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Digital Competency of Teachers in Relation to Selected Variables: Gender, Type of Institution, and Level of Institution

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Abstract

This cross-sectional survey examines differences in self-reported digital competence among teachers by gender, institutional management, and educational level. A purposive and snowball sample of 100 school, college, and university teachers completed the 19-item Teachers' Digital Competence Scale (TDiCoS). Scores were compared using independent-samples t-tests and one-way analysis of variance (ANOVA). Female respondents reported higher scores (M = 64.78) than male respondents (M = 57.83), t(98) = 2.03, p = .045. Respondents in private institutions also scored higher (M = 64.81) than those in government institutions (M = 56.52), t(98) ≈ 2.34, p ≈ .021. Scores differed by institutional level, F(2, 97) = 3.58, p = .031; Tukey's test identified a difference between school and university respondents (p = .036), but not between the other pairs. Nonprobability recruitment, self-report measurement, and the very small university subgroup (n = 6) limit generalization. These exploratory findings indicate group differences within the surveyed sample and suggest a need for context-sensitive professional development and further research with balanced samples.

Keywords: Competence; Education; Gender; Institutions; Teachers; Technology.

Kompetensi Digital Guru dalam Kaitannya dengan Variabel Tertentu: Gender, Jenis Institusi, dan Jenjang Institusi

Abstrak

Survei potong lintang ini mengkaji perbedaan kompetensi digital yang dilaporkan sendiri oleh guru berdasarkan gender, pengelolaan institusi, dan jenjang pendidikan. Sebanyak 100 guru sekolah, perguruan tinggi, dan universitas yang dipilih menggunakan teknik purposive sampling dan snowball sampling menyelesaikan 19 butir Teachers' Digital Competence Scale (TDiCoS). Skor dibandingkan menggunakan uji-t sampel independen dan analisis varians satu arah (ANOVA). Responden perempuan melaporkan skor yang lebih tinggi (M = 64,78) dibandingkan responden laki-laki (M = 57,83), t(98) = 2,03, p = 0,045. Responden dari institusi swasta juga memperoleh skor lebih tinggi (M = 64,81) dibandingkan responden dari institusi pemerintah (M = 56,52), t(98) ≈ 2,34, p ≈ 0,021. Skor menunjukkan perbedaan berdasarkan jenjang institusi, F(2, 97) = 3,58, p = 0,031. Uji Tukey mengidentifikasi perbedaan antara responden dari sekolah dan universitas (p = 0,036), tetapi tidak menemukan perbedaan pada pasangan kelompok lainnya. Penggunaan teknik pengambilan sampel nonprobabilitas, pengukuran berdasarkan laporan diri, dan jumlah responden universitas yang sangat kecil (n = 6) membatasi generalisasi temuan. Hasil eksploratif ini menunjukkan adanya perbedaan antarkelompok dalam sampel yang diteliti serta mengindikasikan perlunya pengembangan profesional yang sesuai dengan konteks dan penelitian lanjutan menggunakan sampel yang lebih seimbang.

Kata kunci: Gender; Guru; Institusi; Kompetensi; Pendidikan; Teknologi.

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INTRODUCTION

Teachers' use of digital technologies encompasses communication, access to educational resources, preparation of instructional materials, and technology-supported learning activities (Mondal & Pal, 2022; Kadve et al., 2023). Effective integration requires more than access to devices: it also depends on teachers' confidence and ability to select and use appropriate digital tools. Digital competence is therefore a

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relevant dimension of teachers' professional practice, although its level may vary across individuals and educational settings (Tzafilkou et al., 2023).

Research has considered differences in digital competence related to demographic and professional characteristics, including age, subject specialization, teaching experience, and institutional conditions (Anand & Sapna, 2024; Babu & Suneela, 2023; Meher et al., 2025; Radhamani & Kalaivani, 2023). Yet prior findings are not consistent across populations and measures. A comparison involving multiple types and levels of institutions may help show how reported competencies differ across settings without assuming that any individual characteristic is itself a cause of those differences.

