (Eds.), International guide to student achievement (pp. 257– 259). New York, NY: Routledge.

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science, 1(2), 175- 191.

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science, 1(2), 175- 191.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. Journal of research on technology in education, 41(4), 393-416.

Heitink, M., Voogt, J., Fisser, P., Verplanken, L., & van Braak, J.

(2017). Eliciting teachers' technological pedagogical knowledge. Australasian Journal of Educational Technology, 33(3).

Hermans, R., Tondeur, J. , Van -Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. Computers & Education, 51(4), 1499-1509.

Hill, H. C., Rowan, B., & Ball, D. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. American Educational Research Journal, 42, 371-406. doi:10.3102/00028312042002371

Hofer, M. & Grandgenett, N. (2012). TPACK Development in Teacher Education: A Longitudinal Study of Preservice Teachers in a Secondary M.A.Ed. Program.JRTE, 45(1), pp. 83–106

Hsu, L., & Chen, Y. J. (2019). Examining teachers' technological pedagogical and content knowledge in the era of cloud pedagogy. South African Journal of Education, 39(1).

Hudson, P., English, L., Dawes, L., King, D., & Baker, S. (2015). Exploring links between pedagogical knowledge practices and student outcomes in STEM education for primary schools. Australian Journal of Teacher Education (Online), 40(6), 134.

Jamieson-Proctor, R., Albion, P., Finger, G., Cavanagh, R., Fitzgerald, R., Bond, T., & Grimbeek, P. (2013). Development of the TTF TPACK Survey Instrument. Australian Educational Computing, 27(3),26-35.

Keller, M. M., Neumann, K., & Fischer, H. E. (2017). The impact of physics teachers' pedagogical content knowledge and motivation on students' achievement and interest. Journal of Research in Science Teaching, 54(5), 586-614.

Khan, Z., Lew, Y. K., & Sinkovics, R. R. (2015). International joint ventures as boundary spanners: technological knowledge transfer in an emerging economy. Global Strategy Journal, 5(1), 48-68.

Kleickmann, T., Richter, D., Kunter, M., Elsner, J., Besser, M., Krauss, S., & Baumert, J. (2013). Teachers' content knowledge and pedagogical content knowledge: The role of structural differences in teacher education. Journal of teacher education, 64(1), 90-106.

Koh, J. H. L., & Divaharan, S. (2011). Developing pre-service teachers' technology integration expertise through the TPACK-developing instructional model. Journal of Educational Computing Research, 44(1), 35-58.

König, J., Bremerich-Vos, A., Buchholtz, C., & Glutsch, N. (2020). General pedagogical knowledge, pedagogical adaptivity in written lesson plans, and instructional practice among preservice teachers. Journal of curriculum studies, 52(6), 800-822.

Krauss, S., Brunner, M., Kunter, M., Baumert, J., Blum, W., Neubrand, M., & Jordan, A. (2008). Pedagogical content knowledge and content knowledge of secondary mathematics teachers. Journal of Educational Psychology, 100(3), 716–725. doi: 10.1037/0022- 0663.100.3.716

Kurt, G., Mishra, P., & Kocoglu, Z. (2013, March). Technological pedagogical content knowledge development of Turkish pre-service teachers of . In Society for Information Technology & Teacher Education International Conference (pp. 5073-5077). Association for the Advancement of Computing in Education (AACE).

L. Niess, (2005) "Preparing teachers to teach science and mathematics with technology: developing a technology pedagogical content knowledge," Teaching and Teacher Education, vol. 21, no. 5, pp. 509–523, 2005.View at: Publisher Site | Google Scholar

Lee, M.-H., & Tsai, C.-C. (2010). Exploring teachers' perceived self-efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. Instructional Science, 38, 1–21.

Loewenberg Ball, D., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of teacher education, 59(5), 389-407.

Lucenario, J. L. S., Yangco, R. T., Punzalan, A. E., & Espinosa, A. A. (2016). Pedagogical content knowledge-guided lesson study: Effects on teacher competence and students' achievement in chemistry. Education Research International, 2016.

M. Barak and Y. J. Dori, "Enhancing undergraduate students' chemistry understanding through project-based learning in an IT environment," Science Education, vol. 89, no. 1, pp. 117– 139, 2005.View at: Publisher Site | Google Scholar

Malik, S., Rohendi, D., & Widiaty, I. (2019). Technological Pedagogical Content Knowledge (TPACK) with Information and Communication Technology (ICT) Integration: A Literature Review. 5th UPI International Conference on Technical and Vocational Education and Training (ICTVET 2018). Atlantis Press. DOI:10.2991/ictvet-18.2019.114

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. Computers in Human Behavior 101,334–349. https://doi.org/10.1016/j.chb.2019.08.003

Meyer KE, Sinani E. 2009. When and where does foreign direct investment generate positive spillovers? A metaanalysis. Journal of International Business Studies 40(7):1075–1094.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework or integrating technology in teachers' knowledge. Teachers College Record, 108 (6), 1017-1054

Moono, S. (2017). Teachers' and pupils' perceptions of Information Communication Techonology (ICT) as an examinable curriculum subject in selected secondary schools of Mazabuka district, Zambia (Doctoral dissertation, The University of Zambia).

