

Trainers' and Trainees' Level of Competence in Technical Vocational Education and Training: Basis for Competency Development Plan

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Abstract

This study examined trainers' competence using the Technological Pedagogical Content Knowledge (TPACK) framework and its relationship with trainees' academic performance in an online and distance learning environment at Zamboanga Sibugay Polytechnic Institute (ZSPI). Anchored on the TPACK Framework and Self-Determination Theory, the study employed a quantitative correlational design with documentary analysis involving 11 trainers and 110 trainees from 11 technical-vocational qualifications. Data were gathered using an adopted and modified TPACK Survey and trainees' official grades and were analyzed using mean, standard deviation, Analysis of Variance, and Pearson Product-Moment Correlation. Trainers demonstrated high overall competence, with a weighted mean of 3.88; Content Knowledge (CK) obtained the highest mean of 4.06, while Technological Content Knowledge (TCK) had the lowest mean of 3.76. Trainees demonstrated good academic performance, with a mean grade of 87.23. Significant differences in trainers' competence were found across age groups, while educational attainment showed no significant differences in most competence areas except TCK. Among the TPACK dimensions, only CK showed a statistically significant positive moderate relationship with trainees' academic performance ($r=0.341$, $p=0.011$). The study recommends strengthening trainers' technological content knowledge, entrepreneurship and managerial skills, digital instruction and assessment, industry upskilling, and innovative instructional practices, while reinforcing trainees' basic, common, and core competencies. The study supports SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation and Infrastructure) through improved TVET instruction, industry-relevant competencies, and technology integration. Its sustainability impact centers on strengthening institutional instructional capacity, technological integration, and trainees' readiness for changing workplace demands.

Keywords: Academic Performance; Content Knowledge; Online and Distance Learning; Technological Pedagogical Content Knowledge; Technical-Vocational Education and Training; Trainer Competence; Zamboanga Sibugay Polytechnic Institute

1. Introduction

The COVID-19 pandemic transformed educational delivery by requiring institutions to adopt online and distance learning. This shift increased demands on educators to integrate technology, pedagogy, and content while maintaining learner engagement and academic performance (Hodges et al., 2020). These challenges were particularly significant in Technical-Vocational Education and Training (TVET), where trainers must develop practical, industry-relevant competencies. This study examines trainers' competence using the Technological Pedagogical Content Knowledge (TPACK) framework and its relationship with trainees' academic performance in an online and distance learning environment.

The transition to online learning required educators to redesign instruction, assessment, and learner engagement while responding to inequalities in digital access (Hodges et al., 2020). In TVET, these demands were more complex because trainers must deliver theoretical knowledge while ensuring the development of practical and industry-ready competencies. TESDA trainers are also expected to possess appropriate qualifications and competency-based instructional preparation, making trainer competence essential to maintaining instructional quality under flexible learning modalities.

ICT can improve instructional delivery and expand opportunities for technology-supported teaching when it is purposefully integrated with pedagogy and content. Recent evidence shows that technology-integration preparation can strengthen teachers' knowledge for technology-supported instruction (Wilson, Ritzhaupt, & Cheng, 2020). Technology integration is particularly relevant in TVET because instruction must remain responsive to workplace and industry standards. Studies of vocational teachers show that digital competence, attitudes toward technology, technology-use frequency, and contextual support are important to technology integration in vocational education (Cattaneo, Antonietti, & Rauseo, 2022; Antonietti, Cattaneo, & Amenduni, 2022). Strengthening these competencies is therefore important for effective technology-supported TVET instruction. Globally, the pandemic forced educational institutions to rapidly adopt remote and distance learning. In the Philippines, this transition was intensified by financial constraints and limited access to digital devices and internet connectivity. Teodoro (2020) reported that about five million school-age children were threatened with not enrolling due to these barriers, while UNESCO (2020) documented the wider disruption to education caused by COVID-19. Within this national context, the study focuses on trainers and trainees of Zamboanga Sibugay Polytechnic Institute (ZSPI), a TESDA-administered institution, particularly those involved in online and distance learning during School Year 2020–2021.

