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Influence of Mathematics Teachers' Technology Integration, Competence, and Effectiveness on Learners' Engagement

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ABSTRACT

Theories of educational technology hold that teachers' competence enables integration and that integration engages learners when it is embedded in effective, constructivist teaching. This descriptive-correlational study tested these links by examining the influence of mathematics teachers' technology integration, technological competence, and teaching effectiveness on the engagement of Grade 9 learners in Area 2 of the DepEd Schools Division of Leyte in School Year 2025–2026. Data were collected from 114 teachers and 381 learners selected through stratified random sampling, using four Likert scales with good to excellent reliability (α = .88 to .93) and approximately normal composite scores. Technology integration declined sharply across the SAMR continuum, from substitution (*M* = 3.64) and augmentation (*M* = 3.47) to modification (*M* = 2.73) and redefinition (*M* = 1.85). Teachers' competence was weakest in content development (*M* = 3.18) and troubleshooting (*M* = 3.40), and their effectiveness was strongest in relational expertise (*M* = 3.54). Learners' engagement fell from affective (*M* = 3.13) to behavioral (*M* = 2.85) to cognitive (*M* = 2.51). Training, school, educational attainment, and position were associated with integration and competence, and family and school factors with engagement. Competence was strongly related to integration (*r* = .72), integration to effectiveness (*r* = .58) and engagement (*r* = .51), and effectiveness to engagement (*r* = .63). The results are consistent with TPACK and constructivist theory and suggest that technology influences engagement mainly through effective teaching. A district-based Learning Action Cell that builds TPACK and self-efficacy and is evaluated by learners' cognitive engagement is proposed.

Introduction

A teacher who projects a worksheet onto a screen and a teacher who has learners collect local data, model it in a spreadsheet, and defend their conclusions to classmates are both "using technology." The two practices differ greatly in what they ask of learners, and therefore in how much they can engage them. Distinguishing between these uses and understanding what allows teachers to move from one to the other is a central problem in mathematics education today (Drijvers, 2023; Hamilton et al., 2020).

Teachers' technology use is shaped by what they know and can do. TPACK holds that effective integration requires technological knowledge to be combined with pedagogical and content knowledge (Koehler et al., 2021; Mishra & Koehler, 2006), and the Unified Theory of Acceptance and Use of Technology explains that teachers adopt tools when they expect them

to help, find them manageable, and have supportive conditions (Venkatesh et al., 2021). Teaching effectiveness, meaning the quality of teachers' explanation, expertise, relationships, and disposition, determines how learners experience whatever tools are used (Mendez & Lopez, 2023). Engagement, the outcome these variables are meant to serve, includes learners' feelings, actions, and thinking (Fredricks et al., 2020).

Although these theories are well established, few Philippine studies have examined integration, competence, effectiveness, and engagement together in the same set of classrooms. This study examined the influence of mathematics teachers' technology integration, technological competence, and teaching effectiveness on the engagement of Grade 9 learners in Area 2 of the DepEd Schools Division of Leyte during School Year 2025–2026. It asked how far teachers have progressed along the SAMR continuum, how competent and effective they are, how engaged their learners are, which characteristics of teachers and learners are associated with these variables, and whether the teacher variables are significantly related to engagement. Because the design is correlational, influence is examined in terms of significant association. The results informed the design of a district-based Learning Action Cell (LAC) in mathematics.

Literature Review

A Constructivist View of Technology in Mathematics

Constructivist learning theory holds that learners build understanding by exploring, testing, and reflecting rather than receiving information passively. Digital tools serve constructivist learning when they let learners visualize abstract relationships, manipulate variables, and test conjectures (Drijvers, 2023; Barana et al., 2022). Dynamic geometry, graphing platforms, and collaborative environments have been shown to support inquiry in mathematics (Tabieh & Hamzeh, 2022; Rahimi & Rezvani, 2023), and exploratory digital work strengthens learners' confidence, persistence, and cognitive engagement (Aldahmash & Alshahrani, 2022). The SAMR model gives these ideas an operational form: substitution and augmentation improve the efficiency of existing tasks, while modification and redefinition redesign tasks so that learners analyze, collaborate, and create (Hamilton et al., 2020). Situated Learning Theory adds that mathematics becomes more meaningful when learners work on authentic problems within communities of practice (Lave & Wenger, 2020; Brown et al., 2021), and Connectivism highlights how digital networks let learners co-construct knowledge beyond the classroom (Siemens, 2020; Downes, 2021).

