Factors Influencing Digital Literacy and ICT Competence of Pre-Service Teachers in Taguig for ICT-Based Instructional Materials Development

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DOI: https://doi.org/10.47772/IJRISS.2026.101000094

Received: 12 October 2026; Accepted: 17 October 2026; Published: 30 October 2026

ABSTRACT

Digital literacy and Information and Communication Technology (ICT) competence are crucial skills for pre-service teachers in designing ICT-based instructional material, yet the context-related factors in which they are developed need to be explored. This study sought to ascertain the role of prior educational learning experiences, resource availability, institutional support, and demographic profile, as possible factors in the digital literacy and ICT competence of pre-service teachers in Taguig. A descriptive-correlational research was conducted on 94 fourth-year Bachelor of Secondary Education pre-service teachers in the Polytechnic University of the Philippines–Taguig Campus and Taguig City University who volunteered to participate in the study and were selected using stratified random sampling. The researcher-made survey questionnaires were administered to the participants and analyzed using descriptive and Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis. The results of the study demonstrated that the respondents were Very Proficient in utilizing technology in teaching practices (M = 3.74, SD = 0.35) and developing digital content (M = 3.55, SD = 0.15), while exhibiting Always ICT engagement (M = 3.64, SD = 0.14) and Very Competent digital competence (M = 3.56, SD = 0.13). Contextual factors significantly influenced ICT competence but not digital literacy. ICT competence significantly influenced digital literacy and mediated the relationship between contextual factors and digital literacy. The demographic profile did not moderate the relationships in the model. The importance of the above-mentioned factors cannot be underestimated; therefore, the need to improve pre-service teachers' ICT proficiency through enhanced learning opportunities, access to resources, and institutional support is prioritized.

Keywords: Digital literacy, ICT competence, contextual factors, pre-service teachers, technology integration

INTRODUCTION

Background and Literature

As stated in SDG4 of the UN, quality education involves teachers capable of working confidently in a digital environment. As such, Philippine policies have been geared towards this objective, wherein AmBisyon Natin 2040 is set to establish a competitive workforce in the context of the digitized economy (NEDA, 2015); the Enhanced Basic Education Act (Republic Act No. 10533, 2013) mandates ICT literacy in the curriculum; ICT integration in the teaching profession has been identified as an aspect of teacher professionalism by the Philippine Professional Standards for Teachers (DepEd, 2017); and flexible learning modalities were institutionalized in higher education in light of the COVID-19 pandemic (CHED, 2020). In the standards for BSEd programs, technology use in facilitating learning is also expected from graduates of the said program. (CHED, 2017).

Nevertheless, in spite of all these recommendations, it appears from the recent study that the preservice teachers feel more confident in their skills when using the technology for everyday purposes than for the advanced one. To be more specific, based on the findings of a meta-review of 38 papers, although the knowledge of the preservice teachers concerning the basics of technology is adequate, their skills in creating digital content, integrating pedagogy, and problem-solving should be further developed (Zhang et al., 2026). In addition, in an Austrian study almost half of the preservice teachers felt that their education was inadequate for developing students' digital competence (Dolezal et al., 2025).

The Context seems to be as important as individual competence. Researches carried out in the Philippines found out that unstable internet, insufficient access to devices and institutional support influence digital learning (Chin et al., 2022; Javier, 2022; Manalo et al., 2022; Napanoy et al., 2021). Vizconde and Tomás (2023) compared resource-rich and resource-poor contexts. Among 425 pre-service English teachers, ICT self-efficacy, collegial collaboration and infrastructure support explained digital competence (Dai, 2023); school support and self-efficacy – pre-service teachers' content creation using generative AI technologies (Liang & Lu, 2025); and school support – the relationship between ICT competence and attitudes towards digitalization among in-service Philippine teachers (Caratiquit & Javier, 2025). As for the research on the differences between demographics, the results are contradictory: while age and sex were significant in some researches (Cabezas-González et al., 2021; Niyazova et al., 2023), they were insignificant in others (Diquito et al., 2022; Miran & Cruz, 2025; Weinhandl et al., 2025).