This study therefore examines self-reported digital competence among 100 respondents in relation to three selected characteristics: gender, government or private institutional management, and school, college, or university level. It asks whether mean competence scores differ across these groups, using a common 19-item instrument. The contribution is a descriptive comparison within the recruited sample rather than a representative estimate of teachers' competence or a causal assessment of institutional conditions. This distinction is important because the nonprobability sampling design and uneven subgroup sizes constrain generalization.

REVIEW OF RELATED LITERATURE

Findings on gender differences in teachers' digital competence have been mixed. Anand and Sapna (2024) found no statistically significant gender difference but reported differences associated with teaching subject and experience. Babu and Suneela (2023) reported gender and locality differences among secondary teachers, whereas Meher et al. (2025) identified demographic differences, including higher scores among men in their study. Grande-de-Prado et al. (2020) also examined gender-related patterns in digital competence among teachers in training. Such variation suggests that the direction of gender differences should not be assumed to apply uniformly across settings or instruments.

Studies of institutional contexts suggest that digital competence has multiple dimensions. Althubyani (2024) examined teachers' competence and their perceptions of digital technologies, while Singh et al. (2025) described variation across basic ICT use, communication, instructional integration, and content creation. Research among teachers in Ghana reported moderate competence and associations with prior experience (Modzeb-Ekpampo et al., 2026). Majeed et al. (2025) likewise related digital literacy and ICT self-efficacy to functional skills. These results caution against treating familiarity with a technology as equivalent to its pedagogical application.

At different educational levels, teachers may encounter different digital tasks and professional expectations. Tzafilkou et al. (2023) examined competence in primary and secondary education using an instrument that included pedagogical and professional elements. Radhamani and Kalaivani (2023) also reported relationships between competence and teachers' educational or training backgrounds. The existing literature supports further group comparisons, but differences in study populations, measures, and recruitment prevent a single expectation about which group should score highest. The present study addresses these comparisons descriptively rather than proposing a causal account.

OBJECTIVES

The objectives of the study were:

To compare mean digital competence scores between male and female respondents.

To compare mean digital competence scores between respondents from government and private institutions.

To compare mean digital competence scores among school, college, and university respondents.

HYPOTHESES

The following null hypotheses were examined:

H01: Mean digital competence scores do not differ between male and female respondents.

H02: Mean digital competence scores do not differ between respondents at government and private institutions.

H03: Mean digital competence scores do not differ among school, college, and university respondents.

METHODOLOGY

A cross-sectional descriptive survey was conducted using nonprobability purposive and snowball sampling. The questionnaire was distributed through Google Forms, initially to teachers known to the researcher and subsequently through referrals from those contacts. The final sample comprised 100 respondents employed at schools, colleges, or universities. The sample included 40 male and 60 female respondents, 33 from government and 67 from private institutions, and 68 school, 26 college, and 6 university respondents. Recruitment through existing networks may have favored teachers with internet access and those connected to participating contacts; the sample should therefore not be treated as representative of all teachers. The study compared groups as observed rather than randomly assigning respondents to conditions.

RESEARCH INSTRUMENT

Digital competence was measured with the 19-item Teachers' Digital Competence Scale (TDiCoS; Yılmaz Ergül & Taşar, 2023). The positively worded items use five response options, from Never (1) to Always (5). Total scores range from 19 to 95; higher scores indicate greater self-reported competence. Means and standard deviations summarize the data. Independent-samples t-tests compare gender and institutional management, while one-way ANOVA followed by Tukey's HSD assesses educational-level differences. The significance threshold was set at alpha = .05. The questionnaire measures reported behavior, not observed digital skills.

DATA ANALYSIS

Table 1. Digital competence scores by gender (independent-samples t-test)

Groups	n	Mean	S.D.	t test
Male	40	57.83	16.96	2.03
Female	60	64.78	16.73	(df = 98)

Note. Two-sided test; significance threshold alpha = .05.