What Teachers Bring: Competence and Effectiveness

TPACK explains why technical skill alone is insufficient. Teachers must also know how a tool serves a particular mathematical idea and a particular pedagogical purpose (Koehler et al., 2021). Competence spans basic operations, troubleshooting, productivity software, web resources, communication media, and content development, and without it, technology use remains superficial (Setiyani et al., 2020). Filipino teachers show strong basic but weaker advanced competencies (Chandra & Ali, 2024), and competence predicts both effectiveness and engagement in mathematics (Li & Wang, 2024). Social Cognitive Theory adds that teachers' self-efficacy with technology shapes their willingness to try new practices, and learners' self-regulation shapes how they benefit (Bandura, 2020; Zimmerman & Schunk,

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2022). Teaching effectiveness, in its behavioral, content, relational, and personal dimensions, is linked to engagement through clear explanation, adaptive strategies, and supportive climates (Zhang et al., 2024; Mendez & Lopez, 2023; Uya, 2023).

Contextual Conditions

Integration depends on context. Inadequate training and weak institutional support constrain teachers in many systems (Musasa et al., 2024), school culture and collaboration shape adoption in Philippine public high schools (Cortez et al., 2024), and sustained teacher communities support integration more effectively than isolated workshops (Lim & Tondeur, 2020). Constructive Alignment requires that technology-based activities and assessments be designed around intended learning outcomes (Biggs, 2021; Biggs & Tang, 2020). Philippine policy supports these directions through the Excellence in Teacher Education Act (Republic Act No. 11713, 2022), the Information Technology Education Act (Republic Act No. 10929, 2016), the MATATAG curriculum (Department of Education, 2023), and DepEd's policy on Learning Action Cells (Department of Education, 2022b).

Hypothesized Pathway

Taken together, these theories suggest a pathway. Competence enables integration; integration at higher SAMR levels, mediated by effective teaching, enables the constructive and situated learning that produces engagement. The present study tested the bivariate links in this pathway.

Methodology

Design. The study used a quantitative descriptive-correlational design, describing naturally occurring conditions and testing relationships among them without manipulation (Creswell & Creswell, 2018; Fraenkel et al., 2019).

Respondents. Through stratified random sampling, 114 mathematics teachers and 381 Grade 9 learners from Area 2 of the DepEd Schools Division of Leyte took part in School Year 2025–2026.

Instruments. The questionnaire consisted of profile sheets for teachers and learners and four four-point Likert scales: a 20-item SAMR-based integration scale emphasizing mathematics-specific practices such as dynamic geometry, simulations, collaborative platforms, and real-world data modeling (Hamilton et al., 2020); a 30-item technological competence scale with six domains (Chandra & Ali, 2024; Li & Wang, 2024); a 20-item teaching effectiveness scale with four dimensions (Mendez & Lopez, 2023); and a 15-item engagement scale with three dimensions (Fredricks et al., 2020). The constructs were rated as perceived by the respondent groups.

Table 1
Reliability and Normality of the Study Scales

Scale	Items	α	Skewness	Kurtosis
Technology integration (SAMR)	20	.89	0.152	−0.324
Technological competence	30	.92	−0.098	0.245
Teaching effectiveness	20	.90	0.213	−0.112
Learner engagement	15	.88	−0.067	0.309
Overall instrument	85	.93	—	—

Note. Reliability from the pilot test (15 teachers and 15 learners, Area I); skewness and kurtosis from the composite scores of the main sample.

Pilot testing in Area I with 15 teachers and 15 learners who were not part of the main sample indicated good to excellent reliability (Table 1; Taber, 2018). Skewness and kurtosis values within ±2 indicated approximately normal composite scores (George & Mallery, 2019).