Theoretical and Conceptual Framework

The research is based on ICT Competency Standards for Teachers (ICT-CST) with six strands which include ICT Foundations, Curriculum and Assessment Integration, Teaching-learning approaches, Empowering learners, Digital citizenship and Professional learning and on Digital Citizenship Competency (DCC) framework consisting of domains like digital literacy, safety and resilience, participation and agency, emotional intelligence and creativity and innovation (Milambiling et al., 2024). The concept of technological pedagogical content knowledge (Mishra & Koehler, 2006) guides the operationalization of ICT competence as the prerequisite for integrating technology in the classroom.

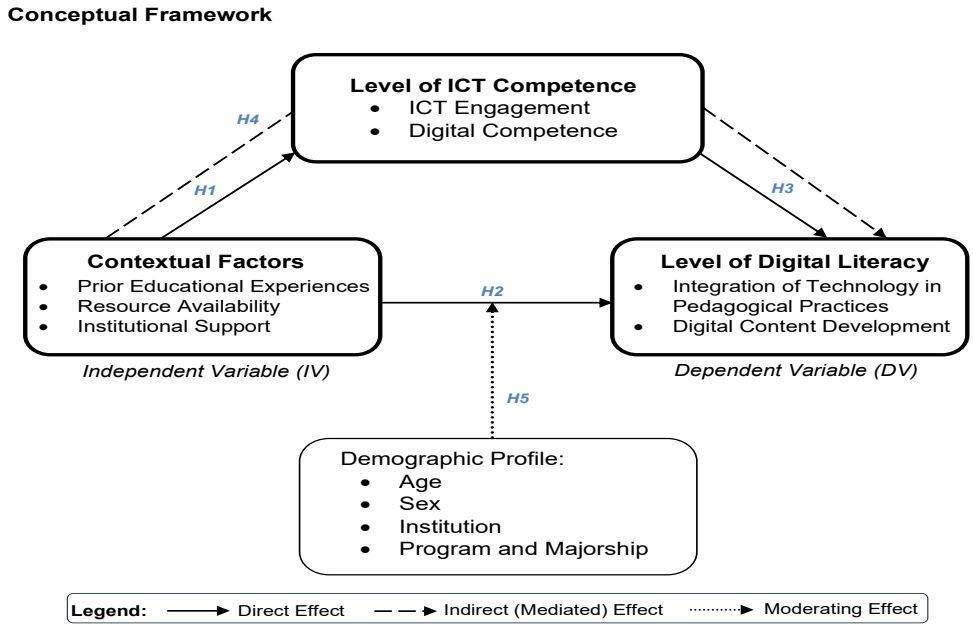


Figure 1. Conceptual Framework Illustrating the Relationships among ICT Competence, Contextual Factors, and Digital Literacy of Pre-Service Teachers

Figure 1 displays the model where contextual factors (educational background, availability of resources, institutional support) represent the independent variable, ICT competence (ICT engagement and digital competence) represents the mediator variable, digital literacy (technological integration in teaching practices

and digital content creation) stands for the outcome while demographic profile (age, gender, institution, course and field of study) moderates the relation between contextual factors and digital literacy.

Research Gap, Objectives and Hypotheses

The previous researches have described competency levels and single predictors, but very few have determined how the combination of resources, institutional environment, and previous experience function together in a certain path in a certain institution in the Philippines, and there are none for English and Math Majors whose training uses different technologies. The research will address the above for the development of ICT instructional materials.

The objectives of the study were to (a) describe the profile of respondents; (b) determine the level of digital literacy (technology integration; digital content development) and ICT competence (ICT engagement; digital competence); (c) describe contextual factors; and (d) test the following hypotheses:

H1. Contextual factors significantly influence ICT competence.

H2. Contextual factors significantly influence digital literacy.

H3. ICT competence significantly influences digital literacy.

H4. ICT competence significantly mediates the relationship between contextual factors and digital literacy.

H5. Demographic profile significantly moderates the relationship between contextual factors and digital literacy.

METHODOLOGY

Research Design and Participants

This study was descriptive-correlational which is quantitative in design. The target population of the study consisted of 124 fourth-year Bachelor of Secondary Education students majoring in English and Mathematics of the Polytechnic University of the Philippines – Taguig Campus and Taguig City University for the Academic Year 2025 – 2026. Stratified random sampling by institution and major was used to choose 94 respondents. The sample consisted of 51 respondents from PUP–Taguig (54%) and 43 respondents from TCU (46%) with 60 respondents majoring in English (64%) and 34 respondents majoring in Mathematics (36%).

