



TECHNOLOGICAL, PEDAGOGICAL, AND CONTENT KNOWLEDGE (TPACK) IN TLE EDUCATION: IMPLICATIONS FOR K-10 CURRICULUM REFORM

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ABSTRACT

Through its Revised K–10 Curriculum, the Department of Education aims to solidify foundational skills, advance 21st-century learning, and bridge education with industry requirements. In this context, Technology and Livelihood Education (TLE) plays a salient role in preparing learners for employment, entrepreneurship, and lifelong learning. This study assessed the extent of integration of the Technological Pedagogical Content Knowledge (TPACK) framework in the teaching practices of secondary TLE teachers in Malasiqui Districts I, II-A, and II-B. Guided by a quantitative descriptive design, the study employed a validated survey to measure teachers' integration of content knowledge, pedagogical strategies, and technological tools within the revised curriculum. The results showed full integration of the TPACK framework across all assessed dimensions. Teachers aligned content with industry standards, employed localised and differentiated instruction, and effectively utilized emerging technologies and multimedia resources. The use of collaborative platforms, gamified learning tools, and digital assessments demonstrated strong technological competence. Furthermore, teachers actively engaged in professional development to sustain instructional innovation. These findings affirm that TLE teachers are well-equipped to implement the revised curriculum through inclusive, context-responsive, and technology-enhanced instruction. The study underscores the significance of continuous teacher training, institutional support, and infrastructure development in strengthening TPACK competencies. It contributes to educational reform discourse by offering evidence of effective curriculum implementation and advocating for a contextualized framework to support ongoing teacher development in technical and vocational education.

Keywords: *TPACK; Technology and Livelihood Education; Revised K-10 Curriculum; teacher readiness; differentiated instruction; educational technology*

INTRODUCTION

The rapid evolution of technology in the 21st century has fundamentally transformed how educators teach and how students learn, making it imperative for teachers to harness the intersection of technology, pedagogy, and content knowledge to deliver meaningful, relevant, and future-ready instruction.

The Department of Education (DepEd) in the Philippines introduced the Revised K-10

Curriculum to enhance the delivery of basic education by streamlining content, emphasizing the mastery of foundational skills, and aligning with 21st-century learning standards (DepEd, 2023). The curriculum aims to cultivate lifelong learners who are adaptable, innovative, and globally competitive. For Technology and Livelihood Education (TLE) teachers, this shift is particularly significant given the curriculum's focus on equipping students with practical skills



necessary for employment, entrepreneurship, and sustainable livelihoods (Maceda Jr., 2020). The successful implementation of the Revised K-10 Curriculum hinges on educators' competence, particularly their readiness to integrate technological tools, apply effective pedagogical strategies, and deliver content aligned with global standards (Mishra & Koehler, 2006; Padillo et al., 2021).

Despite its forward-looking vision, challenges persist in the effective rollout of the Revised K-10 Curriculum. Previous studies and pilot evaluations have highlighted concerns over teacher readiness, resource availability, and outdated instructional practices (Gutierrez, 2024; Ceremonia-Cerd, 2024). Abalde and Oco (2023) stressed that learners' weak performance in assessments such as PISA reflects systemic issues, including curriculum overload, teacher shortages, and technological gaps. The Philippine Institute for Development Studies (PIDS, 2022) similarly noted that without adequate teacher training and support systems, educational reforms may fall short of their intended outcomes. In the context of TLE, the lack of access to digital tools, inadequate content-specific training, and limited use of innovative teaching methods have been identified as critical barriers to curriculum effectiveness (Pillay & Panth, 2022; Gouëdard et al., 2020).