Procedure and analysis. Following approval from the Graduate School and the Schools Division Superintendent of Leyte, school heads, administrators, and teachers were oriented, and questionnaires were administered in person or through a secure online platform. Challenges with schedules, connectivity, and late responses were met with flexible timeframes and follow-up visits. Descriptive statistics, chi-square tests, and Pearson's *r* were applied at $\alpha = .05$.

Ethics. All respondents gave informed consent, participation was voluntary with the right to withdraw, and data were anonymized, stored securely, and handled in accordance with the Data Privacy Act of 2012.

Results and Discussion

Who the Respondents Were

The teachers were predominantly mid-career (31–40 years, 36.8%; 41–50 years, 26.3%), female (59.6%), and married (68.4%). Their academic preparation was strong: 42.1% had master's units and 34.2% held a master's degree, while 7.9% had doctoral units or a doctorate. Teacher II (39.5%) and Teacher I (30.7%) were the most common positions, and most had attended one to three (36.0%) or four to six (34.2%) relevant trainings. The learners were mainly 14 (40.9%) and 15 years old (31.0%), with a near balance of girls (51.7%) and boys (48.3%), and most came from households earning less than ₱20,000 monthly (58.2%). From a social cognitive perspective, a mid-career, graduate-trained workforce has the self-efficacy and theoretical grounding to attempt new practices, provided it has models and support (Bandura, 2020; Gomez & Albrecht, 2021).

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Progress Along the SAMR Continuum

Table 2

Extent of Technology Integration in Mathematics Instruction per SAMR Indicator

SAMR Level and Indicator	Mean	Level
Substitution	**3.64**	**Very High**
Uses digital PDFs or slides for notes	3.91	Very High
Uses a projector or interactive whiteboard in place of the chalkboard	3.85	Very High
Provides digital copies of textbooks and worksheets	3.78	Very High
Uses a word processor for written solutions	3.42	High
Gives online quizzes in the same format as paper quizzes	3.25	High
Augmentation	**3.47**	**High**
Uses graphing calculators for visualization	3.82	Very High
Uses equation editors to prepare materials	3.68	Very High
Uses online platforms with automated feedback	3.55	Very High
Uses online tools for answer keys and item randomization	3.20	High
Uses spreadsheets to generate graphs	3.10	High
Modification	**2.73**	**Moderate**
Uses dynamic geometry software (GeoGebra)	2.95	Moderate
Uses interactive simulations (PhET)	2.85	Moderate
Facilitates real-time digital collaboration	2.78	Moderate
Has learners analyze authentic data sets	2.65	Moderate
Has learners create screencasts explaining their process	2.40	Low
Redefinition	**1.85**	**Very Low**
Runs community data projects with proposed solutions	2.05	Low
Arranges global collaboration through video conferencing	1.95	Very Low
Assigns long-term computational modeling projects	1.85	Very Low
Has learners design and publish interactive math games	1.75	Very Low
Conducts global data-sharing investigations	1.65	Very Low

Note. 3.50–4.00 = Very High; 3.00–3.49 = High; 2.50–2.99 = Moderate; 2.00–2.49 = Low; 1.00–1.99 = Very Low.

The SAMR results show a steep decline from enhancement to transformation (Table 2). Substitution was Very High (M = 3.64), with digital notes and slides (3.91) and projectors (3.85) nearly universal. Augmentation was High (M = 3.47), with graphing calculators (3.82) and equation editors (3.68) common, although spreadsheets for graphing (3.10) were less used. At modification (M = 2.73, Moderate), GeoGebra (2.95) and PhET simulations (2.85) appeared occasionally, and learner-made screencasts (2.40) were rare. Redefinition was Very Low (M = 1.85), with global data-sharing (1.65) and learner-designed math games (1.75) almost absent.

Read through constructivist theory, this means that technology in these classrooms mostly supports the teacher's presentation rather than the learners' construction of knowledge. The tools that let learners explore, such as dynamic geometry, simulations, and authentic data, are used only moderately, and the tools that let them create and connect with wider communities are barely used at all (Hamilton et al., 2020; Drijvers, 2023). Situated and connectivist forms of learning, in which learners solve real problems and share knowledge across networks, are

therefore largely unavailable to them (Lave & Wenger, 2020; Siemens, 2020). The plateau is consistent with Philippine and international findings that teachers stop at functional uses without sustained collaborative support (Cortez et al., 2024; Musasa et al., 2024).

