

Teachers' Technological Readiness and Attitudes Toward Learning Management System Adoption: Basis for Faculty Enhancement Program

Schievvie Mae Revilla Abanilla
University of La Salette, Inc.
phichee3@gmail.com

Date Submitted:

August 16, 2026

Date Accepted:

September 25, 2026

Date Published:

October 12, 2026

DOI:

10.5281/zenodo.2331902

ABSTRACT

This study assessed elementary teachers' technological readiness and attitudes toward learning management system (LMS) adoption at Casa Del Niño Schools System Inc. as the basis for a faculty enhancement program. Using a quantitative descriptive-evaluative design, the study involved all 66 eligible generalist elementary teachers during School Year 2025–2026 through total enumeration. A survey adapted from technological pedagogical content knowledge (TPACK) and LMS-attitude instruments gathered demographic information, ratings across seven readiness domains, and ratings of usefulness, ease of use, attitude, behavioral intention, and competency. Frequency, percentage, and mean were used to analyze the responses. The respondents were predominantly female (65.2%) and aged 22–29 years (75.75%). Overall technological readiness was very high ($M = 3.26$), with

lower domain means in Content Knowledge ($M = 3.12$), Pedagogical Content Knowledge ($M = 3.21$), and integrated TPACK ($M = 3.23$). Overall LMS-adoption attitude was highly positive ($M = 3.55$); behavioral intention recorded the highest dimension mean ($M = 3.64$), whereas self-rated competency was relatively lowest ($M = 3.45$). A proposed six-month, TPACK-anchored faculty enhancement program therefore prioritizes subject-specific LMS lesson design, guided practice, peer mentoring, and formative monitoring. These descriptive findings indicate favorable perceived readiness and acceptance while identifying targeted professional-learning needs; the proposed program has not yet been evaluated for effectiveness.

Keywords: *learning management system, technological readiness, teacher attitudes, TPACK, technology acceptance, faculty enhancement program*

INTRODUCTION

Learning management systems (LMS) have become important platforms for distributing content, managing assessment, communicating with learners, and sustaining educational activities beyond face-to-face classrooms. Although access to digital infrastructure makes implementation possible, effective use also depends on teachers' capacity to select, adapt, and apply the platform within instructional practice. The growing use of online and blended modalities has therefore intensified the need to examine teacher readiness together with attitudes toward educational technology, rather than assuming that possession of digital tools is equivalent to meaningful adoption (Al-Fraihat et al., 2020; Scherer et al., 2021).

Two complementary perspectives frame this concern. The Technological Pedagogical Content Knowledge (TPACK) framework explains the interconnected knowledge of technology, pedagogy, and disciplinary content required for effective technology integration (Mishra & Koehler, 2006). The Technology Acceptance Model (TAM), in contrast, focuses on perceived usefulness and perceived ease of use as central explanations of users'

acceptance of a system (Davis, 1989). Together, these perspectives distinguish teachers' perceived capability to employ an LMS from their disposition and intention to continue using it. Adult learning principles further suggest that professional development should be responsive to teachers' actual instructional tasks and experiences (Knowles, 1984).

This issue is relevant to Philippine private basic education, where teachers may use LMS tools to support flexible delivery despite school interruptions. Philippine studies have described the importance of computer self-efficacy in LMS use (Caballo et al., 2024), classroom acceptance of locally designed LMS environments (Galura et al., 2023), and sustained support in LMS utilization (Garcia et al., 2022). Nevertheless, evidence drawn from other institutions cannot establish the specific knowledge domains and professional-learning priorities of generalist elementary teachers within Casa Del Niño Schools System Inc. (CDNSSI), whose teachers must teach multiple learning areas.

Accordingly, the study assessed the age and sex profile of eligible CDNSSI elementary teachers; their self-reported technological readiness across the seven TPACK domains; and their LMS-adoption attitudes in terms of perceived usefulness, perceived ease of use, attitude toward use, behavioral intention, and competency. It also used the observed descriptive patterns to propose a faculty enhancement program. The inquiry was descriptive and did not test the influence of demographic characteristics or estimate causal or statistical relationships between readiness and attitudes.