The study is anchored on the Mishra and Koehler's TPACK Framework of 2006 which was based on Shulman's 1986 PCK framework. TPACK integrates Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK), together with Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). The framework emphasizes that effective instruction requires the integration of technology, pedagogy, and subject content. Self-Determination Theory (SDT) by Ryan & Deci (2020) states that motivation drives skill mastery and engagement in training programs and connects to trainee performance and lifelong learning readiness. Through autonomy, competence, and relatedness, motivation can promote participation, persistence, and continued competency development among TVET trainees.

Despite the increasing importance of technology integration in TVET, evidence continues to emphasize the need to strengthen TVET teachers' digital capabilities and professional competencies for technology-supported instruction (Subrahmanyam, 2022; Diao et al., 2023). The study therefore assesses trainers' competence across the TPACK dimensions and trainees' academic competence, examines differences in trainers' competence according to profile categories, and determines the relationship between trainers' competence and trainees' academic performance. Trainers' length of service and qualification handled are included as intervening variables. The findings serve as the basis for developing an intervention or competency development plan for improving the teaching and learning process in TVET.

The study aligns with SDG 4 – Quality Education through its focus on improving trainer competence, technology-supported instruction, and trainees' learning outcomes. It also relates to SDG 8 – Decent Work and Economic Growth because TVET develops technical and industry-relevant competencies for employment, and SDG 9 – Industry, Innovation and Infrastructure through the integration of technology into technical-vocational instruction. The study contributes to educational and institutional sustainability by providing evidence for competency development and improved instructional delivery in TVET. It supports technological sustainability by strengthening trainers' ability to integrate technology, pedagogy, and technical content. It also contributes to socio-economic sustainability by supporting the development of trainees' industry-relevant competencies and their readiness to respond to changing workplace demands.

2. Material and methods

2.1 Research Design

The study used a quantitative correlational design with documentary analysis to determine the relationship between trainers' competence and trainees' academic performance in online and distance TVET. Data were collected during the last week of the first semester of School Year 2020–2021. The cross-sectional approach involved collecting data within a relatively brief period and comparing variables of interest.

2.2 Locale of the Study

The study was conducted at Zamboanga Sibugay Polytechnic Institute (ZSPI), a Technical Education and Skills Development Authority (TESDA)-administered technical training institution in Zamboanga Sibugay Province. The 12.34-hectare campus provides an environment for technical education focused on industry and labor-market needs. The institution aims to develop students' Knowledge, Language, Attitude, Skills and Habits (KLASH) to improve productivity, employability, and workforce effectiveness. The location presented in the original manuscript identifies the geographical setting of ZSPI within the province.

2.3 Respondents of the Study

The respondents consisted of 11 regularly employed ZSPI trainers handling major subjects in TVET programs and 110 trainees representing 11 qualifications. Trainer profiles included age, qualification handled, and length of service. The trainee respondents represented Food and Beverage Services NC II, Housekeeping NC II, Food Processing NC II, Electronics and Products Assembly NC II, Tailoring NC II, Carpentry NC II, Machining NC I, Shielded Metal Arc Welding NC II, Automotive NC I, Automotive NC II, and Motorcycle Small Engine Services NC II.

2.4 Sample and Sampling Procedure

The study included all 11 trainers through total enumeration because of the manageable trainer population. For the trainees, cluster sampling was employed, with 10 trainees randomly selected from each of the 11 qualifications, resulting in 110 trainee respondents. Thus, the study involved 121 respondents consisting of 11 trainers and 110 trainees.

2.5 Research Instrument

The primary instrument was an adopted and modified TPACK Survey originally developed by Akman and Guven (2015). It was adapted to the TVET context and the study objectives, while trainees' official grades were obtained from the school registrar. The original instrument reported a Cronbach Alpha reliability coefficient of 0.977. The modified questionnaire consisted of respondent profile information and 35 statements measuring trainers' competence based on Mishra and Koehler's TPACK Framework (2006). Responses were rated using a five-point scale ranging from (1) Very Poor to (5) Excellent. The questionnaire-checklist was reviewed by a committee of experts from Universidad de Zamboanga to establish content validity and ensure alignment between the research objectives and questionnaire items. Revisions were made based on the experts' comments and suggestions, and reliability was established using the Cronbach's Alpha 0.977 through the Statistical Package for Social Sciences (SPSS).