Female respondents had higher mean scores (M = 64.78, SD = 16.73) than male respondents (M = 57.83, SD = 16.96). The difference was statistically significant, $t(98) = 2.03$, $p \approx .045$, with an estimated Cohen's d of 0.41. This result describes the recruited sample; it does not establish that gender causes differences in digital competence.

Table 2. Digital competence scores by institutional management (independent-samples t-test)

Groups	n	Mean	S.D.	t test
Government	33	56.52	18.86	2.34
Private	67	64.81	15.51	(df = 98)

Note. Two-sided pooled-variance test; significance threshold alpha = .05. Values are reconstructed from rounded summary statistics.

Respondents from private institutions reported higher scores (M = 64.81, SD = 15.51) than those from government institutions (M = 56.52, SD = 18.86). Using the pooled-variance t-test consistent with 98 degrees of freedom, the rounded summary statistics yield t(98) ≈ 2.34, p ≈ .021, with an estimated Cohen's d of 0.50. This association does not show whether institutional resources, training opportunities, or differences in respondent composition account for the difference.

Table 3. Descriptive statistics for digital competence scores by educational level

S.No	Type of Institution	N	Mean	S.D.
1	School	68	64.35	15.97
2	College	26	59.42	16.34
3	University	6	46.50	25.10

School respondents formed the largest subgroup (n = 68), followed by college respondents (n = 26) and university respondents (n = 6). The university group's small size and comparatively large standard deviation (SD = 25.10) require caution in interpreting between-level contrasts.

Table 4. One-way ANOVA of digital competence scores by educational level

ANOVA					
Sources of Variance	Sum of Squares	df	Mean Squares	F	P Value
Between Groups	1990.62	2	995.31		
Within Groups	26931.38	97	277.64	3.5849	0.031475
Total	28922.00	99			

A one-way ANOVA identified an overall difference in scores across educational levels, F(2, 97) = 3.58, p = .031. The estimated proportion of variance associated with the grouping factor was eta squared = .069. Tukey's HSD was used for the reported pairwise comparisons. Because group sizes were unequal, particularly at university level, these inferential results should be interpreted as exploratory; homogeneity-of-variance checks were not reported.

Table 5. Tukey HSD comparisons of digital competence scores across educational levels

Tukey HSD Post-Hoc Test Results					
Comparisons	Diff	SE	Q	P value	Significant (α = .05)
School vs College	4.9299	2.7168	1.8146	0.408084	No
School vs University	17.8529	5.0178	3.5579	0.035739	Yes
College vs University	12.9231	5.3363	2.4217	0.205744	No
Critical Q (α = .05): 3.3661 | k = 3, df = 97					

Tukey's HSD indicated a statistically significant difference between school and university respondents (mean difference = 17.85, p ≈ .036). The comparisons between school and college respondents (p ≈ .408) and between college and university respondents (p ≈ .206) were not statistically significant. These findings do not support a general ranking of all three educational levels, especially given that only six respondents were in the university subgroup.

FINDINGS

H01 was rejected at the .05 level: female respondents had higher mean self-reported digital competence scores than male respondents in this sample.

H02 was rejected at the .05 level: respondents from private institutions had higher mean scores than those from government institutions in this sample.

H03 was rejected for the omnibus ANOVA. In Tukey comparisons, only the school–university difference was statistically significant; the other two pairwise differences were not.

DISCUSSION

GENDER AND SELF-REPORTED DIGITAL COMPETENCE

The first finding was a difference in self-reported digital competence between female and male respondents. Women obtained a higher mean score (M = 64.78, SD = 16.73) than men (M = 57.83, SD = 16.96), with t(98) = 2.03, p = .045. The estimated standardized difference (Cohen's d approximately 0.41) suggests a modest separation between the two groups in the recruited sample. Its interpretation should remain proportionate to the evidence. The difference concerns responses to a frequency-based questionnaire rather than a direct assessment of teachers' performance on digital teaching tasks. It also does not establish that gender explains the observed variation, because other characteristics that might influence competence were not held constant.