Literature Review

Theoretical Foundations of Technological Readiness and LMS Acceptance

The TPACK framework holds that technical knowledge alone does not ensure sound instructional integration. Technological Knowledge (TK), Content Knowledge (CK), and Pedagogical Knowledge (PK) are supplemented by Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and their combined intersection, TPACK (Mishra & Koehler, 2006). In a generalist elementary teaching context, these distinctions are especially pertinent because the same teacher may be expected to prepare LMS-supported instruction in mathematics, science, literacy, and social studies. The instrument adapted for the present study operationalized the seven domains through teachers' self-assessments (Mane, 2025).

TAM addresses a related but different dimension: whether teachers consider a platform useful, manageable, and worth continued use. Perceived usefulness and ease of use can shape attitudes and intended technology use, although high self-reported acceptance must not be confused with directly observed classroom implementation (Davis, 1989). In addition to core acceptance constructs, the present study assessed perceived competency as a practical, self-evaluated dimension of LMS adoption. The framework consequently provided a descriptive vocabulary for organizing the reported attitudes, not a basis for making causal claims from the survey.

The proposed professional-development response was further informed by adult learning theory, which emphasizes experience, professional relevance, and problem-centered learning (Knowles, 1984). Innovation diffusion also draws attention to the practical process by which users become familiar with and adopt new practices (Rogers, 2003). In combination, the three theoretical lenses support the progression from identifying instructional knowledge needs and user attitudes to planning school-based training, guided practice, and peer assistance.

Teachers' Technological Readiness and Institutional Context

Technological readiness involves more than familiarity with devices. It includes the ability to judge which tools fit particular learning goals, organize digital resources, manage learner interaction, and design appropriate assessment. In their evaluation of e-learning systems, Al-Fraihat et al. (2020) emphasized that successful educational technology entails multiple system, learner, and organizational considerations. Studies of teachers' online teaching readiness similarly demonstrate that readiness is multidimensional and varies with the context of implementation (Scherer et al., 2021).

In the Philippines, Abella and Dela Rosa (2023) examined digital literacy and competence among selected teachers and documented differences associated with teachers' experiences and circumstances. However, findings from wider populations do not necessarily describe all schools or demonstrate that a young faculty is automatically technology proficient. Garcia et al. (2022) investigated educators' experiences using Quipper as an LMS at Saint Paul University-Surigao, highlighting how the actual organization of an LMS-mediated teaching environment matters in assessing adoption. Such studies support context-specific assessments instead of universal assumptions about readiness.

Local instructional demands and subject requirements also affect whether teachers can translate general technical familiarity into purposeful classroom integration. Caballo et al. (2024) linked computer self-efficacy with the effectiveness of a Quipper LMS setting, while Mangarin et al. (2024) discussed LMS-based mathematics learning and the constraints surrounding its use. These findings reinforce the rationale for examining CK, PCK, and integrated TPACK alongside TK and TPK, rather than treating all technology-readiness domains as interchangeable.

Teachers' Attitudes and Continued LMS Adoption

Acceptance research suggests that use intentions are connected to the benefits and usability teachers perceive in educational systems. Davis (1989) identified perceived usefulness and perceived ease of use as foundational acceptance constructs. In the present setting, usefulness concerns such functions as lesson preparation, performance monitoring, communication, and learner support; ease of use concerns teachers' assessments of the effort required to learn, navigate, and apply the platform. These are subjective survey ratings, not independent tests of LMS functionality.

Philippine investigations provide illustrations of how acceptance can be assessed in situated educational environments. Galura et al. (2023) used an extended technology-acceptance approach to study a Google Classroom-based LMS design and documented user judgments of acceptability. Garcia et al. (2022) described LMS utilization among secondary-school teachers, while Caballo et al. (2024) emphasized educator self-efficacy in the use of the Quipper platform. Although these studies differ in participant groups and systems, each demonstrates the need to consider educators' experiences alongside technological availability.

Positive attitude and future intention are promising but do not, by themselves, establish instructional competence or guarantee sustained use. Rogers (2003) suggests that adoption unfolds through a process, and Scherer et al. (2021) show why teacher readiness should not be treated as uniform. For this reason, the present study separately reports teachers perceived usefulness, ease of use, affective attitude, behavioral intention, and self-evaluated competency. The comparison of those domains is more informative for faculty planning than an overall acceptance scores alone.