2.6 Data Gathering Procedure

Permission to conduct the study and administer the questionnaire was obtained from the ZSPI School Administrator through a written request. After approval, informed consent was secured from participants, who were informed that participation was voluntary and that their identities would remain confidential and coded. Consent was also obtained from trainees before their academic records were accessed through the school registrar. Official grades and survey data were securely stored and accessible only to the researcher, while identifying information was excluded from the manuscript.

2.7 Data Analysis Techniques

Data were analyzed using the Statistical Package for Social Sciences (SPSS). Mean and standard deviation were used to determine trainers' competence and trainees' academic performance. Two-way Analysis of Variance (ANOVA) was used to determine significant differences in trainers' competence when categorized according to their profile, while Pearson Product-Moment Correlation was used to determine the significant relationship between trainers' competence and trainees' academic performance.

2.8 Ethical Considerations

Permission from the ZSPI School Administrator and informed consent from participants were obtained before data collection. Participation was voluntary, and respondents could refuse participation or withdraw their data. Participants' identities were coded and kept confidential, while research data were stored on a password-protected computer accessible only to the researcher. Trainees also provided consent for access to their official grades, which were securely maintained and reported without personally identifying information.

3. Results and Discussion

3.1 Trainers' Level of Competence

3.1.1 Technological Knowledge

Trainers demonstrated a high level of Technological Knowledge (TK), with an overall mean of 3.89. Using digital cameras and cellphones to produce instructional outputs obtained the highest mean of 4.09, while using printers and scanners for document reproduction had the lowest mean of 3.65. Both were described as often practiced. The findings indicate that trainers generally possess the technological skills required for instruction, although the comparatively lower competence in using printers and scanners suggests an area for improvement. Recent vocational-education evidence shows that teachers' digital competence is influenced by personal and contextual factors and is important for effective technology integration (Cattaneo, Antonietti, & Rauseo, 2022; Antonietti, Cattaneo, & Amenduni, 2022).

3.1.2 Pedagogical Knowledge

Trainers exhibited a high level of Pedagogical Knowledge (PK), with an overall mean of 3.94. Implementing different teaching strategies received the highest mean of 4.01, while evaluating performance using classic and alternative measuring tools obtained the lowest mean of 3.88. Both indicators were often practiced. The results demonstrate trainers' ability to employ varied instructional approaches, although assessment practices can still be strengthened. In fully online vocational education, student-centered pedagogy remains important, although contextual factors may influence how teachers enact such practices (Cox & Prestridge, 2020). More recent TVET competency literature likewise emphasizes the integration of pedagogical, technological, and occupational competencies in teachers' professional development (Diao et al., 2023).

3.1.3 Content Knowledge

Trainers demonstrated high Content Knowledge (CK), with an overall mean of 4.06. Knowledge and skills in teaching basic competencies received the highest mean of 4.17, whereas teaching entrepreneurship obtained the lowest mean of 3.94. Both were interpreted as often practiced. The findings indicate strong mastery of essential technical content, although entrepreneurship instruction represents an area for further development. Recent vocational-education research identifies content knowledge as an important component of teachers' overall TPACK competence and professional practice (Maknun, 2022; Diao et al., 2023).

3.1.4 Pedagogical Content Knowledge

Trainers showed high Pedagogical Content Knowledge (PCK), with an overall mean of 3.85. Selecting teaching strategies appropriate to the qualification or course recorded the highest mean of 3.95, while applying content knowledge within and across curriculum areas had the lowest mean of 3.78. Both indicators were often practiced. The results suggest that trainers can generally connect instructional strategies with technical content, although integration across learning areas could be strengthened. PCK remains a core component of the TPACK framework, linking knowledge of subject matter with knowledge of how that content can be taught effectively (Shulman, 1986; Mishra & Koehler, 2006).

