PANTAO
(International Journal of the Humanities and Social Sciences)
Volume 5, Issue 4
ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

Towards an action plan for ICT integration in TLE: A study on teacher practices and challenges in a public secondary school

Jasmin S. Comahig*
Cebu Technological University-Main Campus, Cebu City, Philippines

ABSTRACT

This descriptive-correlational study assessed the status of Information and Communication Technology (ICT) integration among Technology and Livelihood Education (TLE) teachers at Jagobiao National High School during the School Year 2025–2026. Using a validated questionnaire administered to 16 TLE teachers, the research examined their demographic profile, the extent of ICT integration across five instructional areas, the challenges encountered, and the relationship between teacher profiles and ICT use. Findings revealed that teachers strongly agreed on the value of ICT, with high levels of integration in lesson delivery, planning, monitoring, assessment, and reporting. However, significant barriers persisted, most notably slow internet connectivity, unequal student access to devices, technical disruptions, and difficulties in providing timely feedback and personalized instruction. Analysis of variance showed that demographic factors (age, sex, experience, rank) did not significantly influence ICT integration; rather, access to and proficiency with software tools were more critical determinants. Based on the results, the study concludes that while TLE teachers are willing and capable ICT users, systemic and infrastructural challenges hinder optimal integration. Consequently, the researcher developed "Project TECH-TLE: Enhancing ICT Integration for Continuous Learning," a targeted action plan designed to address identified gaps through infrastructure improvement, capacity-building, technical support, and the promotion of pedagogical software use. The plan serves as a practical, evidence-based guide for the school and stakeholders to strengthen ICT-enabled TLE instruction and ensure learning continuity.

Keywords: Vocational Education, ICT Integration, Technology and Livelihood Education (TLE), descriptive-correlation, action plan, Mandaue City, Cebu, Philippines.

Date Submitted: October 01, 2026
Date Accepted: October 08, 2026
Date Published: October 28, 2026

INTRODUCTION

The integration of Information and Communication Technology (ICT) in education has become a critical factor in enhancing teaching and learning processes, particularly in Technology and Livelihood Education (TLE). The increasing reliance on digital tools enables educators to deliver lessons more interactively and flexibly, which is essential to ensure continuity in learning amid disruptions such as class suspensions (Chen et al., 2018). Research

*Corresponding author / Email: jasmin.comahig@deped.gov.ph
DOI: http://doi.org/10.69651/PIJHSS05041694

Recommended citation:
Comahig, J. S. (2026). Towards an action plan for ICT integration in TLE: A study on teacher practices and challenges in a public secondary school. Pantao (International Journal of the Humanities and Social Sciences) 5 (4), 1768-1785. http://doi.org/10.69651/PIJHSS05041694

shows that ICT integration significantly improves learners' academic performance and motivation, especially in practical subjects like TLE where technology facilitates the demonstration of skills and concepts (Gnambs, 2021; Thaheem et al., 2021). The COVID-19 pandemic underscored the need for effective ICT use in education, revealing both the potential and the challenges in sustaining student engagement and instructional delivery through digital means (Delcker & Ifenthaler 2021).

Despite the recognized benefits of ICT, educators still face challenges such as limited technological competencies, inadequate technical support, outdated equipment, and poor internet connectivity (Morales et al., 2021; Nagy & Dringó-Horváth, 2024), which hinder full integration in instruction. These challenges can be explained through the Technology Acceptance Model (TAM), where teachers' perceived usefulness of ICT and their self-efficacy significantly influence their willingness and ability to integrate technology in TLE; when teachers believe ICT improves instruction and feel confident using it, motivation and actual use increase, supporting continuous learning despite external constraints (Pan et al., 2020).

Internationally, ICT integration in education continues to show persistent gaps despite substantial investments, as many countries struggle to align technology use with pedagogical goals due to insufficient teacher training, limited systemic support, and unequal digital readiness exposed during the pandemic (Fernández-Gutiérrez et al., 2020; OECD, 2021; Blaskó et al., 2021; Daniel, 2020). Evidence from countries such as Finland and South Korea indicates that although hardware availability is high, effective ICT use is constrained by the lack of continuous professional development and instructional innovation (Bates, 2015; König et al., 2020). These challenges have led to global calls for approaches that go beyond infrastructure to emphasize sustained teacher capacity building, mentorship, and curricular integration, underscoring that meaningful ICT integration depends more on contextualized professional development and ongoing support than on access alone, a lesson relevant to the Philippine context (Pettersson, 2021; Costa, 2021).

In the Philippines, ICT integration in education continues to face challenges despite government efforts, as gaps persist in internet connectivity, teacher training, and access to updated ICT tools, particularly in remote and last-mile schools (DepEd, 2022; UNESCO, 2023). Only a limited number of schools benefit from free public Wi-Fi, and many teachers lack the confidence and skills needed for effective ICT integration (Goles et al., 2024; Morales et al., 2021). Guided by the Technology Acceptance Model, these challenges show that perceived ease of use influences perceived usefulness and self-efficacy, which in turn affect teachers' intention to adopt ICT, underscoring the importance of strengthening teacher competencies and clearly demonstrating the instructional value of ICT in TLE to promote sustained technology use (García et al., 2024).

This digital divide hampers the potential of blended and online learning modalities to support continuous education during disruptions such as pandemics and natural disasters. Further, research suggests that teacher attitudes and competencies toward ICT are uneven, requiring focused efforts to enhance professional development and institutional support (Travero, 2023). Persistent infrastructural and pedagogical gaps underscore the need for studies that assess the current status of ICT use in specific subject areas like TLE and inform action plans tailored to local realities to ensure sustainable digital transformation in Philippine schools (Liang, 2021; Edouard, 2023).

At the local level, Jagobiao National High School mirrors national challenges in ICT integration, as concerns persist about the sustainability, adequacy, and maintenance of technological resources provided by the Mandaue City Division to support learning continuity in TLE. Despite the expansion of science and technology programs, the extent of ICT use in TLE instruction remains underexplored, with issues such as limited professional development, varying teacher ICT skills, and infrastructural constraints affecting effective integration. These

gaps highlight the need for contextualized research to identify specific challenges and inform a practical action plan that will strengthen ICT integration and support continuous learning at the school level.