Musau, L. M., & Abere, M. J. (2015). Teacher Qualification and Students' Academic Performance in Science Mathematics and Technology Subjects in Kenya. International Journal of Educational Administration and Policy Studies, 7(3), 83-89.

Owston, R. (2007). Contextual factors that sustain innovative pedagogical practice using technology: An international study. Journal of Educational Change, 8, 61–77

Öz, H. (2015). Assessing pre-service English as a foreign language teachers' technological pedagogical content knowledge.

Ozudogru, M. & Ozudogru, F. (2019). Technological Pedagogical Content Knowledge of Mathematics Teachers and the Effect of Demographic Variables. Contemporary Educational Technology, 10(1), 1-24. https://doi.org/10.30935/cet.512515

Park, S., & Chen, Y. C. (2012). Mapping out the integration of the components of pedagogical content knowledge (PCK): examples from high school biology classrooms. Journal of Research in Science Teaching, 49(7), 922e941. http://

dx.doi.org/10.1002/tea.21022.

Pierson, M. (2001). Technology integration practice as a function of pedagogical expertise. Journal of Research on Computing in Education, 33(4), 413- 430

Pompea, S.M. & Walker, C.E. (2017). The importance of pedagogical content knowledge in curriculum development for illumination engineering. 14th Conference on Education and Training in Optics and Photonics, ETOP 2017, 2017, Hangzhou, China. https://doi.org/10.1117/12.2270022

Redmond, P., & Lock, J. (2019). Secondary pre-service teachers' perceptions of technological pedagogical content knowledge (TPACK): What do they really think? Australasian Journal of Educational Technology, 35(3).

Santos, J. M., & Castro, R. D. (2021). Technological Pedagogical content knowledge (TPACK) in action: Application of learning in the classroom by pre-service teachers (PST). Social Sciences & Humanities Open, 3(1), 100110.

Schmidt, W. H., Tatto, M. T., Bankov, K., Blömeke, S., Cedillo, T., Cogan, L., Schwille, J. (2007). The preparation gap: Teacher education for middle school mathematics in six countries. East Lansing, MI: MSU Center for Research in Mathematics and Science Education.

Siemens, G. (2005). Connectivism: A learning theory for the digital age. International Journal of Instructional Technology and Distance Learning, 2(1), 3-10.

Simons, P. R. J. (2002). Digitale didactiek: Hoe (kunnen) academici leren ICT te gebruiken in hun onderwijs [Digital pedagogy: how (can) teachers learn to use ICT in their educational practice]. Inaugural speech. Utrecht: IVLOS, Utrecht University.

Simpson, S. (2008). Western EFL teachers and East-West classroom-culture conflicts. RELC Journal 39: 381-394.

Tatto, M. T., & Senk, S. (2011). The mathematics education of future primary and secondary teachers: Methods and findings from the Teacher Education and Development Study in Mathematics. Journal of Teacher Education, 62, 115-120. doi:10.1177/0022487110386798

Tutak, F. A., & Adams, T. L. (2015). A study of geometry content knowledge of elementary preservice teachers. International Electronic Journal of Elementary Education, 7(3), 301- 318.

Vamvakoussi, X., Van Dooren, W., & Verschaffel, L. (2012). Naturally biased? In search for reaction time evidence for a natural number bias in adults. The Journal of Mathematical Behavior, 31, 344e355.

Van de Grift, W., Helms-Lorenz, M., & Maulana, R. (2014). Teaching skills of student teachers: Calibration of an evaluation instrument and its value in predicting student academic engagement. Studies in Educational Evaluation, 43, 150–159. https://doi.org/10.1016/j.stueduc.2014.09.003

Van der Lans, R. M., van de Grift, W., & van Veen, K. (2015). Developing a teacher evaluation instrument to provide formative feedback using student ratings of teaching acts. Educational Measurement: Issues and Practice, 34(3), 18–27. https://doi.org/10.1111/emip.12078

Van Driel, J. H., & Berry, A. (2010). Pedagogical content knowledge. In International encyclopedia of education (pp. 656-661). Academic Press.

Wang, C. J. (2019). Facilitating the emotional intelligence development of students: Use of t echnological pedagogical content knowledge (TPACK). Journal of Hospitality, Leisure, Sport & Tourism Education, 25, 100198.

Zhang, S., Liu, Q. & Cai, Z. (2019). Exploring primary school teachers' technological pedagogical content knowledge (TPACK) in online collaborative discourse: An epistemic network analysis. British Journal of Educational Technology, 0(0), 1-19. Retrieved from http://www.epistemicnetwork.org/wpcontent/uploads/sites/3/2019/09/willey.df

Affiliations and Corresponding Information

Ronel D. Nugal
Davao De Oro State College New Bataan Branch, Philippines

Jessica P. Morales
Davao De Oro State College New Bataan Branch, Philippines

Rodney Soreen A. Dayday
Davao De Oro State College New Bataan Branch, Philippines

Gabrele D. Cubero
Davao De Oro State College New Bataan Branch, Philippines