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Strengthening Teacher Professionalism in the Digital Era: A Meta-Analysis of Digital Competence and Creativity as Drivers of Contextual Performance

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Abstract: Strengthening Teacher Professionalism in the Digital Era: A Meta-Analysis of Digital Competence and Creativity as Drivers of Contextual Performance. Objectives: This study aims to synthesize empirical findings on the relationships among digital competence, creativity, and teachers' contextual performance through a systematic literature review and meta-analysis. **Methods:** A total of 26 empirical articles published between 2020 and 2025 were selected using the PRISMA protocol and established inclusion criteria. Among these, fourteen studies investigated the relationship between digital competence and contextual performance, whereas twelve studies examined the relationship between teacher creativity and contextual performance. Effect sizes were extracted as correlation coefficients (r), and all analyses were conducted using JASP. **Findings:** The meta-analysis results indicated that digital competence had a positive and significant effect on teachers' contextual performance (ES = 0.061; Z = 3.625; $p < .001$). The effect size was small, which can be explained by the fact that digital competence is only one factor among various determinants of contextual behavior, such as intrinsic motivation, creativity, and organizational commitment. However, this small effect remained consistent across studies, indicated by non-significant heterogeneity (Q = 0.875; p = 1.000). This finding indicates that digital competence continues to contribute to teachers' adaptability, collaboration, and proactive behavior in digital work contexts. The validity of this estimate was strengthened by Egger's test (p = 0.350), which indicated the absence of publication bias. Analysis of teacher creativity also showed a positive and significant effect on contextual performance (ES = 0.067; Z = 3.305; $p < .001$). Despite being a small effect, creativity consistently contributed to variations in teachers' contextual behavior, particularly in initiative, teamwork, and engagement in non-instructional activities. The homogeneity across studies supports the stability of this relationship. **Conclusions:** Overall, these findings confirm that digital competence and creativity play essentials supporting roles in shaping teachers' contextual performance in the digital education era. Both reinforce adaptive, collaborative, and contribution-oriented professional behavior, thus providing an empirical basis for strategies to improve teacher professionalism that are more relevant to the demands of the modern education ecosystem.

Keywords: digital competence; teacher creativity; contextual performance; meta-analysis.

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INTRODUCTION

In the past two decades, the dynamics of education have required teachers to not only carry out formal instructional tasks but also demonstrate extra-role behaviors that support the social and organizational sustainability of schools (Meyers et al., 2020). These behaviors are known as contextual performance, which includes a willingness to help colleagues, active involvement in school activities, and an open attitude to change and continuous professional learning (Yang et al., 2009). Contextual performance is a crucial dimension of teacher professionalism because it directly contributes to the formation of a collaborative work culture and an innovative climate in schools (Widodo, 2024).

However, various empirical findings indicate that teachers' contextual performance has not yet developed optimally across various educational contexts. Teachers still face challenges in maintaining professional collaboration, adapting pedagogical practices to changing demands, and proactively engaging in school initiatives. These challenges are increasingly prominent in the context of rapid technological change, particularly following the pandemic, when schools are faced with the need to balance digital transformation with organizational cohesion (Rapanta, 2020). If this situation persists, the impact could include weakened professional interactions, limited pedagogical innovation, and a decline in teachers' contributions to sustainable school development (Lee et al., 2025). Recent research also confirms that the underachievement of teachers' contextual performance remains a real problem across various education systems (Rozimela et al., 2025).

In the context of these changes, digital competence has emerged as a central construct in contemporary educational studies. Post-pandemic, the understanding of digital competence has undergone a significant shift. Digital competence is no longer viewed solely as technical skills in using technological devices, but rather as a multidimensional capacity encompassing pedagogical, professional, and collaborative dimensions (Redecker, 2020). This framework positions digital competence as a crucial foundation for the quality of learning and professional interactions between teachers in the school environment.