Conducting this study is essential to provide an updated and focused assessment of ICT integration in TLE instruction at Jagobiao National High School during SY 2025–2026, a period when sustaining learning continuity remains a priority amid ongoing challenges. By examining the demographic profile of TLE teachers, their extent of ICT use, and the difficulties they encounter in lesson planning, delivery, assessment, monitoring, and reporting, the study will identify specific needs and resource gaps that hinder effective integration. The findings will serve as a basis for an evidence-based action plan to strengthen ICT practices, enhance teaching effectiveness, promote student engagement, and support continuous learning, while contributing to broader national and local efforts toward digital transformation in Philippine education.

Statement of the problem

This study determined the status of ICT integration among Technology and Livelihood Education (TLE) teachers at Jagobiao National High School during the School Year 2025–2026 as a basis for developing a targeted action plan to enhance teaching and learning continuity.

Specifically, this study sought to answer the following questions:

1. What is the demographic profile of the respondents in terms of age, sex at birth, position and rank, years of teaching experience, highest educational attainment, subject area handled, participation in ICT related professional development, and primary ICT resources used for online and blended instruction in TLE?
2. What is the extent of ICT integration in TLE instruction in terms of lesson planning and preparation, lesson delivery, assessment and evaluation, student monitoring, and report preparation?
3. What are the significant challenges hindering ICT integration in lesson planning and preparation, lesson delivery, assessment and evaluation, student monitoring, and report preparation?
4. Is there a significant difference in the overall extent of ICT integration among teachers when grouped according to their demographic profiles?
5. Based on the findings of the study, what action plan can be proposed to strengthen ICT integration in TLE instruction?

METHODOLOGY

Research design

This study utilized a descriptive-correlational research design to assess the extent of ICT integration among TLE teachers at Jagobiao National High School during School Year 2025–2026. The descriptive component was employed to determine the respondents' demographic profile, level of ICT integration in instruction, and challenges encountered in using ICT, while the correlational component examined the relationship between selected demographic variables, such as age, sex, position, years of teaching experience, and educational attainment, and the extent of ICT integration in lesson planning, lesson delivery, assessment, monitoring, and report preparation. This design was appropriate because it

provided a systematic description of existing practices and enabled the investigation of possible relationships between teacher characteristics and ICT integration without manipulating any variables.

Respondents and locale of the study

This study was conducted at Jagobiao National High School in Mandaue City, Cebu, a public secondary school equipped with ICT laboratories and other learning facilities that support technology-based instruction. The respondents were the 16 TLE teachers teaching from Grades 7 to 12 during School Year 2025–2026, selected through purposive sampling because of their direct involvement in ICT integration in lesson planning, delivery, assessment, monitoring, and report preparation. Their relevant experience and expertise provided reliable data for assessing the extent of ICT integration and the challenges encountered in TLE instruction.

Research instrument

This study utilized an adapted questionnaire based on the work of Rodriguez and Habla (2024) to gather data on ICT integration among TLE teachers at Jagobiao National High School. The instrument consisted of three parts: Part I collected the respondents' demographic profile; Part II assessed the extent of ICT integration in lesson planning, lesson delivery, assessment, monitoring, and report preparation using a five-point Likert scale; and Part III identified the problems encountered in ICT integration. The questionnaire served as the primary data-gathering tool, and the results provided the basis for analyzing ICT integration practices and developing an action plan to strengthen technology-enhanced teaching and learning in TLE.

Data analyses procedure

The study followed three stages: pre-gathering, where permissions were secured, respondents were oriented, and informed consent was obtained; data gathering, where questionnaires were distributed, completed, collected, and encoded for analysis; and post-data gathering, where responses were tabulated, analyzed, interpreted, and used as the basis for conclusions, recommendations, and an action plan. Ethical standards were strictly observed by ensuring voluntary participation, confidentiality, anonymity, compliance with the Data Privacy Act of 2012 (RA 10173), and secure data handling. Statistical tools used included frequency and percentage for the respondents' profile, weighted mean and standard deviation for determining the extent of ICT integration, ranking for identifying the most common problems encountered, and Analysis of Variance (ANOVA) to test the significance of differences between respondents' demographic characteristics and the extent of ICT integration at the 0.05 level of significance.

RESULTS AND DISCUSSION

This section presents and interprets the data gathered from 16 Technology and Livelihood Education (TLE) teachers of Jagobiao National High School, Mandaue City, Cebu, during School Year 2025-2026. The study used a descriptive-correlational research design. The 16 respondents were Grades 7 to 12 TLE teachers selected through purposive sampling. Data were collected with a questionnaire adapted from Rodriguez and Habla (2024), which covered the respondents' demographic profile, the extent of ICT integration on a five-point Likert scale,

and the problems encountered in ICT integration. Frequency and percentage described the profile, weighted mean and standard deviation measured the extent of ICT integration, ranking identified the most common problems, and analysis of variance, reported in the tables as non-parametric tests, examined differences between respondent characteristics and ICT integration at the 0.05 level of significance. The discussion is grounded in the data gathered, and each result is interpreted in direct relation to the objectives of the study.

Demographic profile of the respondents

In terms of age, 9 respondents (56%) were 46 years old and above, 3 (19%) were 41 to 45, 1 (6%) was 31 to 35, and 3 (19%) were 26 to 30. In terms of sex at birth, 10 respondents (62%) were female and 6 (38%) were male, for a total of 16 (100%). The workforce is therefore largely composed of experienced, mature and predominantly female educators whose familiarity and confidence with emerging digital technologies may vary. Age and gender may thus influence teachers' readiness, adaptability and frequency of ICT use, which calls for age-responsive and supportive professional development. Peng et al. (2023) found that female teachers tend to show stronger positive attitudes and digital competence toward ICT adoption. Gamboa (2022) emphasized that older educators often face ICT challenges because of limited training opportunities and the need for sustained mentoring, peer support and hands-on experience. Tiangco (2025) likewise reported that advancing age is associated with greater digital literacy challenges and lower motivation to adopt new technologies, which reinforces the value of customized capacity-building for a predominantly older and female teaching workforce.

By position and rank, 7 respondents (44%) were Teacher I, 6 (37%) were Teacher III, and 3 (19%) were Master Teachers, for a total of 16 (100%). Most teachers were thus at the foundational and intermediate stages of their careers, which suggests limited opportunities for ICT leadership and advanced technology-related decision-making. Differentiated professional development is therefore warranted, with Master Teachers serving as mentors and leaders in technology integration. This is supported by Reyna and Baguio (2025), who stressed the digital competencies and mentoring role of Master Teachers in driving ICT adoption. Caparal et al. (2025) found that teachers' positions significantly influence ICT practices, with higher-ranked educators often showing greater capacity to support integration. Casilao (2025) reported that professional development and technology integration are significantly associated with teaching position, which highlights the potential of Master Teachers to lead ICT initiatives alongside Teacher I and Teacher III personnel.