In response to these issues, this study aims to assess the level of readiness among TLE teachers in the Malasiqui Districts (I, II-A, II-B) in implementing the Revised K-10 Curriculum through the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006). It will examine the extent of integration of technological, pedagogical, and content knowledge approaches. By identifying readiness gaps, this research seeks to develop a contextualized framework to enhance TPACK among TLE teachers and support the effective delivery of the revised curriculum. In doing so, it contributes to the ongoing discourse on educational reform and teacher capacity-building in the Philippine context. The findings of this study promise to

shed light on the extent to which TLE teachers have truly embraced the integration of technology, pedagogy, and content—raising questions that challenge assumptions, reveal the gaps and strengths of current practice, and ultimately point the way toward a more empowered and effective teaching workforce.

OBJECTIVES OF THE STUDY

This study assesses the extent of integration of the Technological Pedagogical Content Knowledge (TPACK) framework in the teaching practices of secondary TLE teachers in Malasiqui Districts I, II-A, and II-B in the implementation of the DepEd Revised K-10 Curriculum. Specifically, the study aimed to:

1. Determine the extent of integration of TPACK in TLE instruction along the Technological Approach;
2. Determine the extent of integration of TPACK in TLE instruction along the Pedagogical Approach;
3. Determine the extent of integration of TPACK in TLE instruction along the Content Knowledge Approach; and
4. Propose a framework to enhance the TPACK of TLE teachers in response to the DepEd Revised K-10 Curriculum.

METHODOLOGY

This quantitative descriptive study investigated how TPACK integration and resource adequacy influence the implementation of the Revised K-10 Curriculum in Malasiqui Districts. The research design was deemed appropriate because it sought to describe and measure existing conditions regarding teachers' integration of technological, pedagogical, and content knowledge without manipulating variables.

Using stratified random sampling, 107 TLE teachers from 20 schools across Malasiqui Districts I, II-A, and II-B participated in the study. Data were gathered through a researcher-



developed and validated questionnaire using a 5-point Likert scale, with responses ranging from 1 (Minimally Integrated) to 5 (Fully Integrated). The scale was interpreted as follows: 4.21–5.00 (Fully Integrated), 3.41–4.20 (Mostly Integrated), 2.61–3.40 (Moderately Integrated), 1.81–2.60 (Slightly Integrated), and 1.00–1.80 (Minimally Integrated). Analysis of data involved the computation of weighted means for each indicator and domain. Ethical protocols, including obtaining informed consent and maintaining respondent confidentiality, were strictly observed throughout the study.

RESULTS AND DISCUSSION

This section presents the level of integration of Technological Pedagogical and Content Knowledge (TPACK) in the teaching practices of secondary TLE teachers. It examines how effectively technology, pedagogy, and content are combined in classroom instruction, aligned with the implementation of the Revised K-10 Curriculum. The findings provide insights into teachers' preparedness and capacity to deliver effective, integrated instruction in Technology and Livelihood Education.

1. Integration of TPACK in the Teaching of Technology and Livelihood Education along Technological Approach

Technological Approach

The findings reveal that the technological approach of the TPACK framework is fully integrated in the teaching of Technology and Livelihood Education (TLE) across all dimensions assessed. The overall weighted means for all indicators fall within the 4.41 to 4.70 range, indicating that TLE teachers are highly proficient and committed to integrating technology in their instructional practices.

It can be noted that teachers reported strong access to and frequent use of digital tools, educational software, and DepEd-developed

resources. This aligns with the findings of Koehler and Mishra (2009), who emphasized that effective integration of technology in classrooms begins with access and regular use of tools tailored for instruction. The strong utilization of e-learning platforms also reflects DepEd's push towards digital transformation in Philippine education (DepEd Order No. 35, s. 2016).

Teachers demonstrated confidence in operating ICT tools and using online assessments and digital portfolios. This supports Harris, Mishra, and Koehler (2009), who stated that teachers with high TPACK proficiency effectively align instructional strategies with digital tools. The high participation in ICT training reflects adherence to ongoing professional development, which is essential in sustaining technological competence (Inan & Lowther, 2010).