In line with these conceptual developments, recent research has increasingly focused on mapping teachers' digital competencies using validated instruments and multidimensional measurement models. Various studies have attempted to systematically identify domains of teachers' digital competencies to obtain a more accurate picture of their readiness to face the demands of technology-based learning (Batanero et al., 2021). Efforts to improve these instruments are also ongoing, including the development of measurement tools with strong validity across content and pedagogy (Almenara, 2023). However, the diversity of educational contexts necessitates cross-cultural and cross-system validation to ensure broader reliability of digital competency measurements (Núñez, 2024).

Beyond definition and measurement issues, research also shows variations in teachers' digital competency levels across regions, disciplines, and educational levels. This variation reflects differences in access to resources, professional development opportunities, and institutional policy support (Dai et al., 2024). While these findings provide important insights into teachers' digital readiness, most research continues to focus on technology use and instructional readiness. The contribution of digital competency to teachers' extra-role behaviors within the school organization, as part of contextual performance, has rarely been explicitly examined (Vanegas et al., 2025).

In addition to digital competence, teacher creativity is also positioned as a crucial factor in professional performance. Creativity relates to

teachers' ability to design innovative learning strategies, adapt instructional approaches to diverse student needs, and respond flexibly to complex classroom situations (Han & Abdrahim, 2023). In practice, creativity impacts not only the quality of learning but also teachers' contextual behaviors, such as sharing ideas, helping colleagues, and contributing to school development.

Recent literature suggests a link between creativity and digital competence, particularly as technology opens up new opportunities for pedagogical innovation (Hämäläinen, 2024). Several studies indicate that technological mastery can expand teachers' creative expression, although these findings largely stem from higher education contexts and require further testing in school settings (Guillénet al., 2024). Furthermore, debate continues regarding the role of creativity in teacher performance. Some studies view creativity as a direct antecedent of professional effectiveness, while others suggest that the influence of creativity is highly dependent on environmental conditions, such as institutional support, collegial collaboration, and resource availability (Hu et al., 2021).

Overall, previous research suggests that the relationship between digital competence, teacher creativity, and contextual performance has a strong conceptual foundation, but the available empirical evidence remains fragmented. Most studies are correlational, conducted in diverse contexts, and use heterogeneous measurement instruments. This makes it difficult for researchers to draw general conclusions about the strength, direction, and consistency of the relationships between variables. Furthermore, few studies simultaneously examine the contributions of digital competence and creativity to teacher contextual performance or analyze variation in effect sizes across studies (Zomer, 2024).

This fragmentation underscores the need for a more systematic and quantitative synthetic approach. This approach is necessary to integrate empirical findings from various research contexts, identify consistent patterns of relationships, and explain variation in findings through relevant mediating and moderating factors.

To address this gap, this study conducted *a Systematic Literature Review* (SLR) and a meta-analysis to synthesize empirical evidence on the relationships among digital competence, teacher creativity, and contextual performance. This study aimed to map the effect sizes of relationships among variables, identify commonly used measurement indicators, and examine mediating and moderating factors, such as institutional support, self-efficacy, and technology access, that could explain variation in findings across studies. In doing so, this study seeks to go beyond narrative reviews and provide a stronger empirical basis for understanding teachers' contextual performance in contemporary education systems.

This introductory section concludes with the formulation of research questions that serve as the guide for the meta-analytic analysis, namely: (1) to what extent is the strength and direction of the relationship between digital competence and teachers' contextual performance based on the meta-analysis findings, and what are the practical implications of a small but statistically significant effect size; (2) how does teacher creativity influence contextual performance across educational and research contexts, and to what extent is this influence consistent based on meta-analytic evidence; and (3) what measurement indicators are used in the literature for digital competence, teacher creativity, and contextual performance, and what factors mediate or moderate the relationship between these variables, thus explaining the variation in effect sizes across studies. This formulation ensures that the meta-analysis is systematically directed at uncovering empirical patterns, methodological diversity, and conceptual gaps relevant to the

development of teacher professional development research and policy.