On years of teaching experience, 10 respondents (63%) had 10 years and above, 4 (25%) had 1 to 3 years, and 2 (12%) had 4 to 6 years, for a total of 16 (100%). The workforce is predominantly seasoned, with extensive classroom exposure and established pedagogical practices. Veteran teachers bring valuable expertise but may find it harder to adapt to emerging technologies because of long-standing routines, whereas less experienced teachers often show greater familiarity with digital tools. Ghavifekr et al. (2024) noted that experienced teachers can integrate ICT effectively when given adequate training and technological support. Peng et al. (2023) found that longer teaching experience may be associated with lower digital competence in the absence of continuous professional development. Caparal et al. (2025) emphasized experience-based professional development and mentoring for ICT integration in technical and vocational education. Refresher training, hands-on opportunities and mentoring for veteran teachers, together with active innovation roles for newer teachers, are therefore appropriate.

For highest educational attainment, 12 respondents (75%) had Master's units, 3 (19%) held a Bachelor's degree, and 1 (6%) had Doctorate units, for a total of 16 (100%). This indicates a workforce committed to professional growth beyond undergraduate education. Graduate-level coursework suggests exposure to advanced pedagogical concepts and potentially higher readiness for ICT integration, although the single respondent with Doctorate units points to limited opportunities for advanced research and leadership in educational innovation. Howard et al. (2022) reported that teachers with higher educational qualifications show stronger ICT self-efficacy and integration practices. Peng et al. (2023) found a positive relationship between educational attainment and ICT competence, with Master's-level teachers more proficient than those with only bachelor's degrees. Caparal et al. (2025) emphasized qualification-based professional development and specialized ICT training in technical and vocational education.

Regarding subject area handled, 15 respondents (94%) taught TLE, confirming their specialization in vocational and skills-based education. Many also handled additional subjects: Araling Panlipunan (3 respondents, 19%), MAPEH (3, 19%), Values Education (2, 13%), English (1, 6%) and Mathematics (1, 6%). Values Education, Mathematics, English and MAPEH were handled as additional load together with TLE. These multiple assignments may increase workload, lesson preparation demands and the complexity of integrating ICT across disciplines, which could affect the quality of technology-enhanced instruction unless adequate support is provided. Sumalinog et al. (2022) reported that subject-specialization mismatches in Technical-Vocational-Livelihood programs can affect instructional quality and professional effectiveness. Caparal et al. (2025) emphasized specialization-aligned professional development. Gamboa (2022) observed that vocational teachers managing multiple responsibilities often need additional ICT training, hands-on support and capacity-building.

On participation in ICT-related professional development, 14 respondents (87.5%) had attended ICT-focused training and 2 (12.5%) had not, for a total of 16 (100.00%). This high participation suggests a positive culture of professional growth and readiness for ICT integration, although the small group of non-participants shows a need for more inclusive access to training. Sasing (2020) noted that ICT professional development in Philippine public schools has significantly strengthened teachers' technology competencies and confidence. Prudente et al. (2024) found that sustained ICT training improves digital pedagogical skills and classroom technology use. Caparal et al. (2025) emphasized that continuous and targeted professional development is essential, particularly in technical-vocational education.

The primary ICT resources used for online and blended teaching in TLE are described next. For hardware, all 16 teachers (100%) used laptops, 10 (63%) used smartphones, 8 (50%) used desktop computers, 6 (38%) used television, 6 (38%) used tablets, 2 (13%) used scanners, and 2 (13%) used radio. For software and platforms, Facebook and Messenger were each used by 15 teachers (94%), Google Meet by 12 (75%), Wifi or internet by 11 (69%), and Google Classroom and Zoom by 6 each (38%). Teachers therefore relied on accessible, versatile devices and communication-oriented platforms that support both synchronous and asynchronous learning and are familiar to students. This reliance underscores the need for professional development that maximizes the instructional potential of these tools for assessment, content delivery and interactive learning. It also shows that stronger internet connectivity and wider access to formal learning management systems could improve blended learning. Caparal et al. (2025) reported widespread use of laptops and social media among technical-vocational teachers. Gamboa (2022) highlighted the effectiveness of smartphones and Facebook for technology-supported vocational instruction. Sasing (2020) emphasized adequate ICT resources, internet access and digital training for sustained integration.

Extent of ICT integration in TLE instruction

ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

For lesson planning and preparation, teachers strongly agreed across all indicators, with an average weighted mean of 4.50 and item means from 4.38 to 4.69. The highest-rated statement was that ICT integration in lesson plan preparation is essential for effective teaching (mean 4.69, SD 0.48). Teachers also strongly agreed that ICT enhances the creation of lesson plans (4.63, SD 0.62), improves students' engagement and understanding of lessons (4.56, SD 0.63), and incorporates ICT elements into lesson plans (4.50, SD 0.63). Further strongly agreed items were that ICT improves the overall quality of lesson plans (4.44, SD 0.73) and builds confidence in using ICT tools for lesson preparation (4.44, SD 0.63). The lowest-rated items, at 4.38, were integrating ICT for the diverse learning needs of students (SD 0.81) and the opportunity to apply the ICT training acquired in preparing lessons (SD 0.72). Teachers thus regard ICT as an integral part of planning that supports content organization, responsiveness to diverse learners and confidence, so schools should keep providing digital resources, infrastructure and professional development. These findings are consistent with Wang et al. (2022), Caparal et al. (2025) and Ghavifekr et al. (2024), who linked positive perceptions of ICT in planning to lesson quality, differentiated instruction, teacher confidence and successful technology-enhanced practice.