Teachers' Competence, Effectiveness, and Learners' Engagement

Table 3

Summary of Competence, Effectiveness, and Engagement by Dimension

Construct	Dimension	Mean	Level
Technological competence	Basic computer operations	3.72	Very High
	Setup, maintenance, and troubleshooting	3.40	High
	Word processing, spreadsheets, and presentation	3.51	Very High
	Web resources use and management	3.50	Very High
	Communication media skills	3.53	Very High
	Content development and management	3.18	High
Teaching effectiveness	Teaching-related behavior	3.44	High
	Subject matter expertise	3.49	High
	Relational expertise	3.54	Very High
	Personality	3.49	High
Learner engagement	Affective	3.13	High
	Behavioral	2.85	Moderate
	Cognitive	2.51	Moderate

Note. 3.50–4.00 = Very High; 3.00–3.49 = High; 2.50–2.99 = Moderate; 2.00–2.49 = Low; 1.00–1.99 = Very Low.

Competence was Very High in four domains and High in two (Table 3). The weakest were setup and troubleshooting (M = 3.40), where troubleshooting common problems was lowest (3.10), and content development (M = 3.18), where developing multimedia content was lowest (3.05). In TPACK terms, teachers have solid technological knowledge for operating and communicating but less of the specialized knowledge needed to build mathematics-specific digital tasks (Koehler et al., 2021; Chandra & Ali, 2024). Social Cognitive Theory adds an explanation for the troubleshooting gap: teachers who doubt their ability to fix problems are less likely to attempt complex tools in front of a class (Bandura, 2020). Similar profiles, with strong routine skills and weaker specialized ones, have been documented among basic education teachers on Samar Island (Panela, 2025d).

Teaching effectiveness was High to Very High, with relational expertise strongest (M = 3.54) and teaching-related behavior lowest (M = 3.44). The relatively low indicators for real-world connections (3.05), adaptability (3.15), and feedback (3.18) correspond to the practices that situated learning and constructive alignment emphasize (Lave & Wenger, 2020; Biggs & Tang, 2020), and that technology at the higher SAMR levels can support.

Learners' engagement weakened from affective (M = 3.13) to behavioral (M = 2.85) to cognitive (M = 2.51). Learners like their teachers (3.45) and follow rules (3.35), but rarely self-

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regulate (2.25) or go beyond requirements (2.35). Within student engagement theory, cognitive engagement is the dimension most directly tied to understanding (Fredricks et al., 2020), and within Social Cognitive Theory, self-regulation is the mechanism through which learners turn instruction into learning (Zimmerman & Schunk, 2022). The weakness of this dimension matches the scarcity of modification- and redefinition-level tasks that would require learners to plan, choose strategies, and justify their thinking.

Characteristics Associated With the Variables

Teachers' integration and competence were significantly associated with number of trainings (χ^2 = 42.56 and 51.32), school (χ^2 = 31.29 and 22.47), educational attainment (χ^2 = 25.17 and 28.93), and position (χ^2 = 19.45 and 24.16), and more weakly with age and years in teaching, but not with sex or civil status. These results fit UTAUT's emphasis on facilitating conditions: training and school support, not personal characteristics, are associated with teachers' integration (Venkatesh et al., 2021; Lim & Tondeur, 2020). Learners' engagement was associated with family income (χ^2 = 31.47), school (χ^2 = 23.94), and both parents' education and occupation, but not with age or sex. Perceived effectiveness was associated with the same family and school factors and with learner sex (χ^2 = 9.87, p = .043). Engagement thus has ecological roots in families and schools (Reyes & Santos, 2023; Smith & Johnson, 2024). The sex association for perceived effectiveness may reflect gendered patterns of classroom interaction (Tan & Chen, 2021), though it could also arise if the effectiveness items are interpreted differently by girls and boys; Rasch-based analysis of a Philippine teacher scale shows how such measurement differences by gender can be detected (Panela, 2025a).