Instrument and Data Collection

The researcher developed questionnaire consisted of 35 items, divided into seven sub-constructs: RA (Resource Availability) with five items, IS (Institutional Support) with five items, PELE (Prior Educational Learning Experiences) with five items, ICTE (ICT Engagement) with five items, DC (Digital Competence) with five items, ITPP (Integration of Technology in Pedagogical Practices) with five items, and DCD (Digital Content Development) with five items. Therefore, there were 10 items for digital-literacy sub-construct, 10 items for ICT-competence sub-construct and 15 items for contextual-factor sub-construct. A four point scale was used for the responses to each dimension: proficiency (4 = Very Proficient to 1 = Not Proficient), frequency (4 = Always to 1 = Never), competence (4 = Very Competent to 1 = Not Competent), and agreement (4 = Strongly Agree to 1 = Strongly Disagree).

The questionnaire was reviewed for content and clarity by three experts: Ms. Erica L. Caturay, Mr. Israel G. Ortega and Mr. Karl Kristian Villacorta. After being reviewed by experts, the instrument was tested with 30 students in BSEd English 3-1 at the pilot level. The internal consistency of the seven five-item sub-constructs ranged from .71 to .90 with Cronbach's alpha and met the criteria of acceptable to excellent internal consistency listed for the study. Pilot participants were outside of the sample.

Table 1. Pilot-test Internal Consistency by Sub-Construct

Table 2. Respondent Profile (n = 94)

Sub-construct	Items	Cronbach's alpha	Interpretation
Integration of Technology in Pedagogical Practices	5	.89	Good
Digital Content Development	5	.71	Acceptable
ICT Engagement	5	.71	Acceptable
Digital Competence	5	.84	Good
Resource Availability	5	.90	Excellent
Institutional Support	5	.76	Acceptable
Prior Educational Learning Experiences	5	.89	Good

Data Analysis

Descriptive statistics were used to summarize the profiles and ratings of the respondents. Partial least squares structural equation modeling (PLS-SEM) in the WarpPLS 8.0 software was used to examine the structural relationships. The indicator loadings, composite reliability (CR), average variance extracted (AVE), ratios of the indicator to the other indicators HTMT2, path coefficients, p-values, effect sizes, full-collinearity variance inflation factors (VIF), R^2, and Q^2 were analyzed.

RESULTS

Respondent Profile

Table 3. Descriptive Statistics for Study Dimensions

Characteristic	Category	n	%
Age	20–22 years	75	80
	23–25 years	19	20
Sex	Female	69	73
	Male	25	27
Institution	PUP–Taguig	51	54
	Taguig City University	43	46
Major	English	60	64
	Mathematics	34	36

Most respondents were aged 20–22 years (80%) and female (73%). The sample represented both institutions and both majors, with somewhat more respondents from PUP–Taguig and the English major.

Respondent Profile Self-Reported Digital Literacy, ICT Competence, and Contextual Factors

Table 4. Construct-Level Convergent-Validity and Reliability Statistics

Dimension	Mean	SD	Reported interpretation	Level
Technology integration in pedagogical practices	3.74	0.35	Very Proficient	Very High
Digital content development	3.55	0.15	Very Proficient	Very High
ICT engagement	3.64	0.14	Always	Very High
Digital competence	3.56	0.13	Very Competent	Very High
Prior educational learning experiences	3.52	0.03	Strongly Agree	Very High
Resource availability	3.58	0.10	Strongly Agree	Very High
Institutional support	3.35	0.06	Strongly Agree	Very High

Each dimension reported was rated high by the respondents. The mean for the integration of technology in pedagogical practices was 3.74 and the mean for digital content development was 3.55. The average scores for ICT engagement and digital competence were 3.64 and 3.56 respectively. Prior educational learning experiences received higher ratings (M = 3.52) than institutional support (M = 3.35), which received higher ratings than resource availability (M = 3.58). Compared to other items, the development of learning materials using video (M = 3.21) and troubleshooting in common technical problems (M = 3.26) were comparatively low-rated. These are the "perceptions" of abilities and conditions, not "facts" of demonstrated performance.