Faculty Enhancement, Practice-Based Learning, and Research Synthesis

Faculty development can focus on the practical intersection of content, pedagogy, and LMS tools. Adult learners are more likely to benefit from tasks that correspond to authentic professional demands, such as developing subject-aligned activities, practicing assessment workflows, and reflecting on learner feedback (Knowles, 1984). The TPACK framework provides a complementary structure for identifying which dimensions of teacher knowledge such exercises should strengthen (Mishra & Koehler, 2006).

Empirical work from Philippine schools offers a rationale for connecting professional learning to actual platform use. Abella and Dela Rosa (2023) underline the importance of teachers' digital competence, while Caballo et al. (2024) draw attention to self-efficacy and LMS effectiveness. Similarly, Mangarin et al. (2024) show the relevance of applications designed for particular learning areas. Collectively, these studies support subject-specific demonstrations, guided LMS lesson creation, and sustained coaching rather than exclusively lecture-based digital literacy sessions.

Overall, the reviewed theory and empirical work indicate that an institutionally relevant faculty enhancement program should respond to both knowledge-domain patterns and user attitudes. The specific gap addressed in this study is the absence of a documented baseline for CDNSSI's generalist elementary teachers that

concurrently describes their seven TPACK readiness domains and five LMS-adoption attitude dimensions. The conceptual framework summarizes how these inputs informed data collection and the development of a proposed, rather than experimentally tested, enhancement program.

Verified work on subject-specific TPACK training and teachers' collaborative lesson-design discourse reinforces the case for supported professional learning (Lachner et al., 2021; Yeh et al., 2021). Research applying an extended acceptance model to SPACE-LMS users likewise illustrates how perceived usefulness, ease of use, and self-efficacy can be examined together (Sesmiarni et al., 2024).

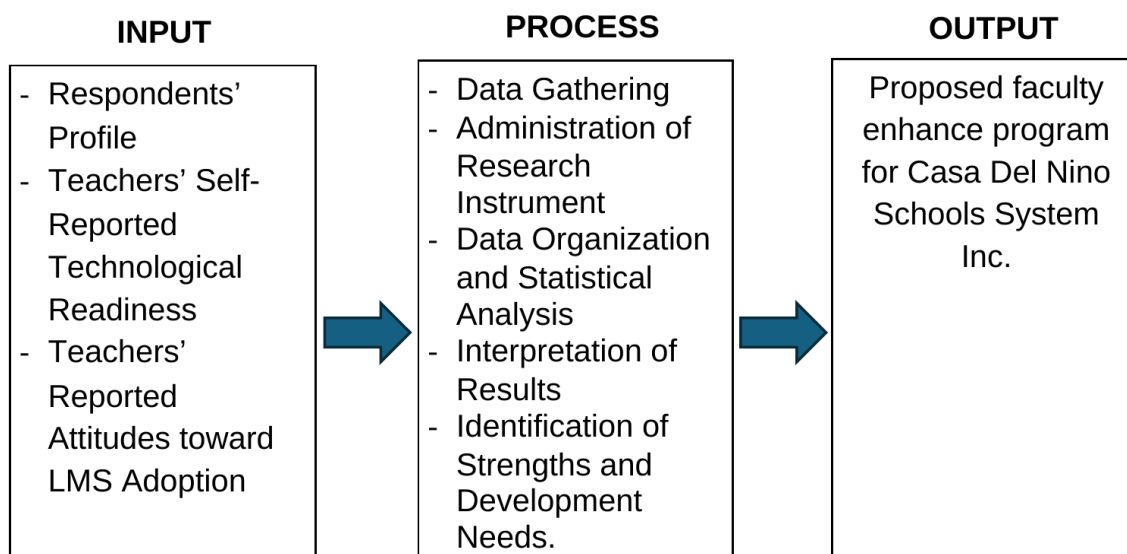


Figure 1. *The Paradigm of the Study*

METHODS

Research Design

The study employed a quantitative descriptive-evaluative research design. It documented the existing demographic characteristics, self-reported technological readiness, and LMS-adoption attitudes of eligible elementary teachers without manipulating study variables. The evaluative element involved identifying relatively lower mean domains to guide a proposed faculty enhancement program; no intervention or experimental comparison was undertaken.