Influence of the Teacher Variables on Engagement

Table 4

Correlation Matrix of Integration, Competence, Effectiveness, and Engagement

Variable	1	2	3	4
1. Technology integration	—			
2. Technological competence	.72*	—		
3. Teaching effectiveness	.58*	.45*	—	
4. Learner engagement	.51*	n.r.	.63*	—

Note. *p < .001. n.r. = not reported in the source manuscript.

Every reported link in the hypothesized pathway was positive and significant (Table 4). Competence was strongly related to integration (r = .72), integration was moderately related to effectiveness (r = .58) and to engagement (r = .51), and effectiveness was the strongest correlate of engagement (r = .63). Competence was moderately related to effectiveness (r = .45).

The pattern supports the theoretical pathway in its broad outline. The strong competence–integration link is what TPACK predicts: teachers integrate what they can competently use (Koehler et al., 2021; Li & Wang, 2024). The stronger association of engagement with effectiveness than with integration indicates that technology's influence on learners depends largely on the teaching in which it is embedded. This is consistent with research showing that

engagement follows pedagogical mediation of digital tools (Rahimi & Rezvani, 2023) and the quality of instructional interaction (Zhang et al., 2024; Mendez & Lopez, 2023). Constructivist theory explains why: a tool that only displays content leaves learners in the same passive role, whereas a teacher who uses it to pose problems, give feedback, and invite explanation changes that role. These correlations show association and do not establish causation. A mediation test of whether effectiveness carries the effect of integration on engagement, and the omitted competence–engagement coefficient, are needed to confirm the pathway.

Design of the Learning Action Cell

The theoretical reading of the results suggests three design principles for the LAC. First, it should build TPACK rather than technical skill alone, through sessions in which teachers redesign actual Grade 9 lessons using GeoGebra, simulations, and data tools, aligned with learning outcomes and assessments (Biggs, 2021; Hamilton et al., 2020). Second, it should strengthen teachers' self-efficacy through modeling, mastery experiences, and peer coaching across schools (Bandura, 2020; Harris & Davis, 2023). Third, it should judge success by learners' cognitive engagement rather than by frequency of technology use. Capacity building of this kind depends on time, mentoring, and administrative backing, as teachers' experiences with action research during the pandemic have shown (Panela, 2025e).

Conclusion

Mathematics teachers in Area 2 of the Schools Division of Leyte use technology mainly to substitute for and augment traditional tools, with limited modification and very little redefinition. They are competent with routine digital tasks but less so with troubleshooting and content development, and they are perceived as effective, particularly in their relationships with learners. Grade 9 learners are affectively engaged but cognitively less invested. Teachers' integration and competence are associated with training, school, and professional standing, and learners' engagement with their schools and families. Competence is strongly related to integration, and teaching effectiveness and integration are significantly related to engagement, with effectiveness the stronger correlate. These findings are consistent with the view that technology influences engagement through effective, constructivist teaching.

The division should establish a district-based LAC in mathematics that develops teachers' TPACK through lesson redesign at the modification and redefinition levels, strengthens advanced competencies and self-efficacy through mentoring and peer coaching, and measures its success by learners' cognitive engagement. School-level conditions, including resources, scheduling, and leadership support, should be improved alongside training, and teachers' well-being under added professional demands should be considered; digital supports for managing workplace stress have shown promise among Filipino teachers (Panela, 2026). Because learners' engagement habits were disrupted by the pandemic, schools should continue to attend to learners' well-being as part of the effort to re-engage them (Panela, 2025b). Future studies should test the full pathway through path analysis or structural equation modeling and should report learners' and teachers' ratings separately. Further follow-up on post-pandemic learner adjustment is also warranted (Panela, 2025c).

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References

Aldahmash, A. H., & Alshahrani, S. (2022). Digital learning environments and student engagement in mathematics education. *International Journal of Instruction*, *15*(3), 215–232. https://doi.org/10.29333/iji.2022.15312a

Bandura, A. (2020). *Social cognitive theory in the digital age: Implications for education and learning*. Springer.