Furthermore, the highest mean score in this domain underscores the deliberate use of technology that is tightly aligned with the Revised K-10 Curriculum competencies. According to Voogt, Fisser, Roblin, Tondeur, and van Braak (2013), alignment between technology use and curriculum goals is a hallmark of mature TPACK integration. The use of industry-standard software also ensures relevance and real-world application of TLE subjects, preparing learners for future vocational or entrepreneurial endeavors.

Technology is used not just for delivery, but to actively engage students, foster collaboration, and improve motivation through gamification. This corroborates Balalle (2024), who found that technology-supported student interaction increases engagement and achievement. Tools such as Google Workspace and educational games promote constructivist, student-centered learning—central to 21st-century education models.

Teachers noted reliable access to the internet, technical support, and policy frameworks that sustain technology use. According to Ertmer and Ottenbreit-Leftwich (2010), administrative support, technical infrastructure, and policy backing are critical



enablers for meaningful technology integration. The results suggest a well-supported environment that empowers teachers to sustain and innovate in their use of ICT.

The data strongly suggest that the technological domain of TPACK is fully integrated in the TLE instruction of secondary teachers in Malasiqui Districts. These results are consistent with global and local research highlighting the importance of infrastructure, teacher proficiency, curricular alignment, student engagement, and support systems for successful technology integration. The high scores indicate that TLE teachers are not only equipped with digital tools but are also pedagogically empowered to use them in ways that enrich learning, engage students, and meet curriculum standards.

2. Integration of TPACK in the Teaching of Technology and Livelihood Education along Pedagogical Approach

Pedagogical Approach

The data highlight a strong integration of pedagogical knowledge in the teaching of Technology and Livelihood Education (TLE), with all five evaluated domains falling within the "Fully Integrated" range, boasting average weighted means between 4.56 and 4.74. This suggests that TLE teachers are not only familiar with but also effectively applying pedagogical strategies grounded in the Technological Pedagogical Content Knowledge (TPACK) framework. Their instructional approaches are aligned with current educational standards that emphasize personalized learning, collaboration, authentic assessment, 21st-century skills, and ongoing professional growth.

In terms of Differentiated Instruction, teachers are successfully adapting lessons to cater to students' varying learning needs, preferences, and abilities. Multimedia tools and multiple forms of assessments are regularly used to make learning more accessible and engaging. This approach is supported by Tomlinson (2001),

who advocates that adjusting content, process, and products according to learner profiles significantly boosts academic outcomes. Similarly, Koehler and Mishra (2009) note that technological knowledge enhances teachers' ability to tailor instruction through digital tools.

A high level of integration is observed in the domain of Collaboration and Team-Based Learning. Teachers implement cooperative strategies through group work and digital collaboration platforms like Google Docs, alongside peer evaluation and reflection activities to build communication and teamwork. Johnson and Johnson (2009) emphasize that cooperative learning enhances both academic outcomes and interpersonal skills, while Gillies (2016) points out that technology-supported collaboration strengthens motivation and accountability, especially in TLE settings.

Regarding Assessment and Feedback Mechanisms, TLE educators use various digital tools such as Kahoot, Google Forms, and e-portfolios to assess student understanding and provide structured, timely feedback. Shute (2008) highlights the importance of formative feedback in supporting learning, while Anderson and Krathwohl (2001) link effective assessment practices to the development of higher-order thinking. Mishra and Koehler (2006) also point out that technological knowledge plays a crucial role in shaping sound pedagogical decisions.

The Adaptation to the 21st-Century Learning Framework is evident through the integration of critical thinking, creativity, problem-solving, and collaboration in lesson plans. Teachers use real-world scenarios and digital platforms to foster these essential skills. The P21 Framework (2009) stresses the importance of equipping learners with these competencies, while Voogt et al. (2013) argue that technology-infused pedagogy is key to preparing students for the demands of the modern world.

Finally, Teacher Professional Development and Readiness is strongly evident. TLE educators are engaged in ongoing training focused on TPACK, participating in peer mentoring and professional learning communities. Darling-Hammond et al. (2017)



affirm that sustained and collaborative professional development directly enhances instructional effectiveness. Likewise, Reiser et al. (2024) emphasize that TPACK-centered training empowers teachers to confidently integrate technology and pedagogy into content instruction.