Research Locale

The research was conducted within Casa Del Niño Schools System Inc. (CDNSSI), a private school system with campuses identified in the thesis as Ilagan, Sta. Rosa, Ciudad de Calamba, and Roxas. The Ilagan campus was described as having used the LMS for six years and the other identified campuses as having adopted it for approximately two years. The system provided a relevant setting for examining the readiness and attitudes of generalist elementary teachers engaged in LMS-supported delivery.

Participants and Sampling Technique

All 66 eligible generalist elementary teachers from the participating CDNSSI campuses in School Year 2025–2026 were included through total enumeration. Respondents were teachers handling several learning areas and using, or expected to use, the school's LMS. As all members of the identified eligible population participated, the study did not use a probability sample intended to represent schools outside this institutional system.

Research Instrument

A three-part self-report questionnaire was used. The first part recorded age and sex. The second examined TK, CK, PK, PCK, TCK, TPK, and integrated TPACK, using the TPACK survey adapted by Mane (2025) from an earlier instrument. The third examined LMS attitudes across perceived usefulness, perceived ease of use, attitude toward use, behavioral intention to use, and perceived competency. The thesis attributed the attitude questionnaire to a survey by Finnerty, identified there as published in 2024, but did not supply a complete bibliographic entry for this instrument source. The original instrument attribution requires confirmation before submission.

Responses were collected using four-point agreement and attitude categories, as described in the thesis. For technological readiness, the mean intervals were 3.25–4.00 (very high), 2.50–3.24 (high), 1.75–2.49 (low), and 1.00–1.74 (very low). For attitudes, the respective ranges were high positive, positive, low, and very low. The instrument and response scales assessed participants' perceptions; they did not measure observed technological performance or actual frequency of LMS use.

Data Gathering Procedure

The researcher secured institutional and school-administration permission and coordinated with school personnel to identify eligible teachers. The questionnaire was distributed electronically, together with a participant information letter and informed-consent material. Returned responses were encoded, organized, and checked for completeness before descriptive analysis.

Data Analysis

Frequency counts and percentages described the participants' age and sex. Arithmetic means summarized each technological-readiness and LMS-attitude dimension and supported interpretation using the scale intervals reported above. Domain comparisons informed the content of the proposed faculty enhancement program. Although an isolated sentence in the thesis referred to inferential analysis, no inferential results or tests were presented; therefore, no significance tests, correlations, or predictive effects are reported here.

Ethical Consideration

Participants were informed of the study purpose and procedures, and their participation was voluntary. The thesis reported obtaining informed consent, allowing withdrawal without penalty, coding responses to protect identities, presenting only aggregated findings, and restricting access to study data. It further stated that participation would not affect employment or performance appraisal. The source described AI-based language assistance for manuscript preparation but attributed research design, data collection, analysis, and interpretation to the researcher; this statement does not imply that AI generated the study results.

RESULTS AND DISCUSSION

Profile of the Respondents

Table 1 presents the demographic distribution of the 66 elementary teachers. Female respondents numbered 43 (65.2%), whereas male respondents numbered 23 (34.8%). Teachers aged 22–29 accounted for 50 respondents (75.75%); the remaining respondents were aged 30–37 (11; 16.67%), 38–45 (1; 1.52%), and 46–53 (4; 6.06%). Thus, the participating faculty was predominantly female and concentrated in the youngest reported age category.

Table 1. *Frequency and Percentage Distribution by Sex and Age (N = 66)*

Profile	Frequency	Percentage
Sex: Female	43	65.2%
Sex: Male	23	34.8%
Age: 22–29	50	75.75%
Age: 30–37	11	16.67%
Age: 38–45	1	1.52%
Age: 46–53	4	6.06%

The age concentration may have implications for planning and peer-learning opportunities, but the present analysis did not compare readiness or attitudes statistically by age or sex. Research involving selected Filipino teachers found differences in digital literacy associated with professional experience (Abella & Dela Rosa, 2023), whereas the current demographic findings alone cannot establish such differences for CDNSSI.