Barana, A., Marchisio, M., & Sacchet, M. (2022). Interactive technologies and learning analytics to support mathematics education. *Education and Information Technologies*, *27*(4), 5319–5343. https://doi.org/10.1007/s10639-021-10803-9

Biggs, J. (2021). *Constructive alignment in teaching and learning: Principles and practice*. Higher Education Academy Press.

Biggs, J., & Tang, C. (2020). *Teaching for quality learning at university* (5th ed.). McGraw-Hill Education.

Brown, J. S., Collins, A., & Duguid, P. (2021). Situated cognition and the culture of learning. *Educational Researcher*, *50*(2), 71–81.

Chandra, V., & Ali, S. (2024). Teachers' digital competence and instructional effectiveness in developing countries. *Computers & Education Open*, *5*, 100148. https://doi.org/10.1016/j.caeo.2024.100148

Cortez, R. P., Santos, M. D., & Lim, C. I. (2024). Contextualizing success: An ecological view of technology integration in Philippine public high schools. *Asia-Pacific Journal of Educational Technology*, *9*(1), 45–62.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Department of Education. (2022b). *DepEd Order No. 35, s. 2022: The learning action cell (LAC) as a K to 12 basic education program school-based continuing professional development strategy*.

Department of Education. (2023). *The MATATAG curriculum: K–10 curriculum framework*.

Downes, S. (2021). Learning networks in practice: Connectivist approaches to digital learning. *International Review of Research in Open and Distributed Learning*, *22*(3), 1–18.

Drijvers, P. (2023). Digital technology in mathematics education: Why it works (or doesn't). *ZDM–Mathematics Education*, *55*(1), 1–14. https://doi.org/10.1007/s11858-022-01430-6

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). *How to design and evaluate research in education* (10th ed.). McGraw-Hill Education.

Fredricks, J. A., Filsecker, M., & Lawson, M. A. (2020). Student engagement, context, and learning: A review of the literature. *Research in Education*, *101*(1), 1–24. https://doi.org/10.1177/0034523720904319

George, D., & Mallery, P. (2019). *IBM SPSS statistics 26 step by step: A simple guide and reference* (16th ed.). Routledge.

Gomez, J., & Albrecht, B. (2021). Postgraduate engagement as a predictor of innovative teaching practice. *Journal of Digital Learning in Teacher Education, 37*(2), 112–125.

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2020). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends, 64*(3), 433–441. https://doi.org/10.1007/s11528-020-00483-0

Harris, K. L., & Davis, R. A. (2023). Career stages and technology adoption: A study of teacher professional learning communities. *Teaching and Teacher Education, 121*, 103941.

Koehler, M. J., Mishra, P., & Cain, W. (2021). What is technological pedagogical content knowledge (TPACK)? *Journal of Education, 201*(1), 13–19. https://doi.org/10.1177/0022057420988727

Lave, J., & Wenger, E. (2020). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Li, Q., & Wang, Y. (2024). Teachers' technological competence and its impact on mathematics teaching effectiveness and student engagement. *Educational Technology Research and Development, 72*(1), 89–110. https://doi.org/10.1007/s11423-023-10261-4

Lim, C. P., & Tondeur, J. (2020). Teacher communities for integrating technology: A sustainable approach. In *Educational technology beyond content* (pp. 31–42). Springer.

Mendez, R. P., & Lopez, M. G. (2023). Teaching effectiveness and student engagement in mathematics classrooms. *Journal of Educational Research and Practice, 13*(2), 145–160. https://doi.org/10.5590/JERAP.2023.13.2.10

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

Musasa, J., Ndhlovu, D., & Maphosa, C. (2024). Contextual challenges in integrating digital technologies in mathematics classrooms. *African Journal of Research in Mathematics, Science and Technology Education, 28*(1), 56–69. https://doi.org/10.1080/18117295.2023.2284507

Panela, T. L. V. (2025a). Gender-based analysis of Teacher Empowerment Scale: Examining factor structure and Rasch model fit in higher education. *Environment and Social Psychology, 10*(11), 3570. https://doi.org/10.59429/esp.v10i11.3570