3. Integration of TPACK in the Teaching of Technology and Livelihood Education along Content Knowledge Approach

Content Knowledge Approach

The study revealed that the integration of the TPACK framework in the teaching of TLE in the Malasiqui District is fully integrated across all five content knowledge domains assessed. Teachers demonstrated the effective implementation of differentiated instruction by designing varied strategies, utilizing multimedia resources, and applying diverse assessment techniques tailored to learners' needs. These practices align with the findings of Tomlinson (2014) and Chai, Koh, and Tsai (2013), who emphasized that differentiated instruction supported by digital tools fosters inclusivity and improves learning outcomes.

Collaboration and team-based learning were also strongly implemented, as evidenced by the use of group projects, peer feedback, and collaborative digital platforms such as Google Docs. These findings are consistent with the work of Voogt et al. (2013) and Mishra and Koehler (2006), who highlighted how technology-supported collaboration enhances student interaction, engagement, and accountability in group settings. Similarly, teachers employed digital assessment tools like Kahoot, Quizizz, and Google Forms, alongside authentic performance-based evaluations. According to Redecker and Johannessen (2013), such tools provide meaningful and timely feedback while improving the quality of assessment and learning reflection.

Moreover, TLE teachers effectively incorporated 21st-century skills into their lessons by integrating real-world problems and fostering critical thinking, communication, creativity, and

collaboration. These strategies are supported by Silva (2009) and Vygotsky's (1978) socio-constructivist theory, which advocates for authentic, student-centered learning facilitated through technology. Professional development and teacher readiness were likewise fully integrated, with teachers actively participating in TPACK-focused training, workshops, and peer collaboration. These practices affirm the findings of Koehler, Mishra, and Cain (2013) and Desimone (2009), who underscored the importance of continuous professional learning in sustaining pedagogical and technological effectiveness.

The results confirm that TLE teachers in the Malasiqui Districts have achieved a high level of TPACK integration in their pedagogical practices. Their commitment to differentiated, collaborative, and 21st-century instruction—combined with continuous professional development—supports the delivery of inclusive, relevant, and future-ready education. These results highlight the effectiveness of TPACK as a guiding framework in aligning content, pedagogy, and technology in vocational and technical education.

4. Proposed Framework to Enhance the TPACK of TLE Teachers in Response to the DepEd Revised K-10 Curriculum

The integration of Technological Pedagogical Content Knowledge (TPACK) is fundamental to equipping Technology and Livelihood Education (TLE) teachers with the competencies needed to effectively implement the Department of Education's (DepEd) Revised K-10 Curriculum. As digital transformation continues to reshape the educational landscape, there is an increasing demand for teachers to adopt innovative and technology-driven pedagogical approaches that enhance learning outcomes. This proposed framework is designed to strengthen TLE teachers' TPACK through focused professional development, strategic instructional innovation, and the meaningful integration of technology into content delivery.



The framework aims to achieve seven interconnected objectives that collectively advance the quality of TLE instruction across all levels. At its core, it seeks to enhance teachers' competencies in utilizing digital tools and technology-based instructional materials for effective teaching and learning, while simultaneously working to develop innovative, inclusive, and engaging teaching strategies that address the diverse needs of every learner. Alongside these pedagogical aspirations, the framework calls for the continuous updating of instructional content so that it reflects current industry standards and the latest technological advancements across the various fields of TLE. Recognizing that change must be supported, it likewise aims to facilitate the integration of technology into pedagogy through structured training programs and collaborative learning opportunities that build both confidence and capacity among educators. Technology is further leveraged to support the contextualization and real-world application of TLE subject matter, ensuring that students connect what they learn to the world beyond the classroom. The framework also endeavors to refine teaching methodologies to ensure content mastery and learner-centered delivery — approaches that place students at the heart of every lesson. Finally, and perhaps most ambitiously, it seeks to establish a systematic approach to TPACK implementation that encompasses administrative backing, ICT infrastructure development, and a continuous program evaluation process that ensures the framework remains responsive, relevant, and effective over time.