Technological Readiness Across TPACK Domains

As shown in Table 2, the overall technological-readiness mean was 3.26, classified as very high readiness under the thesis scale. Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK) each obtained 3.34, while Technological Content Knowledge (TCK) obtained 3.30 and Pedagogical Knowledge (PK) 3.27. Content Knowledge (CK) obtained the lowest domain mean (3.12), followed by Pedagogical Content Knowledge (PCK; 3.21) and integrated TPACK (3.23). The pattern suggests comparatively stronger familiarity with technology and technology-supported methods than with some subject-specific applications.

Table 2. *Summary of Teachers' Self-Reported Technological Readiness*

TPACK domain	Mean	Readiness
Technological Knowledge (TK)	3.34	Very high
Content Knowledge (CK)	3.12	High
Pedagogical Knowledge (PK)	3.27	Very high
Pedagogical Content Knowledge (PCK)	3.21	High
Technological Content Knowledge (TCK)	3.30	Very high*
Technological Pedagogical Knowledge (TPK)	3.34	Very high
Integrated TPACK	3.23	High
Overall	3.26	Very high

At the item level, the technology-knowledge indicators included keeping up with important new technologies ($M = 3.52$) and learning technologies easily ($M = 3.41$), whereas experimenting frequently with technology ($M = 3.23$) and knowing many different technologies ($M = 3.20$) received lower ratings. Pedagogical knowledge likewise reflected relatively strong confidence in adapting teaching to student understanding and assessing learning in multiple ways (both $M = 3.33$), but comparatively lower confidence in differentiated style, familiar misconceptions, and classroom management (each $M = 3.21$ – 3.23). This variation cautions against interpreting the overall readiness mean as equally strong competence on every instructional task.

Content-specific results were particularly relevant because respondents taught multiple subjects. In CK, the statement on sufficient social studies knowledge obtained 2.19, a low-readiness classification, while sufficient mathematics knowledge received 2.98. In TCK, familiarity with technologies for literacy received 3.44, higher than the mathematics-technology item at 3.21. In integrated TPACK, combining technology, pedagogy, and

content in literacy received 3.33 compared with 3.20 in mathematics and 3.17 in social studies. These item-level comparisons help explain why the proposed program emphasizes content-focused practice instead of concentrating only on LMS navigation.

This readiness pattern is consistent with the conceptual distinction in TPACK: knowing how to operate technology and knowing how to represent disciplinary ideas through technology are related but separate capacities (Mishra & Koehler, 2006). Studies in the Philippine setting have similarly drawn attention to the relevance of self-efficacy and discipline-specific applications in LMS-supported teaching (Caballo et al., 2024; Mangarin et al., 2024). The present data, however, are self-ratings and should not be read as observations of teaching quality or learner achievement.

Teachers' Attitudes Toward LMS Adoption

The five LMS-attitude dimensions were all within the high-positive range, with an overall mean of 3.55 (Table 3). Behavioral Intention to Use/Adoption was highest ($M = 3.64$), followed by Attitude Toward Use ($M = 3.60$). Perceived Usefulness scored 3.54, and the detailed results table gave Perceived Ease of Use as 3.53. The lowest of the five dimensions was self-rated Competency ($M = 3.45$), although it remained high positive. Teachers thus reported strong willingness to use the LMS alongside a comparatively greater need to build confidence through practical application.

Table 3. *Teachers' Self-Reported Attitudes Toward LMS Adoption*

Attitude dimension	Mean	Interpretation
Perceived Usefulness (PU)	3.54	High positive
Perceived Ease of Use (PEOU)	3.53	High positive
Attitude Toward Use (ATT)	3.60	High positive
Behavioral Intention (BI)	3.64	High positive
Self-rated Competency	3.45	High positive
Overall	3.55	High positive

The strongest usefulness item was finding the LMS useful in class ($M = 3.72$). Teachers also valued using the LMS in class ($M = 3.66$) and planned to use it to enhance learners' interest ($M = 3.67$). The lowest competency item concerned selecting and using an LMS to support teaching and learning ($M = 3.34$), whereas feeling prepared to use the LMS in teaching received 3.52. These scores suggest that the respondents' favorable general attitudes were not matched uniformly by every item of self-evaluated applied competency.