Mesurement Model

Contextual factors and ICT competence and digital literacy had composite reliability values of .70 or above (CR = .910, CR = .856, and CR = .888, respectively). For the three constructs however, the AVE values were below the traditional .50 limit (CF = .414, ICTC = .390, DL = .447), which means convergent validity is not adequately proved based on this criterion. Several loadings were low, including ICTE1 (.273), DC3 (.344), RA4 (.375), RA2 (.451), RA1 (.461), DCD1 (.456), and RA5 (.484). The reported indicator loadings were statistically significant ($p < .001$), but this is not enough to prove the reliability of the indicators or convergent validity. The results of these findings need to be interpreted with caution and further examination of the measurement model should be conducted.

Table 5. Indicator Loadings for the Measurement Model

Construct	AVE	Composite reliability (CR)
Contextual factors	.414	.910
ICT competence	.390	.856
Digital literacy	.447	.888

The HTMT2 ratios were .674 between contextual factors and ICT competence; .494 between contextual factors and digital literacy; and .753 between ICT competence and digital literacy. For each ratio, it was below the .85 criterion indicating discriminant validity under this criterion. These statistics for the measures at the construct level and all 30 indicator loadings are presented in Table 3 and Table 4, respectively.

Table 6. Structural Model Hypothesis-Testing Results

Indicator	Loading	Indicator	Loading	Indicator	Loading
RA1	.461	IS1	.716	PELE1	.769
RA2	.451	IS2	.698	PELE2	.739
RA3	.620	IS3	.636	PELE3	.713
RA4	.375	IS4	.595	PELE4	.788
RA5	.484	IS5	.664	PELE5	.748
ICTE1	.273	DC1	.736	ITPP1	.761
ICTE2	.539	DC2	.655	ITPP2	.680
ICTE3	.553	DC3	.344	ITPP3	.758
ICTE4	.766	DC4	.754	ITPP4	.636
ICTE5	.695	DC5	.707	ITPP5	.702
DCD1	.456	DCD2	.629	DCD3	.537
DCD4	.697	DCD5	.761		

Structural Model and Hypothesis

Table 7. Explained Variance, Predictive Relevance, and Full-Collinearity VIF

Hypothesis/Path	β	p-value	f^2	Decision
H1: Contextual factors → ICT competence	.579	< .001	.335	Supported
H2: Contextual factors → digital literacy	.156	.059	.073	Not supported
H3: ICT competence → digital literacy	.541	< .001	.343	Supported
H4: Contextual factors → ICT competence → digital literacy	.469	< .001	.147	Supported
H5: Demographic profile × contextual factors → digital literacy	.027	.396	.004	Not supported

H1 was supported by results that showed that contextual factors positively predicted ICT competence ($\beta = .579$, $p < .001$, $f^2 = .335$). The direct contextual factors to digital literacy pathway had a positive link, but statistically insignificant ($\beta = .156$, $p = .059$, $f^2 = .073$), failing to support H2. Digital literacy was significantly predicted by ICT competence ($\beta = .541$, $p < .001$, $f^2 = .343$) which supported H3. H4 was supported with an indirect association between contextual factors and digital literacy via ICT competence, which was significant ($\beta = .469$, $p < .001$, $f^2 = .147$). The demographic moderation effect was not statistically significant ($\beta = .027$, $p = .396$, $f^2 = .004$), thus H5 was not supported. As the design was of a cross-sectional and correlational type, these results reflected statistical relationships but not necessarily causal relationships.

The model explained 33.5% of the variance in ICT competence ($R^2 = .335$; $Q^2 = .336$) and 41.9% of the variance in digital literacy ($R^2 = .419$; $Q^2 = .426$). Full collinearity VIF values for contextual factors, ICT competence and

digital literacy were 1.543, 2.008 and 1.732 respectively. The H5 interaction was very small ($f^2 = .004$) and the sample size (N = 94) might not have been large enough to detect small interaction effects.

Construct	R^2	Q^2	Full-collinearity VIF
ICT competence	.335	.336	2.008
Digital literacy	.419	.426	1.732
Contextual factors	—	—	1.543

DISCUSSION

These descriptive results show that participants felt that they were highly connected with digital tools and that they could integrate technology in the tasks that they perform in relation to teaching. The overall ratings, however, were comparatively low for development of video-based content and technical troubleshooting, suggesting opportunities for enhancing practical training. As the data was self-reported, high scores should be understood as self-perceptions of competence rather than actual competence.