For lesson delivery, the average weighted mean was 4.56 (Strongly Agree), with item means from 4.44 to 4.69. The highest-rated indicator was that ICT enhances students' engagement in lesson delivery (mean 4.69, SD 0.48). Five indicators each had a mean of 4.56 and an SD of 0.51: helping illustrate complex concepts, facilitating interactive and participatory learning, building confidence and competence in delivering lessons, enhancing active participation and collaboration, and providing real-world examples and applications. The lowest-rated indicator was the ability to personalize instruction to the diverse needs of students (4.44, SD 0.51). Teachers therefore see ICT as essential for engaging, interactive and learner-centered delivery, and the narrow spread of standard deviations shows a consistent view across respondents. Tondeur et al. (2021) found that ICT significantly enhances engagement and interactive learning. Howard et al. (2022) reported gains in teacher confidence, effectiveness and real-world application. Mrsic et al. (2023) emphasized participatory, personalized and engaging lesson delivery in technical and vocational education. Sustained investment in infrastructure and professional development is therefore needed to maximize these benefits.

For assessment and evaluation, the average weighted mean was 4.44 (Strongly Agree), with item means from 4.31 to 4.56. The highest-rated indicator was that ICT facilitates efficient and accurate grading (mean 4.56, SD 0.73), followed by creating assessments aligned with learning objectives (4.50, SD 0.63). Three indicators each had a mean of 4.44 and an SD of 0.63: incorporating multimedia elements, providing formative assessment that tracks progress in real time, and identifying students' strengths and weaknesses. Engaging students in ICT-based assessments scored 4.38 (SD 0.62), and the lowest-rated indicator was providing timely feedback to students (4.31, SD 0.70). Teachers thus see ICT as improving the quality, accuracy and efficiency of assessment, although timely feedback was relatively less strongly endorsed, which is consistent with the feedback difficulties reported later. Pérez Echeverría et al. (2025) and Bautista and Sanchez (2025) reported that ICT improves assessment accuracy, engagement and feedback delivery. Tondeur et al. (2021) found support for formative assessment and timely feedback, Howard et al. (2022) highlighted identification of learners' strengths and weaknesses, and Mrsic et al. (2023) noted gains in grading efficiency and monitoring in technical and vocational education.

For student monitoring, the average weighted mean was 4.49 (Strongly Agree), with item means from 4.31 to 4.63. Tracking and monitoring students' progress and performance

effectively, and collecting and analyzing learning outcome data efficiently, each received the highest mean of 4.63 (SD 0.50). Allowing real-time feedback and adjustments to instructional strategies, and enhancing students' active participation and accountability, each scored 4.50 (SD 0.63). Identifying students who need additional support or intervention, and improving the monitoring of overall teaching effectiveness, each scored 4.44 (SD 0.63). The lowest-rated indicator was the use of digital dashboards or platforms to track attendance and participation (4.31, SD 0.79), the largest SD in this area, which indicates more varied practice. Teachers value ICT for evidence-based monitoring, timely adjustment and targeted intervention, which supports investment in monitoring systems, learning management platforms and analytics training. Hakim (2019) reported improved progress monitoring and learning data analysis in vocational education. Tondeur et al. (2021) found that digital technologies help teachers identify students needing support, and Hashim et al. (2023) emphasized responsiveness, accountability and performance gains from real-time feedback systems.

For reports preparation, the average weighted mean was 4.53 (Strongly Agree), with item means from 4.38 to 4.69. The highest-rated indicator was that ICT enhances efficient reports preparation on student performance and outcomes (mean 4.69, SD 0.48), followed by generating reports with data visualization and analysis features (4.63, SD 0.62). Four indicators scored 4.50: enhancing the presentation of assessment results to stakeholders (SD 0.63), customizing reports for different audiences (SD 0.63), providing comprehensive and timely feedback to students (SD 0.63), and easily archiving and accessing past reports and students' performance data (SD 0.52). The lowest-rated indicator was making reports easily accessible and user-friendly for stakeholders (4.38, SD 0.62). Teachers thus perceive ICT as an essential tool for accurate, accessible and data-driven reporting that supports accountability and transparency. Ghavifekr et al. (2024) found improvements in reporting efficiency, data management and visualization. Hakim (2022) reported that digital tools support customized reports for various stakeholders, and Ifinedo et al. (2020) noted that ICT-supported reporting strengthens feedback and data-driven decision-making. Taken together, the average weighted means were 4.56 for lesson delivery, 4.53 for reports preparation, 4.50 for lesson planning and preparation, 4.49 for student monitoring and 4.44 for assessment and evaluation. All five areas fall within the Strongly Agree range of 4.21 to 5.00, and the narrow differences indicate uniformly high integration.

Challenges hindering ICT integration

In lesson planning and preparation, slow internet connectivity was the most frequently reported problem (f = 15, Rank 1). Limited access to ICT resources and the unavailability or unaffordability of specific software, digital content or online platforms were each reported by 10 teachers (Rank 2). The additional time consumed by planning in digital formats was reported by 6 teachers (Rank 4), and disparities in digital skills and proficiency among educators were reported by 4 (Rank 5). The principal barriers are therefore infrastructural and resource-related rather than competency-based, which suggests that teachers generally have the necessary skills but lack adequate technological support. Improved connectivity, expanded access and affordable software are essential, and continuing professional development can reduce the time burden of digital preparation. This is consistent with Istiningsih et al. (2022), Duci (2024) and König et al. (2023), who identified poor connectivity, inadequate resources and software limitations as major obstacles.

In lesson delivery, unequal student access to necessary ICT tools was the most frequently reported challenge (f = 13, Rank 1), followed by technical issues that disrupt lessons (f = 11, Rank 2). Difficulty maintaining student engagement and interaction in online or blended environments, and differing levels of digital literacy among students and teachers,

were each reported by 9 teachers (Rank 3). Ineffective delivery of content through ICT tools, especially for hands-on TLE subjects, was reported by 8 teachers (Rank 5). Access, reliable infrastructure and learner engagement are thus the main barriers, particularly in vocational subjects that require practical application. Equitable access to devices, better connectivity, and blended approaches that combine digital instruction with supervised hands-on activities are needed, along with digital literacy development for teachers and students. Banagiri (2021) identified access disparities and technical disruptions as major obstacles, Oguzor (2020) found that technical issues and varying digital literacy affect blended instruction, and UNESCO-IIEP (2023) emphasized equitable access to ICT resources and infrastructure.