From the TAM perspective, these positive perceptions offer a favorable context for continued LMS adoption (Davis, 1989). Studies involving Philippine LMS designs and classroom use have likewise demonstrated the value of examining user acceptance and practical utilization together (Galura et al., 2023; Garcia et al., 2022). Nevertheless, the present cross-sectional descriptive findings cannot establish that attitudes caused LMS adoption, that an enhancement program would increase usage, or that students' learning outcomes improved.

Proposed Faculty Enhancement Program

Based on the comparatively lower CK, PCK, integrated TPACK, and competency scores, the thesis developed a proposed six-month TPACK-anchored Faculty Enhancement Program for CDNSSI. The program was planned as a developmental response to the baseline findings, not as an intervention already implemented or evaluated. Table 4 condenses the principal activity strands, time frames, and proposed performance targets from the thesis action plan.

Table 4. *Condensed Proposed Six-Month Faculty Enhancement Action Plan*

Focus and period	Proposed activities	Responsible staff	Proposed monitoring target
Content knowledge; Months 1–2	Subject refreshers, emphasizing social studies and mathematics	Academic coordinator and subject focal persons	100% of generalist teachers complete a subject-specific LMS workshop
PCK/TCK/TPAC K; Months 2–4	Develop one LMS-based lesson per core learning area	Academic coordinator and ICT coordinator	90% demonstrate ability to design LMS-integrated lesson plans
Hands-on competency; Months 3–5	Mock classes, guided LMS practice, peer feedback	ICT coordinator and peer coaches	80% improve self-rated competency after training
Instructional leadership; Months 4–6	Prepare peer mentors and coaching arrangements	School head and academic coordinator	Train at least five LMS teacher-mentors
Monitoring; Months 1–6	Monthly check-ins and program adjustments	Academic coordinator	Monthly monitoring records of program participation

The proposed sequence begins with subject-specific content enrichment, proceeds to guided creation of LMS-supported lessons, and then strengthens teaching confidence through rehearsal and coaching. Suggested monitoring tools in the thesis include pre- and post-program self-report measures, an LMS-integrated classroom observation checklist, and a lesson plan rubric. Such tools would require expert review and appropriate validation before their use in evaluating implementation outcomes. The proposed targets are planning benchmarks, not observed achievements.

This approach is consistent with Knowles' (1984) emphasis on experience-based learning and with the content–pedagogy–technology integration described by Mishra and Koehler (2006). It also responds directly to the numerical pattern identified in the study: readiness and willingness were favorable overall, but subject-specific design and independent application offered clearer developmental priorities. Implementation feasibility, teacher workload, internet access, and LMS technical support should be assessed during the initial rollout rather than assumed to be resolved.

CONCLUSION

The study described technological readiness and attitudes toward LMS adoption among 66 generalist elementary teachers of Casa Del Niño Schools System Inc. during School Year 2025–2026. Respondents were predominantly female and aged 22–29. Their overall technological readiness was very high ($M = 3.26$), while their LMS-adoption attitudes were high positive ($M = 3.55$). Stronger means in technology-related readiness and behavioral intention were accompanied by comparatively lower means in Content Knowledge, Pedagogical Content Knowledge, integrated TPACK, and self-rated LMS competency. The findings therefore support the design of a targeted, subject-centered, practice-based faculty enhancement program rather than an exclusively introductory technology orientation. These conclusions concern teachers' self-reported perceptions in the participating school system; they do not establish actual classroom performance, causal relationships, or the effectiveness of the proposed program.

Recommendation

School administrators and academic coordinators are encouraged to pilot the proposed six-month faculty enhancement program, prioritizing mathematics and social studies content reinforcement, TPACK-aligned lesson development across learning areas, and supervised LMS teaching demonstrations. The ICT coordinator and trained peer coaches may facilitate guided application, troubleshoot instructional challenges, and support teachers who would benefit from additional practice. Institutional leaders should allocate adequate instructional time, access to digital resources, and follow-up mentoring so that LMS integration can be incorporated into routine teaching responsibilities.