The mixed findings in the existing literature reinforce the need for a contextual interpretation. Choudhary (2024) and Suhag and Talreja (2026) reported gender-related patterns broadly compatible with the present direction of difference, whereas Ahmad et al. (2024), Meher et al. (2025), and Zhao et al. (2021) identified male advantages in the populations they studied. Other studies found no statistically significant gender differences (Anand & Sapna, 2024; Cantú-Ballesteros et al., 2017; Jafari et al., 2024). These differences across studies should not be reduced to a claim that one set of findings is correct and another is not. The samples include teachers from different educational settings, and the studies may differ in how they define, measure, or aggregate digital competence. Comparisons are therefore informative about variability across contexts but cannot establish a universal gender pattern.

Several explanations are possible but cannot be tested using the available group summaries. Teachers' previous training, access to devices, teaching subjects, professional responsibilities, and everyday opportunities to use digital tools could each be associated with questionnaire scores. The present analysis did not estimate these relationships. Accordingly, the practical response should not be to presume that male or female teachers require uniformly different support. An institutional needs assessment that examines specific instructional tasks and individual skill gaps would be a more defensible basis for allocating professional development. Future analyses could examine whether the observed gender difference remains after accounting for experience, age, subject specialization, institutional setting, and relevant digital-learning opportunities.

INSTITUTIONAL MANAGEMENT AND DIGITAL COMPETENCE

The second finding concerns the type of institutional management. Respondents employed in private institutions had a higher mean digital competence score (M = 64.81, SD = 15.51) than those employed in government institutions (M = 56.52, SD = 18.86). The difference reconstructed from the reported summary statistics was t(98) approximately 2.34, p approximately .021, with an estimated Cohen's d of 0.50. This indicates a moderate difference in the surveyed sample, not an effect attributable to private management itself. The groups were unequal in size (67 private and 33 government respondents), and recruitment through professional contacts could have influenced which teachers from each sector participated.

The result is consistent in direction with comparisons reported by Choudhary (2024) and Kumar and Sharma (2024), although Chaudhary et al. (2026) did not find a statistically significant management-type difference in their study. Venumadhav and Sarsani (2022) also considered institutional and background characteristics in relation to ICT competence. Taken together, this literature suggests that

the distinction between public and private management is worth examining, but the label alone may conceal more specific organizational conditions. Access to equipment, connectivity, technical assistance, institutional expectations, and opportunities for continuing professional development are possible influences; the present survey did not measure those factors directly, and no explanatory pathway can be inferred from the observed mean difference.

For educational institutions, the finding offers a reason to examine the conditions in which teachers work rather than to assume that one sector is uniformly better prepared. A practical assessment could map access to reliable internet, shared digital resources, pedagogical training, and ongoing technical support before selecting interventions. Government and private institutions could both benefit from support tailored to actual teaching demands and available infrastructure. Research using more representative recruitment and measuring these organizational characteristics would help determine whether management type remains associated with competence once the relevant contextual variables are included. Since institutional management may overlap with educational level and other teacher characteristics, their separate influences cannot be identified from the present unadjusted comparisons.

DIFFERENCES ACROSS EDUCATIONAL LEVELS

The third finding was an overall difference in digital competence across school, college, and university respondents, $F(2, 97) = 3.58$, $p = .031$, with an estimated eta-squared value of .069. The group means were 64.35 for school teachers, 59.42 for college teachers, and 46.50 for university teachers. Nevertheless, the omnibus result does not imply that every educational level differs from the others. In the reported Tukey analysis, only the school-university comparison was statistically significant (p approximately .036); the school-college and college-university comparisons were not. These nonsignificant comparisons should not be interpreted as evidence that the respective groups possess equivalent competencies.