In assessment and evaluation, internet connectivity problems that disrupt online assessments were most frequently reported (f = 14, Rank 1). Unequal access to ICT resources affecting students' participation and performance, and the view that authentic assessment of hands-on TLE skills is difficult to replicate online, were each reported by 12 teachers (Rank 2). Inadequate prevention of cheating and unauthorized access to assessment materials, and inadequate accommodation of students with diverse learning needs including those with disabilities, were each reported by 7 teachers (Rank 4). Both technological and pedagogical limitations therefore affect ICT-based assessment, especially for skills requiring practical demonstration. Blended assessment that combines digital evaluation with supervised practical demonstration is advisable, as is specialized training in authentic assessment, academic integrity and inclusivity. Ghavifekr et al. (2024) identified connectivity issues and unequal access as major barriers. Howard et al. (2022) reported that authentic assessment of practical skills remains a significant challenge in technology-supported environments, and UNESCO (2023) recommended hybrid and performance-based strategies to maintain fairness, accessibility and validity.

In student monitoring, technical issues that disrupt monitoring, leading to data inconsistencies and frustration, were most frequently reported (f = 12, Rank 1). Ineffective measurement of student engagement because of ineffective monitoring strategies, and improper selection and implementation of monitoring tools aligned with TLE instructional goals, were each reported by 8 teachers (Rank 2.5). Ineffective use of monitoring tools due to limited teacher digital skills was reported by 7 teachers (Rank 4), and untimely technical support for teachers and students by 6 (Rank 5). The effectiveness of ICT-based monitoring thus depends on reliable infrastructure, appropriately aligned tools and responsive support in addition to teacher competence, since disruptions and poorly aligned systems reduce the accuracy of tracking and limit data-driven decisions. Ghavifekr et al. (2024) identified technical disruptions and tool-selection issues as major barriers. Howard et al. (2022) reported that technical challenges and difficulty measuring engagement often hinder digital monitoring, and Istiningsih et al. (2022) emphasized reliable technical support, appropriate tools and teacher training.

In reports preparation, technical issues that disrupt the process and cause delays and frustration were most frequently reported (f = 14, Rank 1). Compromised data privacy and security in relation to data protection regulations, and a lack of proper training among teachers and administrators in using digital tools for report generation and analysis, were each reported by 9 teachers (Rank 2). The unavailability of digital resources for report generation, and reports that are not user-friendly for stakeholders with varied digital literacy, were each reported by 6 teachers (Rank 4). Reliable infrastructure and educator competence therefore both matter, and schools should provide reporting software, targeted training in data analysis and report generation, and compliance with data privacy and security standards, while designing reports that stakeholders with diverse digital literacy can understand. Ghavifekr et al. (2024) identified

technical disruptions and training deficiencies as major barriers. Howard et al. (2022) reported that privacy concerns and varied stakeholder digital literacy affect digital reporting, and Duci (2024) emphasized secure platforms, adequate training and user-friendly tools. Across all five areas, the most frequently reported problem was a connectivity, access or technical disruption issue.

Differences between teachers' profile and the extent of ICT integration

For sex at birth, the reported test statistics were 16.5 ($p = 0.138$, mean difference 0.375, rank biserial correlation -0.450) for lesson planning and preparation, 18.0 ($p = 0.189$, mean difference 0.429, rank biserial correlation -0.400) for lesson delivery, 12.5 ($p = 0.058$, mean difference 0.832, rank biserial correlation -0.583) for assessment and evaluation, 23.5 ($p = 0.493$, mean difference 2.60e-5, rank biserial correlation -0.217) for student monitoring, and 22.0 ($p = 0.391$, mean difference 0.286, rank biserial correlation -0.267) for reports preparation. All p-values exceeded the 0.05 level of significance ($p = .058$ to $p = .493$), so all null hypotheses were accepted and male and female teachers integrated ICT to a comparable extent. The result for assessment and evaluation ($p = .058$) approached significance and showed a moderate practical difference, but the overall pattern indicates that contextual and organizational factors matter more than sex. This agrees with Amponsah et al. (2022), who found that male and female teachers integrate ICT effectively given equal opportunities, and with Scherer and Siddiq (2019), who noted that gender disparities in digital competence have diminished. Tondeur et al. (2017) likewise emphasized resource access, professional development and administrative support over demographic characteristics. Interventions should therefore benefit all teachers regardless of sex.

For age, Kruskal-Wallis tests with 3 degrees of freedom yielded $\chi^2 = 6.84$ ($p = 0.077$, $\varepsilon^2 = 0.4560$) for lesson planning and preparation, $\chi^2 = 7.05$ ($p = 0.070$, $\varepsilon^2 = 0.4698$) for lesson delivery, $\chi^2 = 6.01$ ($p = 0.111$, $\varepsilon^2 = 0.4004$) for assessment and evaluation, $\chi^2 = 1.36$ ($p = 0.715$, $\varepsilon^2 = 0.0906$) for student monitoring, and $\chi^2 = 2.13$ ($p = 0.546$, $\varepsilon^2 = 0.1420$) for reports preparation. All p-values exceeded 0.05 ($p = .070$ to $p = .715$), so the null hypotheses were accepted and teachers of different age groups integrated ICT at relatively similar levels. This challenges the assumption, popularized by Prensky (2001) through the concepts of digital natives and digital immigrants, that younger teachers are more capable. Scherer et al. (2017) found that age is not a significant predictor of classroom technology use once self-efficacy, experience and institutional support are considered, and Inan and Lowther (2010) reported that teacher beliefs and technology access outweigh demographic factors. The moderate effect sizes for lesson planning and preparation ($\varepsilon^2 = 0.4560$) and lesson delivery ($\varepsilon^2 = 0.4698$) suggest some practical variation that was not statistically significant and may reflect the small sample. Kreijns et al. (2013) noted that age-related differences are often mediated by professional development and collegial support, and Ertmer and Ottenbreit-Leftwich (2010) emphasized pedagogical beliefs, confidence and access to quality professional development. Age-inclusive enhancement programs are therefore appropriate.