Before full implementation, the proposed observation checklist, self-rating instrument, and lesson evaluation rubric should be reviewed for clarity and validated appropriately. The school may compare baseline and post-program evidence and document participation, lesson quality, and actual classroom use without presenting these future indicators as findings of the present study. Future research could include additional school systems, observable LMS use, and validated outcome measures, and could examine demographic or inter-variable relationships using suitable designs and statistical procedures. The original descriptive results remain the necessary starting point for those subsequent investigations.

References

- Abella, J. L., & Dela Rosa, E. (2023). Digital literacy and digital competence of selected Filipino teachers: Basis for a post-pandemic pedagogy. *IJORE: International Journal of Recent Educational Research*, 4(5), 548–569. <https://doi.org/10.46245/ijorer.v4i5.378>
- Al-Fraihat, D., Joy, M., Masa'deh, R., & Sinclair, J. (2020). Evaluating e-learning systems success: An empirical study. *Computers in Human Behavior*, 102, 67–86. <https://doi.org/10.1016/j.chb.2019.08.004>
- Caballo, J. H. S., Regidor, J. C., Alayacyac, J. R. S., Abellanos, J. E., & Monajan, G. J. G. (2024). Computer self-efficacy and effectiveness of Quipper learning management system. *Formosa Journal of Computer and Information Science*, 3(2), 137–146. <https://doi.org/10.55927/fjcis.v3i2.11526>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Galura, J. C., Delos Reyes, E. G., & Pineda, J. L. S. (2023). C5-LMS design using Google Classroom: User acceptance based on extended unified theory of acceptance and use of technology. *Interactive Learning Environments*, 31(9), 6074–6083. <https://doi.org/10.1080/10494820.2022.2028852>
- Garcia, R. C., Arpilleda, A. J., Mallillin, S. M., & Abadiano, M. N. (2022). Utilization of Quipper application as learning management system in teaching as experienced by the junior high school teachers of St. Paul University Surigao. *International Journal of Science and Management Studies*, 5(1), 129–142. <https://doi.org/10.51386/25815946/ijsms-v5i1p113>
- Knowles, M. S. (1984). *The adult learner: A neglected species* (3rd ed.). Gulf Publishing.
- Lachner, A., Fabian, A., Franke, U., Preiß, J., Jacob, L., Führer, C., Küchler, U., Paravicini, W., Randler, C., & Thomas, P. (2021). Fostering pre-service teachers' technological pedagogical content knowledge (TPACK): A quasi-experimental field study. *Computers & Education*, 174, Article 104304. <https://doi.org/10.1016/j.compedu.2021.104304>
- Mane, M. S. B. (2025). Teachers' readiness and the integration of technology in teaching. *International Journal of Multidisciplinary and Current Educational Research*, 7(3), 260–290. https://www.ijmcer.com/wp-content/uploads/2025/05/IJM CER_O0730260290.pdf
- Mangarin, R. A., Pacatang, J. R., Peligor, J. B., & Limpangog, C. M. (2024). The Quipper way of learning mathematics: Through the spectrum of major subjects. *TWIST Journal*, 19(2), 120–131. <https://twistjournal.net/twist/article/view/197>
- 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>
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Scherer, R., Howard, S. K., Tondeur, J., & Siddiq, F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready? *Computers in Human Behavior*, 118, Article 106675. <https://doi.org/10.1016/j.chb.2020.106675>

- Sesmiarni, Z., Hoque, M. E., Susanto, P., Islam, M. A., & Hendrayati, H. (2024). Adoption of SPACE-learning management system in education era 4.0: An extended technology acceptance model with self-efficacy. *Frontiers in Education*, 9, Article 1457188. <https://doi.org/10.3389/feduc.2024.1457188>
- Yeh, Y.-F., Chan, K. K. H., & Hsu, Y.-S. (2021). Toward a framework that connects individual TPACK and collective TPACK: A systematic review of TPACK studies investigating teacher collaborative discourse in the learning by design process. *Computers & Education*, 171, Article 104238. <https://doi.org/10.1016/j.compedu.2021.104238>