The framework is organized around seven interconnected knowledge components, each targeting a distinct dimension of teacher competence. Together, they form a coherent and comprehensive blueprint for professional growth that is both theoretically grounded and practically actionable.

Technological Knowledge (TK) addresses the foundational need to enhance teachers' proficiency in utilizing digital tools for instruction. This component envisions TLE teachers as digitally fluent practitioners who are at ease

navigating the rapidly evolving technological landscape of modern education. To build this competency, the framework calls for the conduct of focused workshops on educational technology use, supported by the provision of accessible digital tools and blended learning models that dramatically expand the scope and impact of classroom delivery.

Pedagogical Knowledge (PK) strengthens the instructional strategies that teachers employ to reach and engage the full diversity of their learners. Recognizing that no two students learn in the same way, this component promotes the application of differentiated instruction techniques that adapt seamlessly to varied learning needs, abilities, and styles. It further champions the implementation of collaborative learning approaches and technology-based assessments — powerful tools that transform passive recipients of information into active, curious, and empowered participants in the learning process.

Content Knowledge (CK) ensures that the subject matter TLE teachers deliver is not only accurate and comprehensive, but dynamically aligned with current industry standards and the most pressing emerging trends. In a world where industries evolve at breathtaking speed, this component keeps TLE instruction ahead of the curve. Teachers are guided to revise their curricula to reflect industry-relevant skills. They are actively encouraged to facilitate industry immersion or exposure programs that dissolve the boundary between school and the professional world, giving both educators and students firsthand insight into real-world practice.

Technological Pedagogical Knowledge (TPK) bridges the worlds of technology and teaching by promoting the seamless integration of digital tools within instructional design and delivery. This component recognizes that technology's true power is realized not when it is used in isolation, but when it is woven purposefully into the fabric of pedagogy. It is supported through peer mentoring and coaching initiatives that build confidence and competence in technology integration among colleagues, and through the promotion of digital tools in lesson



planning — so that technology becomes not a peripheral addition to instruction, but a central, intentional, and transformative force.

Technological Content Knowledge (TCK) focuses on enhancing content delivery by harnessing the power of technology to make TLE subject matter more vivid, accessible, and engaging. This component challenges teachers to go beyond traditional modes of content presentation and explore how technology can bring lessons to life in ways that resonate deeply with learners. It is actualized through the creation of localized and contextualized digital content that reflects the authentic realities and cultural richness of Filipino communities, and through the active promotion of multimedia resource development that transforms the instructional environment into a dynamic, stimulating space for discovery.

Pedagogical Content Knowledge (PCK) recognizes that excellence in TLE instruction demands not only a deep command of the subject matter, but a sophisticated understanding of how that content is best taught to specific learners in specific contexts. This component refines teaching methods for content-specific instruction through two complementary channels: continuous professional development opportunities that keep teachers current with the most effective and evidence-based pedagogical strategies, and the encouragement of action research and active participation in teacher learning communities, vibrant, collegial spaces where educators think critically about their practice, share insights, and grow together in a culture of sustained professional inquiry.

TPACK Integration represents the crowning dimension of the framework, the holistic, seamless application of all knowledge domains within the day-to-day teaching-learning process. This final component does not merely add one more element to the mix; rather, it synthesizes Technological, Pedagogical, and Content Knowledge into a unified and dynamic whole that is greater than the sum of its parts. A comprehensive school-based technology integration plan provides the institutional architecture for this work, ensuring that TPACK

practices are embedded across the entire school system rather than confined to individual classrooms. Meanwhile, secured administrative support for ICT development and a robust monitoring and evaluation system guarantee that the framework is implemented with fidelity, sustained with institutional commitment, and continuously refined through the power of evidence, creating a living, breathing model of educational excellence.