3.1.5 Technological Pedagogical Knowledge

Trainers demonstrated high Technological Pedagogical Knowledge (TPK), with an overall mean of 3.83. Using technologies appropriate to different educational methods obtained the highest mean of 3.95, while selecting, developing, and using appropriate learning resources, including ICT, received the lowest mean of 3.73. The findings indicate that trainers can integrate technology with instructional approaches, although greater development is needed in aligning ICT resources with specific learning goals. Recent meta-analytic evidence indicates that teacher-education interventions can positively improve TPACK and related technology-integration knowledge (Ning, Zhou, Wijaya, & Chen, 2022).

3.1.6 Technological Content Knowledge

Trainers exhibited high Technological Content Knowledge (TCK), with an overall mean of 3.76. Using computer-aided technologies appropriate to learning content obtained the highest mean of 3.83, while using LED technology in presenting lessons obtained the lowest mean of 3.71. The findings suggest that trainers generally match technology with technical content, although this was the lowest-rated overall TPACK domain. Recent studies of vocational and technical-vocational teachers similarly identify technology-related competence as an area requiring continued professional development (Cattaneo, Antonietti, & Rauseo, 2022; Bartolome, 2025).

3.1.7 Technological Pedagogical Content Knowledge

Trainers demonstrated high Technological Pedagogical Content Knowledge (TPCK), with an overall mean of 3.92. Increasing the value of students' learning through technological knowledge obtained the highest mean of 4.16, while integrating content, technology, and formation knowledge into the qualification obtained the lowest mean of 3.78. The results indicate that trainers generally integrate technology, pedagogy, and content effectively, although comprehensive integration of these domains can still be strengthened. The original TPACK framework

emphasizes the interconnected nature of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006), while more recent evidence shows that targeted teacher-education interventions can strengthen TPACK development (Ning et al., 2022).

3.1.8 Overall TPACK-Based Competence of Trainers

Overall, trainers demonstrated a high level of competence, with a weighted mean of 3.88. Content Knowledge obtained the highest mean of 4.06, followed by Pedagogical Knowledge at 3.94, TPCK at 3.92, TK at 3.89, PCK at 3.85, TPK at 3.83, and TCK at 3.76. All domains were interpreted as often practiced. The findings show that trainers are strongest in subject-content mastery, while integrating specific technologies with technical content represents the comparatively weakest area. This pattern is comparable with recent vocational-teacher research reporting generally strong TPACK competence while identifying technology-related domains as areas for continued development (Maknun, 2022; Bartolome, 2025).

3.2 Trainees' Academic Performance

Trainees obtained grades ranging from 78.00 to 92.00, with a mean of 87.23 and a standard deviation of 2.951. The mean was interpreted as good academic performance, although the range indicates variation in achievement among trainees. In online and distance education, learning outcomes can be influenced by instructional design, instructor roles, learner support, and the conditions under which remote instruction is implemented (Hodges et al., 2020). In vocational education specifically, online teaching practices are also shaped by contextual factors that can affect the enactment of student-centered pedagogy (Cox & Prestridge, 2020).

3.3 Differences in Trainers' Competence According to Profile

3.3.1 Differences According to Age

Significant differences according to age were found across all seven competence domains: TK ($F=3.177$, $p=0.048$), PK ($F=3.015$, $p=0.049$), CK ($F=3.628$, $p=0.047$), PCK ($F=3.376$, $p=0.044$), TPK ($F=7.709$, $p=0.000$), TCK ($F=3.207$, $p=0.044$), and TPCK ($F=3.379$, $p=0.045$). All p -values were below the 0.05 significance level; therefore, the null hypothesis was rejected. Trainers aged 21–30 generally obtained higher competence ratings. The findings indicate that age was associated with differences in trainers' competence, particularly in technology-related areas. Because digital competence in vocational education can reflect multiple personal and contextual factors, age-related differences should be interpreted cautiously rather than attributed to age alone (Cattaneo, Antonietti, & Rauseo, 2022). The results emphasize the importance of continued professional development across age groups.