For position and rank, Kruskal-Wallis tests with 2 degrees of freedom yielded $\chi^2 = 0.620$ ($p = 0.733$, $\varepsilon^2 = 0.0413$) for lesson planning and preparation, $\chi^2 = 1.398$ ($p = 0.497$, $\varepsilon^2 = 0.0932$) for lesson delivery, $\chi^2 = 0.247$ ($p = 0.884$, $\varepsilon^2 = 0.0164$) for assessment and evaluation, $\chi^2 = 0.985$ ($p = 0.611$, $\varepsilon^2 = 0.0657$) for student monitoring, and $\chi^2 = 0.249$ ($p = 0.883$, $\varepsilon^2 = 0.0166$) for reports preparation. All p-values exceeded 0.05 ($p = .497$ to $p = .884$), so all null hypotheses were accepted and Teacher I, Teacher III and Master Teachers integrated ICT at comparable levels. The very small effect sizes ($\varepsilon^2 = 0.0164$ to 0.0932) indicate that rank contributed minimally to variation. Gil-Flores et al. (2017) found that professional category and years of service were not significant predictors once resources, professional development and

ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

institutional support were considered. Vanderlinde and van Braak (2010) found that school ICT policies and collaborative cultures influence adoption more than hierarchical position, and Tondeur et al. (2017) concluded that pedagogical beliefs rather than professional status shape integration. Ertmer and Ottenbreit-Leftwich (2010) and Avidov-Ungar and Eshet-Alkakay (2011) highlighted collaborative professional learning communities. Whole-school, collaborative approaches engaging teachers of all ranks and promoting peer mentoring are therefore recommended.

For years of teaching experience, Kruskal-Wallis tests with 2 degrees of freedom yielded $\chi^2 = 0.963$ ($p = 0.618$, $\varepsilon^2 = 0.0642$) for lesson planning and preparation, $\chi^2 = 1.439$ ($p = 0.487$, $\varepsilon^2 = 0.0959$) for lesson delivery, $\chi^2 = 1.595$ ($p = 0.450$, $\varepsilon^2 = 0.1064$) for assessment and evaluation, $\chi^2 = 0.771$ ($p = 0.680$, $\varepsilon^2 = 0.0514$) for student monitoring, and $\chi^2 = 0.569$ ($p = 0.753$, $\varepsilon^2 = 0.0379$) for reports preparation. All p-values exceeded 0.05 ($p = .450$ to $p = .753$), so all null hypotheses were accepted and novice and veteran teachers integrated ICT at comparable levels. The small effect sizes ($\varepsilon^2 = 0.0379$ to 0.1064) indicate that experience explained little of the variance. This challenges the belief that longer service necessarily affects technology adoption. Ottenbreit-Leftwich et al. (2018) found that experienced teachers integrate technology meaningfully by combining digital tools with pedagogical and content knowledge. Liu et al. (2017) reported that experience contributes less than self-efficacy, access and institutional support, and Inan and Lowther (2010) emphasized teacher beliefs and technology availability. Badia et al. (2014) noted that in vocational and skills-based subjects such as TLE, integration is driven more by curricular demands and resource availability than by experience. Professional development should therefore not be differentiated solely by years of service but should promote collaborative learning, peer mentoring and shared expertise, as Trust et al. (2016) advocated through professional learning communities that draw on the complementary strengths of novice and experienced teachers.

For highest educational attainment, Kruskal-Wallis tests with 2 degrees of freedom yielded $\chi^2 = 3.78$ ($p = 0.151$, $\varepsilon^2 = 0.252$) for lesson planning and preparation, $\chi^2 = 3.71$ ($p = 0.157$, $\varepsilon^2 = 0.247$) for lesson delivery, $\chi^2 = 2.67$ ($p = 0.263$, $\varepsilon^2 = 0.178$) for assessment and evaluation, $\chi^2 = 2.38$ ($p = 0.304$, $\varepsilon^2 = 0.159$) for student monitoring, and $\chi^2 = 2.61$ ($p = 0.271$, $\varepsilon^2 = 0.174$) for reports preparation. All p-values exceeded 0.05 ($p = .151$ to $p = .304$), so all null hypotheses were accepted and teachers of different educational attainment integrated ICT at comparable levels. The moderate effect sizes ($\varepsilon^2 = 0.159$ to 0.252) suggest that educational attainment accounted for approximately 16% to 25% of the variance, a practically meaningful difference that may not have reached significance because of the limited sample size, as emphasized by Cohen (1988) and Tabachnick and Fidell (2019). Mueller et al. (2008) reported that advanced educational preparation is associated with stronger pedagogical reasoning and better alignment of technology with instructional goals, and Sang et al. (2010) found that higher attainment is associated with stronger constructivist beliefs supporting integration. The stronger effects for lesson planning and preparation ($\varepsilon^2 = 0.252$) and lesson delivery ($\varepsilon^2 = 0.247$) suggest that advanced preparation may particularly influence instructional design and implementation, consistent with Ertmer and Ottenbreit-Leftwich (2010) and Williams (2015). The smaller effects for student monitoring and reports preparation imply stronger influence from institutional systems and standardized procedures, consistent with Ifinedo et al. (2020). Professional development should remain accessible to all teachers while offering differentiated support, mentoring and pathways for advanced study, as recommended by Darling-Hammond et al. (2017).

Synthesis of findings

The 16 TLE teachers were predominantly female (62%), aged 46 and above (56%), of Teacher I or Teacher III rank (44% and 37%), with 10 or more years of experience (63%), and mostly with Master's units (75%). Nearly all specialized in TLE (94%), and 87.5% had joined ICT-related professional development. They relied mainly on laptops (100%), smartphones (63%), Facebook and Messenger (94% each) and Google Meet (75%). Teachers strongly agreed that ICT is integrated in all five instructional areas, with average weighted means from 4.44 to 4.56, and the most frequent challenges in every area were slow or disrupted connectivity, unequal access and technical disruptions rather than skill deficits. None of the tests of difference by sex, age, position and rank, years of experience or educational attainment reached the 0.05 level of significance, so all null hypotheses were accepted. ICT integration is therefore better explained by access to resources, proficiency with software tools and infrastructural support than by teacher demographics. These results address each objective of the study and add context-specific evidence on ICT use in TLE in a Philippine public secondary school, evidence that is directly usable for planning interventions. They also provide the empirical basis for the proposed action plan, Project TECH-TLE: Enhancing ICT Integration for Continuous Learning, which is presented in the next section together with the conclusions and recommendations.

CONCLUSION

The study concludes that TLE teachers at Jagobiao National High School strongly value and actively integrate ICT across all key instructional areas, demonstrating a high extent of ICT use in lesson planning, delivery, assessment, monitoring, and reporting. However, significant challenges, primarily technical and infrastructural, such as slow internet connectivity, unequal access to ICT tools, and technical disruptions hinder optimal integration. Teacher demographics do not significantly influence ICT integration; instead, access to and proficiency with ICT software are more critical factors. Therefore, to enhance ICT integration and ensure learning continuity in TLE, there is a need for systematic interventions addressing infrastructure, access, and targeted professional development.