Panela, T. L. V. (2025b). Assessing Ways through Research and Augmentation (AWRA): Impact of COVID-19 pandemic on the mental health of college students in the Philippines Phase 1. *Innovations, 80*, 462–475. https://journal-innovations.com/assets/uploads/doc/346b3-462-475.16805.pdf

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DOI: https://doi.org/10.66206/eduheart.ijimr.62

Panela, T. L. V. (2025c). Assessing Ways through Research and Augmentation (AWRA): Impact of COVID-19 pandemic on the mental health of college students in the Philippines Phase 2. *Innovations*, *80*, 476–489. https://journal-innovations.com/assets/uploads/doc/886c9-476-489.16806.pdf

Panela, T. L. V. (2025d). Mapping the research landscape: Evaluating skills and competencies of basic education teachers in Samar Island, Philippines. *Innovations*, *80*, 490–506. https://journal-innovations.com/assets/uploads/doc/1b29b-490-506.16830.pdf

Panela, T. L. V. (2025e). Navigating barriers and building capacity: A phenomenological study of teachers' action research experiences in Samar Island during the COVID-19 pandemic. *Innovations*, *80*, 507–530. https://journal-innovations.com/assets/uploads/doc/6f255-507-530.16831.pdf

Panela, T. L. V. (2026). Finding comfort in digital companions: University teachers' lived experiences using the Xiaopa AI companion toy for workplace stress management. *International Journal of Biosciences (IJB)*, *28*(5), 186–194. https://doi.org/10.12692/ijb/28.5.186-194

Rahimi, M., & Rezvani, E. (2023). Pedagogical mediation and student engagement in technology-enhanced mathematics learning. *Computers & Education*, *190*, 104574. https://doi.org/10.1016/j.compedu.2022.104574

Republic Act No. 10929. (2016). *Information Technology Education Act*. Official Gazette of the Republic of the Philippines. https://www.officialgazette.gov.ph

Republic Act No. 11713. (2022). *Excellence in Teacher Education Act of 2022*. Official Gazette of the Republic of the Philippines. https://www.officialgazette.gov.ph

Reyes, S. P., & Santos, A. B. (2023). Cultural capital and classroom interaction: Bridging the perceptual gap in diverse Philippine classrooms. *International Journal of Inclusive Education*, *27*(5), 521–538.

Setiyani, R., Sugiyo, S., & Widodo, J. (2020). Digital competence of teachers: A conceptual framework. *Journal of Education and Learning*, *14*(4), 573–580. https://doi.org/10.11591/edulearn.v14i4.16233

Siemens, G. (2020). *Connectivism: A learning theory for the digital age* (2nd ed.). University of Manitoba Press.

Smith, J. A., & Johnson, B. T. (2024). Bridging home-school gaps: Interventions supporting students from educationally disadvantaged backgrounds. *Journal of Educational Psychology*, *116*(1), 145–162.

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Tabieh, A. A., & Hamzeh, M. (2022). Inquiry-based learning through technology in mathematics education. *Journal of Mathematics Education*, *15*(2), 123–138. https://doi.org/10.22342/jme.15.2.15980

Tan, J., & Chen, W. (2021). Interaction, feedback, and perception: A meta-analysis of gender dynamics in secondary STEM classrooms. *Journal of Educational Psychology*, *113*(4), 745–761.

Uya, E. G. (2023). Teaching effectiveness and learner engagement in Philippine mathematics classrooms. *Philippine Journal of Education Studies*, *4*(1), 45–59.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2021). Unified theory of acceptance and use of technology: A synthesis and extension. *Information Systems Research*, *32*(1), 1–23. https://doi.org/10.1287/isre.2020.0965

Zhang, D., Lin, C., & Chen, H. (2024). Adaptive teaching practices and learner engagement in mathematics education. *Teaching and Teacher Education*, *125*, 104046. https://doi.org/10.1016/j.tate.2023.104046

Zimmerman, B., & Schunk, D. H. (2022). *Self-regulated learning and academic achievement: Theoretical perspectives and practices*. Routledge.