The school-university contrast requires particular caution. Only six university respondents were included, compared with 68 school respondents and 26 college respondents, and the university group's standard deviation was comparatively large (25.10). This imbalance makes its mean and the resulting pairwise comparison potentially sensitive to a small number of observations. The manuscript also does not report tests of homogeneity of variance or alternative procedures for unequal variances. Consequently, the reported ANOVA and Tukey results are best regarded as exploratory until assumptions can be checked against the original data. The finding should not be converted into a general claim that university teachers have poorer digital competence than school teachers.

An additional issue is whether all educational levels understand and encounter the questionnaire items in the same way. Teachers in schools, colleges, and universities may use digital technologies for different combinations of classroom instruction, communication, assessment, content production, and student support. Tzafilkou et al. (2023) emphasize pedagogical and professional components in the assessment of teachers' digital competence, suggesting that measurement should attend to teaching context. The current study did not examine measurement equivalence across institutional levels or identify which specific digital practices account for the difference. Larger, more balanced samples, instrument reliability estimates for each subgroup where feasible, and comparisons based on comparable teaching tasks would therefore strengthen future evidence.

INTERPRETATION, PRACTICAL IMPLICATIONS, AND STUDY LIMITATIONS

Across all three analyses, the central contribution is the identification of group differences in scores obtained with the same 19-item instrument, rather than the demonstration of mechanisms responsible for those differences. Digital competence is not a single observable skill: it can involve finding and

evaluating resources, communicating digitally, creating materials, and integrating technology with pedagogy. Studies by Althubyani (2024), Tzafilkou et al. (2023), and Singh et al. (2025) examine different dimensions and contexts of digital competence, while Majeed et al. (2025) consider the relevance of digital literacy and ICT self-efficacy for functional skills. This broader literature helps explain why overall questionnaire scores are useful for an initial comparison yet insufficient to establish which particular teaching competencies require improvement.

A proportionate policy implication is to combine periodic assessment with training matched to instructional needs. Rather than applying a uniform training package based on gender, sector, or institutional level, educational administrators could examine where teachers need support in designing digital lessons, managing online assessment, creating accessible materials, or using learning platforms. Peer mentoring and practical workshops may be appropriate options, but their effectiveness should be evaluated rather than assumed. Short pre- and post-training assessments, supplemented where possible by demonstrations of classroom-relevant tasks, would provide stronger evidence about learning outcomes than group means from a one-time self-report survey. The present findings can inform questions for such evaluations; they do not demonstrate the effectiveness of any particular intervention.

The study's methodological limitations place clear boundaries around its interpretation. The purposive and snowball sample was not randomly selected, so the results cannot support population estimates or nationwide generalizations. Gender, institutional management, and educational level were examined in separate comparisons without adjustment for potential confounders or analysis of their overlap. The study relied on self-report measures; reliability for the current sample and relevant statistical assumption checks were not reported. The relatively small university subgroup and the near-threshold p-values for some comparisons warrant additional caution, particularly because multiple group comparisons were conducted. These limitations do not invalidate the descriptive findings, but they indicate that replication, transparent reporting of instrument performance, and a more balanced sampling design are needed before the observed patterns can be considered robust across educational settings.

CONCLUSION

This survey identified differences in self-reported digital competence across gender, institutional management, and educational level within a sample of 100 teachers. Higher average scores were observed among female respondents and among respondents from private institutions. The overall comparison by educational level was also significant, although only the school–university pair differed significantly in the reported post-hoc test.

The results should be considered exploratory. Purposive and snowball recruitment prevented probability-based generalization; the university subgroup was very small; and the analysis did not control for age, experience, subject area, technology access, or institutional characteristics. The study relied on self-report and did not report reliability estimates for the current sample or checks of ANOVA assumptions. These limitations mean that the observed group differences cannot be interpreted as causal effects or assumed to hold across all teachers and institutions.

Future research should use larger, more balanced samples and report instrument reliability and assumption checks. The present findings may nevertheless help motivate needs-based digital competence assessments and professional development across institutional settings.

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CONFLICT OF INTEREST

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