It is recommended that the output of this study, the Action Plan titled "Project TECH-TLE: Enhancing ICT Integration for Continuous Learning" be adopted and implemented by Jagobiao National High School in collaboration with the Department of Education (DepEd) and relevant stakeholders. This plan provides a structured, evidence-based framework for addressing the identified challenges and strengthening ICT integration in TLE instruction. Its implementation is expected to enhance teaching effectiveness, support continuous learning, and improve student outcomes in Technology and Livelihood Education.

REFERENCES

Akram, H., et al. (2022). Teachers' perceptions of technology integration in education. Frontiers in Psychology, 13, Article 920317.

Amponsah, S., Kwesi, A. B., & Ernest, A. (2022). ICT integration in early childhood education: Teachers' gender and digital competence. Journal of Educational Technology & Society, 25(3), 42-54.

Avidov-Ungar, O., & Eshet-Alkakay, Y. (2011). Teachers in a world of change: Teachers' knowledge and attitudes towards the implementation of innovative technologies in schools. Interdisciplinary Journal of E-Learning and Learning Objects, 7(1), 291-303.

Badia, A., Meneses, J., & Sigalés, C. (2014). Teachers' perceptions of factors affecting the educational use of ICT in technology-rich classrooms. Electronic Journal of Research in Educational Psychology, 12(3), 775-802.

Banagiri, R. (2021). Use of ICT in teaching vocational subjects. International Journal of Education and Development Using Information and Communication Technology, 17(3), 149-162. https://files.eric.ed.gov/fulltext/EJ1335793.pdf

Bunting (Eds.), The future of technology education (pp. 1-15). Springer.

Caparal, R. C., Abalos, A. S., & Tagapan, A. G. (2025). ICT integration in pedagogy among teachers in technical-vocational schools. International Journal of Advanced Multidisciplinary Studies, 5(5), 275-287. https://www.ijams-bbp.net/wp-content/uploads/2025/08/5-IJAMS-MAY-2025-275-287.pdf

Casilao, D. P. (2025). Teachers' professional development, technology integration, and learners' engagement. International Journal of Studies in Multidisciplinary Sciences, 8(1), 103. https://www.ijsmsjournal.org/2025/volume-8%20issue-1/ijsms-v8i1p103.pdf

Chen, X., et al. (2018). ICT and student motivation in education. Educational Technology Research.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Erlbaum Associates.

Costa, F. M. (2021). Digital competencies and the integration of ICT in education: Challenges and perspectives. Journal of Educational Technology and Innovation, 8(3), 120–135.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. Learning Policy Institute.

Delcker, J., & Ifenthaler, D. (2021). Teacher professional development needs for ICT integration in classrooms. Computers & Education, 168, Article 104212.

Department of Education (DepEd). (2022). Implementing the Enhanced Basic Education Act (RA 10533). Philippine Journal of Education, 102(2), 54–64.

Department of Information and Communications Technology (DICT). (2022). Philippine ICT policies and educational initiatives. DICT Reports.

DepEd Data Bits. (2022). Philippines ICT in education status report.

Duci, V. (2024). Integrating ICT in vocational education and training. Journal of Research Innovation and Technology, 3(2), 1-15. https://library.acadlore.com/JORIT/2024/3/2/JORIT_03.02_02.pdf

Edouard, M. (2023). Enhancing teacher self-efficacy for ICT integration. Journal of Educational Research, 48(2), 135–150.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. Journal of Research on Technology in Education, 42(3), 255-284.

Espinosa, I. (2023). The role of data privacy and cybercrime laws in ICT in education. Journal of Philippine Legal Studies, 15(1), 33–45.

Fernández-Gutiérrez, M., et al. (2020). Effective education digitalization: A global perspective. OECD Reports.

Gamboa, D. M. D. (2022). Struggles of senior citizen teachers in the utilization of ICT in the new normal. International Journal of Multidisciplinary Research and Analysis, 5(8), 1-10. https://ijmra.in/v5i8/Doc/16.pdf

García, F., Martínez, P., & López, E. (2024). Teachers' attitudes and self-efficacy beliefs in the adoption of ICT tools in higher education. Journal of Educational Computing Research, 62(1), 45–65.

Ghavifekr, S., & Athirah, W. N. (2015). Effectiveness of ICT integration in schools. International Journal of Research in Education and Science, 1(2), 175-184. https://files.eric.ed.gov/fulltext/EJ1105224.pdf

Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Anthony, A. (2024). The role of teachers' ICT self-efficacy and ICT infrastructure. International Journal of Cognitive Research in Science, Engineering and Education, 12(1), 1-12. https://ijcrsee.com/index.php/ijcrsee/article/view/2972

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. Computers in Human Behavior, 68, 441-449.

Goles, T., et al. (2024). Infrastructural challenges in Philippine schools. IJMRAP, 7(10), 110–125.

Goles, T., et al. (2024). Teacher competencies and digital literacy in Philippine schools. Educational Technology & Society, 27(1), 72–85.

Hakim, L. (2019/2022). ICT usage in vocational education and training (VET). Proceedings of the International Conference on Vocational Education and Training. https://www.atlantis-press.com/article/125914642.pdf

Hashim, S., et al. (2023). Adaptive strategies for technical and vocational education amid digital disruption. ASEAN Journal of Science, Engineering and Digital, 3(2), 394/322. https://www.ejournal.bumipublikasinusantara.id/index.php/ajsed/article/download/394/322

Howard, S. K., Tondeur, J., van der Zanden, P. J., & Sleeman, J. (2022). Teachers' perceptions of technology integration in teaching and learning. Frontiers in Psychology, 13, Article 920317. https://doi.org/10.3389/fpsyg.2022.920317

Ifinedo, E., Rikala, J., & Hämäläinen, T. (2020). Factors affecting Nigerian teachers' intentions to use emerging technologies in the classroom. Computers in Human Behavior, 107, Article 106320. https://doi.org/10.1016/j.chb.2020.106320

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. Educational Technology Research and Development, 58(2), 137-154.

Istiningsih. (2022). Impact of ICT integration on the development of vocational high school teacher TPACK in the digital age 4.0. World Journal on Educational Technology: Current Issues, 14(1), 103–116. https://doi.org/10.18844/wjet.v14i1.6642

Jogezai, S. A., et al. (2021). The role of social media in continuing education during COVID-19. Education and Information Technologies, 26(6), 6535–6552.

König, J., et al. (2020). Teacher preparedness in digitalized education. Journal of Education Technology.