This framework provides a structured, multi-dimensional approach to enhancing the TPACK of TLE teachers in support of the DepEd Revised K-10 Curriculum. By targeting specific areas of knowledge and integrating technology with pedagogy and content, this model aims to foster high-quality, responsive, and future-ready teaching practices. The implementation of this framework is expected to improve instructional effectiveness, student engagement, and curriculum relevance in TLE classrooms.

CONCLUSIONS

This study assesses the extent of Technological Pedagogical Content Knowledge (TPACK) integration among Technology and Livelihood Education (TLE) teachers in the Malasiqui District during the implementation of the DepEd Revised K-10 Curriculum. Based on the findings, it can be concluded that TLE teachers have fully integrated TPACK into their instructional practices, as reflected by consistently high mean scores across technological, pedagogical, and content domains. The study confirmed that teachers are proficient in utilizing digital tools, designing differentiated and collaborative learning activities, implementing varied assessment strategies, and aligning content with real-world and industry-based standards. This reflects a significant step toward achieving 21st-century education goals, especially in the context of TLE, where applied learning and technology-enhanced instruction are essential.

These results affirm the effectiveness of continuous professional development, school-based learning communities, and administrative



support in enhancing teacher readiness and capability. The integration of TPACK also addresses the previously identified gaps in digital fluency, curriculum responsiveness, and instructional relevance, thereby contributing to improved student engagement, learning outcomes, and curriculum implementation.

The study also supports Ertmer and Ottenbreit-Leftwich's (2010) argument that teacher beliefs, access to resources, and institutional support are critical factors in successful technology integration. The presence of high TPACK scores suggests that teachers benefit from both internal motivation and external support systems—highlighting the importance of structured professional learning communities and administrative investment in ICT infrastructure. These findings address earlier gaps in the rationale regarding teacher readiness, instructional quality, and curriculum alignment with industry needs. The evidence affirms that when provided with proper training and tools, TLE teachers can effectively deliver 21st-century skills such as critical thinking, collaboration, and digital literacy.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations are offered for national, regional, and global significance and application:

School administrators and DepEd regional offices should sustain and expand ICT infrastructure development across all TLE schools, particularly those in geographically isolated and disadvantaged areas, to ensure equitable access to digital tools and reliable internet connectivity that are essential for TPACK implementation.

TLE teachers should continuously engage in TPACK-focused professional development programs, including workshops, online courses, peer mentoring, and participation in professional learning communities, to further strengthen their technological, pedagogical, and content knowledge competencies in response to rapidly evolving educational standards.

Curriculum developers and DepEd officials should regularly review and update the TLE curriculum in close coordination with industry stakeholders, TESDA, and TVET institutions to ensure that competency-based learning outcomes remain aligned with current and emerging global industry standards, particularly in the integration of IoT, robotics, and automation concepts.

More so, future research should explore the long-term impact of TPACK-based instruction on student performance, as well as investigate the contextual factors—such as leadership, access to technology, and school culture—that influence its sustained implementation. Moreover, experimental studies comparing different professional development models could determine the most effective strategies for enhancing TPACK in vocational education settings.

The proposed TPACK enhancement framework should be pilot-tested, evaluated, and refined across broader educational contexts in the Philippines and other developing countries to validate its applicability and scalability as a model for technical and vocational teacher development.