3.3.2 Differences According to Educational Attainment

No significant differences according to educational attainment were found for TK ($t=1.034$, $p=0.304$), PK ($t=0.446$, $p=0.656$), CK ($t=0.965$, $p=0.337$), PCK ($t=1.597$, $p=0.113$), TPK ($t=1.586$, $p=0.116$), and TPCK ($t=1.927$, $p=0.057$). However, TCK showed a significant difference ($t=2.918$, $p=0.004$), resulting in rejection of the null hypothesis for this domain. These findings indicate that educational attainment was generally not associated with differences in trainers' competence except in Technological Content Knowledge. The original findings further showed that trainers with baccalaureate degrees demonstrated higher TCK competence, suggesting variation in the ability to integrate technology with specialized content. Recent vocational-education research indicates that teacher digital competence is shaped by a combination of personal characteristics, technology-related beliefs, use patterns, and contextual support (Cattaneo, Antonietti, & Rauseo, 2022; Antonietti, Cattaneo, & Amenduni, 2022).

3.4 Relationship Between Trainers' Competence and Trainees' Academic Performance

Among the seven competence dimensions, only Content Knowledge (CK) showed a statistically significant positive moderate relationship with trainees' academic performance ($r=0.341$, $p=0.011$). TK ($r=-0.129$, $p=0.179$), PK ($r=-0.066$, $p=0.495$), PCK ($r=0.013$, $p=0.889$), TPK ($r=0.019$, $p=0.843$), TCK ($r=0.069$, $p=0.472$), and TPCK ($r=0.035$, $p=0.716$) showed negligible and statistically non-significant relationships. Thus, the null hypothesis was rejected only for Content Knowledge. The significant relationship between CK and academic performance is consistent with the theoretical importance of content knowledge within the PCK and TPACK frameworks (Shulman, 1986; Mishra & Koehler, 2006). Recent vocational-teacher research likewise identifies CK as a central component of TPACK competence (Maknun, 2022). The absence of significant relationships for the other competence domains suggests that trainees' academic performance may reflect multiple instructional and contextual factors. Recent evidence indicates that TPACK-related pedagogies can support academic achievement in teacher education, while vocational-teacher digital competence and technology use are also shaped by personal and contextual conditions (Cabero-Almenara et al., 2021; Cattaneo, Antonietti, & Rauseo, 2022).

4. Conclusion & Recommendations

The study concluded that trainers demonstrated generally high competence across the TPACK domains, while trainees achieved good academic performance and met expected learning outcomes in their technical-vocational programs. Trainers' competence differed significantly according to age, with younger trainers generally demonstrating higher competence, while educational attainment showed no significant differences in most competence areas except technological content knowledge. The findings further indicated that content knowledge was the competence area significantly associated with trainees' academic performance, emphasizing the importance of trainers' mastery of technical-vocational content in supporting learning outcomes.

School heads should provide training related to information technology to strengthen technological content knowledge, while instructors and trainers should follow TESDA Training Regulations, strengthen entrepreneurship and managerial skills, improve their knowledge of online and distance learning, integrate digital tools into instruction and assessment, participate in industry immersion and upskilling, adopt innovative instructional strategies, and engage in peer mentoring and professional learning communities. Trainees should strengthen their basic, common, and core competencies. Future researchers may expand the study to other TVET institutions and qualifications, examine additional variables affecting academic performance, use mixed-method or qualitative designs, and conduct longitudinal research on the sustained effects of trainers' competence on trainees' employment and career progression.

The study was limited to trainers and trainees of Zamboanga Sibugay Polytechnic Institute, particularly those involved in online and distance learning during School Year 2020–2021. Its scope was confined to the identified trainer competence areas and trainees' academic performance; consequently, other factors that may influence learning outcomes were not included. The study's limited institutional setting and variables also restrict the broader generalization of its findings, as reflected in the recommendation to include more TVET institutions, qualifications, and additional variables in future research.

5. Compliance with ethical standards

The authors declare no conflict of interest. No external funding was reported for this study. The researchers acknowledge the trainers, trainees, and Zamboanga Sibugay Polytechnic Institute (ZSPI) for their participation and institutional support; participation was voluntary, informed consent was obtained, and data were collected through non-invasive survey and academic-record methods. Participant information was treated confidentially, identities were coded, and no identifying information was disclosed in the manuscript.

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