König, J., Jäger-Biela, D. J., & Glutsch, N. (2023). ICT integration in teachers' lesson plans: A scoping review. Journal of Curriculum Studies, 56(2), 1-25. https://doi.org/10.1080/02619768.2022.2138323

Kreijns, K., Van Acker, F., Vermeulen, M., & Van Buuren, H. (2013). What stimulates teachers to integrate ICT in their pedagogical practices? The use of digital learning materials in education. Computers in Human Behavior, 29(1), 217-225.

Liang, J. (2021). Enhancing ICT pedagogical use: Teacher training and institutional supports. EdTech Review.

Liang, J. (2021). Professional development and teacher ICT competence. EdTech Review, 9(4), 45–57.

Liu, H., Lin, C. H., & Zhang, D. (2017). Pedagogical beliefs and attitudes toward information and communication technology: A survey of teachers in China. Journal of Educational Technology Development and Exchange, 10(1), 1-18.

Morales, L., et al. (2021). Digital divide and teacher competencies in the Philippines. International Journal of Education.

Morales, L., et al. (2021). Legal frameworks supporting ICT integration in Philippine education. International Journal of Educational Development, 75, 102–110.

Morales, L., et al. (2023). Teachers' attitudes and ICT integration in the Philippines. Philippine Journal of Education, 102(1), 67–82.

Mrsic, M., Stimac, H., & Bosnic, Z. (2023). Utilizing ICT-based learning resources to enhance creativity in vocational teacher education. European Journal of Education and Pedagogy. https://www.eriesjournal.com/index.php/eries/article/download/1774/333/8125

Msambwa, M. M. (2024). Integration of ICT in teaching-learning processes. Computers & Education Advances, 5, Article 100170.

Mueller, J., Wood, E., Willoughby, T., Ross, C., & Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. Computers & Education, 51(4), 1523-1537.

Nagy, G., & Dringó-Horváth, A. (2024). Institutional support and teacher ICT usage. Educational Research.

Oguzor, N. S. (2020). Computer usage as instructional resources for vocational training in Nigeria. Contemporary Educational Technology. https://www.cedtech.net/download/computer-usage-as-instructional-resources-for-vocational-training-in-nigeria-6053.pdf

OECD. (2021). Digital transformation in education.

Ottenbreit-Leftwich, A. T., Kopcha, T. J., & Ertmer, P. A. (2018). Information and communication technology dispositional factors and relationship to information and communication technology practices. In J. Voogt, G. Knezek, R. Christensen, & K. W. Lai (Eds.), Second handbook of information technology in primary and secondary education (pp. 231-246). Springer.

Pan, Y., Cheung, W., & Stewart, D. (2020). Exploring the influence of perceived usefulness and self-efficacy on teachers' technology integration in classrooms. Educational Technology Research and Development, 68(4), 1903–1920.

Panakaje, N. (2024). Navigating technology integration for student engagement. Educational Technology Research and Development, 72(1), 45–63.

Peng, R., & Lai, M. (2023). Factors influencing in-service teachers' technology integration model: Innovative strategies for educational technology. PLOS ONE, 18(8), Article e0286112. https://doi.org/10.1371/journal.pone.0286112

Pettersson, F. (2021). Transformative ICT integration in schools. Learning and Technology.

Prensky, M. (2001). Digital natives, digital immigrants. On the Horizon, 9(5), 1-6.

Prudente, M., Peconcillo Jr., E., & Relon, L. (2024). Systematic review of professional development programs for 21st-century skills. EDCOM 2. https://edcom2.gov.ph/media/2024/02/18_Prudente-et-al-Systematic-Review-of-Professional-1.pdf

Reyna, K. C. M., & Baguio, E. L. (2025). Reinventing the role of master teachers in the digital age. International Journal of Scientific and Research Publications, 15(3), 1-10. https://doi.org/10.29322/IJSRP.15.03.2025.p15902

Rodriguez, C. F., & Habla, F. A. (2024). Learning continuity in Technology and Livelihood Education (T.L.E.) instruction through information and communication technology (ICT) integration. United International Journal for Research & Technology, 5(4), 29–43. https://uijrt.com/paper/learning-continuity-tle-ict-integration

Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. Computers & Education, 54(1), 103-112.

Sasing, M. T. (2020). Teacher professional development on ICT in education in the Philippines (Brief). RTI International. https://shared.rti.org/content/teacher-professional-development-ict-education-philippines-brief

Scherer, R., Siddiq, F., & Teo, T. (2017). Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. Computers & Education, 88, 202-214.

Sumalinog, D. C., et al. (2022). Analyzing the match between TVL courses and teachers' specializations. International Journal of Multidisciplinary Studies in Technology, 1(1), 1-15. https://cosmosscholars.com/phms/index.php/ijmst/article/download/1542/1025

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Pearson.

Thaheem, M. J., et al. (2021). ICT in crisis situations: COVID-19 and education continuity. Education Review.

Tiangco, M. D. (2025). Psychological strain and challenges encountered by teachers in digital transformation. e-International Journal of Innovations in Technology, 1, 36. https://www.e-iji.net/dosyalar/iji_2025_1_36.pdf

Tondeur, J., Aesaert, K., & Prestridge, S. (2021). A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies. Computers & Education, 163, Article 104116. https://doi.org/10.1016/j.compedu.2020.104116

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. Educational Technology Research and Development, 65(3), 555-575.

Travero, I. (2023). Technical and pedagogical support for ICT use in Philippine schools. IJMRAP.

Trust, T., Krutka, D. G., & Carpenter, J. P. (2016). "Together we are better": Professional learning networks for teachers. Computers & Education, 102, 15-34.

UNESCO. (2023). Technology in education: Philippine case study.

UNESCO-IIEP. (2023). The use of ICTs in technical and vocational education and training. UNESCO. https://iite.unesco.org/pics/publications/en/files/3214613.pdf

Vanderlinde, R., & van Braak, J. (2010). The e-capacity of primary schools: Development of a conceptual model and scale construction from a school improvement perspective. Computers & Education, 55(2), 541-553.

Wang, J., Li, Y., & Zhang, Q. (2022). Teachers' perceptions of technology integration in teaching and learning. Frontiers in Psychology, 13, Article 920317. https://doi.org/10.3389/fpsyg.2022.920317

Williams, P. J. (2015). Vocational and technology education: International perspectives. In P. J. Williams, A. Jones, & C.