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REFERENCES

- Abalde, J. A., & Oco, N. M. (2023). Philippine basic education challenges in the era of global assessments: A review of PISA results. *Journal of Southeast Asian Education Research*, 8(2), 45–60.
- Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives: Complete edition*. Longman.
- Balalle, H. (2024). Exploring student engagement in technology-based education in relation to gamification, online/distance learning, and other factors: A systematic literature review. *Social Sciences & Humanities Open*, 9, 100870. <https://doi.org/10.1016/j.ssaho.2024.100870>
- Ceremonia-Cerd, J. Q. (2024). Contextual analysis of curriculum development in the Philippines: Progress and challenges. *Global Scientific Journal*, 12(11). <https://www.globalscientificjournal.com>
- Chai, C. S., Koh, J. H. L., & Tsai, C.-C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society*, 16(2), 31–51. <http://www.jstor.org/stable/jeductechsoci.16.2.31>
- Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute. <https://learningpolicyinstitute.org/product/effective-teacher-professional-development-report>
- Department of Education. (2016). *DepEd Order No. 35, s. 2016: The learning action cell as a K to 12 basic education program school-based continuing professional development strategy for the improvement of teaching and learning*. <https://www.deped.gov.ph>
- Department of Education. (2023). *Revised K to 10 curriculum guide: MATATAG curriculum framework*. <https://www.deped.gov.ph>
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181–199. <https://doi.org/10.3102/0013189X08331140>
- Ertmer, P., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs and culture intersect. *Journal of Research on Technology in Education*, 42, 255–284. <http://dx.doi.org/10.1080/15391523.2010.10782551>
- Gillies, R. M. (2016). Cooperative learning: Review of research and practice. *Australian Journal of Teacher Education*, 41, 39–54. <https://doi.org/10.14221/ajte.2016v41n3.3>
- Gouëdard, P., Pont, B., & Viennet, R. (2020). *Education responses to COVID-19: Implementing a way forward* (OECD Education Working Papers, No. 224). OECD Publishing. <https://doi.org/10.1787/8e95f977-en>
- 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, 393–416. <http://dx.doi.org/10.1080/15391523.2009.10782536>
- Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development*, 58, 137–154. <http://dx.doi.org/10.1007/s11423-009-9132-y>



- Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher*, 38(5), 365–379.
<https://doi.org/10.3102/0013189X09339057>
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1).
<https://citejournal.org/volume-9/issue-1-09/general/what-is-technological-pedagogical-content-knowledge>
- Maceda Jr., A. A. (2020). 21st century skills integration in Technology and Livelihood Education (TLE) in Philippine secondary schools. *Asia Pacific Journal of Multidisciplinary Research*, 8(3), 15–24.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
<https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Padillo, G., Manguilimotan, R., Capuno, R., & Espina, R. (2021). Professional development activities and teacher performance. *International Journal of Education and Practice*, 9, 497–506.
<https://doi.org/10.18488/journal.61.2021.93.497.506>
- Philippine Institute for Development Studies. (2022). *Challenges and opportunities in implementing the K to 12 curriculum* (PIDS Policy Notes No. 2022-08). <https://pids.gov.ph>
- Pillay, H., & Panth, B. (2022). *Foundational (K–12) education system: Navigating 21st century challenges*. Queensland University of Technology.
- P21 Partnership for 21st Century Skills. (2009). *P21 framework definitions*. http://static.battelleforkids.org/documents/p21/P21_Framework_DefinitionsBKF.pdf
- Redecker, C., & Johannessen, Ø. (2013). Changing assessment – Towards a new assessment paradigm using ICT. *European Journal of Education*, 48, 79–96.
<https://doi.org/10.2307/23357047>
- Reiser, R. A., Carr-Chellman, A. A., & Dempsey, J. V. (Eds.). (2024). *Trends and issues in instructional design and technology* (5th ed.). Routledge.
<https://doi.org/10.4324/9781003502302>
- Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, 78(1), 153–189.
<https://doi.org/10.3102/0034654307313795>
- Silva, E. (2009). Measuring skills for 21st century learning. *The Phi Delta Kappan*, 90, 630–634.
<https://doi.org/10.1177/003172170909000905>
- Tomlinson, C. A. (2001). *How to differentiate instruction in mixed-ability classrooms*. Pearson Education.
- Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge – A review of the literature. *Journal of Computer Assisted Learning*, 29, 109–121.
<https://doi.org/10.1111/j.1365-2729.2012.00487.x>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds. & Trans.). Harvard University Press.



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