The contextual factors are found to be significant with respect to the respondents' reported ICT competence, indicating that the learning experiences with ICTs, resource availability and institutional support are correlated with the respondents' reported ICT competence. The result is not a causal result because the research design was a cross-sectional descriptive correlation.

The direct path from contextual factors to digital literacy was not statistically significant but the indirect path through ICT competence was statistically significant. An alternate reading is that access to resources and institutional support can become more closely linked with digital literacy when such support can be used to build students' usable ICT skills. The following explanation is tentative and should not be used as evidence of a causal mediation process.

ICT competence was found to be significantly related to digital literacy, highlighting the value of skills and practical importance of digital access and skills development. Authentic tasks that involve pre-service teachers in making instructional videos, creating digital assessments, curating resources, troubleshooting technical issues, and incorporating digital tools into lesson plans can be valuable to teacher-education programs.

The moderation analysis results indicated that there was no statistically significant demographic interaction. This is not to say age, sex, institution or major is never a factor. This analysis might have limited power to detect small interaction effects because there were only 94 respondents and a model with mediation and moderation. This is to be interpreted not as the absence of differences in demography, but as a lack of statistical evidence for it in this sample.

Limitations

It was a self-reported study using questionnaires; thus, social-desirability bias, recall, and different interpretation of competency-related responses by respondents may have influenced the results of this study. It is important to note that the high scores for the mean should not be interpreted as actual competence, but as self-confidence and self-reports. No objective, performance-based assessment, observed teaching task or direct evaluation of instructional materials was done. A sample of 94 fourth year BSEd students in two institutions in Taguig was used. The sample was stratified randomly and drawn from a population of 124; however, the sample size is still relatively small for a mediation and demographic moderation model. The result of no moderation may have been due to statistical power; it is not a conclusion that demographic differences are not important. Care should be taken to generalize to similar settings.

IMPLICATIONS AND RECOMMENDATIONS

Access to technology combined with structured, practice-based learning can be a strategy to enhance digital literacy in teacher-education institutions. Activities that are suggested are making instructional videos, making digital quizzes, making infographics, cooperative online activities, assessing online information, and troubleshooting common tech issues. Institutions can also assess the hands-on ICT training, technical assistance and professional-development offerings.

Future research should use larger sample sizes in additional institutions and specializations, incorporate objective measures of performance in addition to self-report measures, and use longitudinal or experimental designs. Researchers should read the low-loading indicators with the original wording of the items and theoretical justification, summarize the complete statistics of the measurement model and obtain the bootstrapping confidence intervals for all the tested paths from the original output of PLS-SEM. Future moderation studies should consider the sample size and statistical power for moderation effects.

CONCLUSION

In the case of pre-service teachers (n = 94) who participated in this study, self-reported digital literacy and ICT engagement were rated high, while digital competence and contextual support were rated medium to high. ICT competence was significantly predicted by contextual factors and digital literacy was significantly predicted by ICT competence, and the relationship between context and digital literacy was mediated by ICT competence. The effect of the direct relationship between contextual factors and digital literacy was not statistically significant as well as the demographic moderation effect. The results highlight the importance of building up the practical competence of ICT and the access to resources and institutional support. One should be careful when interpreting the results of the self-report design, limited sample, and non-significant moderation. The result of the non-significant moderation, limited sample, and self-report design calls for caution.

Declarations

Ethics approval and informed consent

The study received ethics clearance from the PUP University Research Ethics Committee (Protocol No. 2026-0416). Participants provided electronic informed consent before data collection. Participation was voluntary, and responses were collected anonymously without names.

Funding

The authors received no specific external funding for this study.

Conflict of Interest

The authors declare no competing interests.

Data Availability

De-identified data may be requested from the corresponding author, subject to ethics approval and applicable institutional requirements.

Authors Contribution

All authors contributed to the development and completion of this study. They participated in the development of the research objectives and methodology, the conduct of the research, and the review and revision of the manuscript according to their respective contributions. All authors reviewed and approved the final version of the manuscript for submission.

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