METHOD

Research Design

Based on a summary of previous research, studies on the direct contribution of digital competence and creativity to teachers' contextual performance have indeed increased. However, the available empirical evidence remains scattered and fragmented. Most studies are individual correlational studies that use different instruments and contexts, making the results difficult to generalize. Still, little research systematically examines how these two variables, digital competence and creativity, work simultaneously to foster teachers' extracurricular roles, creating a theoretical and empirical gap that needs to be bridged (Zomer, 2024).

Meta-analyses such as those in this study are necessary because narrative reviews alone are insufficient to synthesize variation in effect sizes, examine heterogeneity across studies, and detect potential publication bias. Rational guidelines for using meta-analyses and systematic reviews are outlined in the PRISMA 2020 statement, which provides a transparent and standardized framework for identifying, selecting, and synthesizing the literature (Page et al., 2021).

Search Strategy

This methodology allows for estimation of pooled effects, testing the consistency of findings, and verifying publication bias through tests such as the Egger test. Therefore, this study provides an original contribution compared to previous narrative reviews. Regarding the use of local sources or national indexes (e.g., publications from Indonesian-language journals or those indexed in SINTA), the literature search remains focused on major curated international databases (such as Scopus, Web of Science, and ERIC). In contrast, Google Scholar or SINTA are used only as a supplement to ensure no relevant studies are missed. This combined approach is permissible provided that screening, documentation, and quality assessment are carried out consistently and have been recognized in the methodological literature as strategies to minimize publication bias and address database coverage limitations (Heck et al., 2024).

Data from the selected articles were extracted using a standard format containing author, year, objectives, methods, variables, and key findings. Next, data items relevant to the digital competence→ creativity→contextual performance relationship model were selected. All stages of the SLR-from criteria determination and literature selection to extraction are summarized in Table 1 as a brief overview of the research process.

Table 1. Stages of SLR research

Stages	Activity
1. Determination of Inclusion Criteria (IC)	IC1: Articles in the form of scientific journals or seminar proceedings. IC2: Publication year is within the range 2020–2025, considering this period represents the most relevant phase of global digital transformation in education following the COVID-19 pandemic, when digital competence, teacher creativity, and contextual performance became central themes in empirical studies. IC3: The article has undergone peer review. IC4: Discuss at least one of the variables: *digital competence, teacher creativity, or contextual performance.* IC5: The type of article is empirical research or Systematic Literature Review (SLR)

	IC6: Written in English or Indonesian. IC7: Available in full text and accessible. IC8: Research subjects are teachers at any level of education.
2. Determination of Information Sources	A literature search was conducted across the following databases: Scopus, Web of Science, ERIC, DOAJ, Google Scholar, and SINTA 1–3.
3. Literature Selection Process	(1) Initial identification using a combination of keywords: *digital competence, digital literacy, ICT skills, teacher creativity, creative teaching, instructional innovation, contextual performance, extra-role behavior.* (2) Initial screening based on title, abstract, and keywords according to inclusion criteria. (3) Further screening by reading the full text.
4. Implementation of the 2020 PRISMA Flow	(1) Records identified: 236 articles obtained from Scopus, Web of Science, ERIC, DOAJ, Google Scholar, and SINTA. (2) Duplicate records removed: 48 articles, resulting in 188 unique records for screening. (3) Title and abstract screening: 188 records were screened, of which 148 records were excluded based on irrelevance to the research variables and inclusion criteria, leaving 40 articles for full-text assessment. (4) Full-text eligibility assessment: 40 full-text articles were assessed for eligibility, and 14 articles were excluded due to insufficient statistical data, non-empirical design, and non-teacher research subjects. (5) Studies included in the final synthesis: 26 articles were included in the systematic literature review and meta-analysis.
5. Data Extraction	Data extraction using a form containing: author name, year, country, research design, variables studied, instruments, main findings, and contributions to the contextual digital competence–creativity–performance model.
6. Data Item Selection (DI)	DI1: Operational definition of digital competence and teacher creativity. DI2: Indicators of digital competence and teacher creativity. DI3: Dimensions of teacher contextual performance. DI4: Research methods used. DI5: Main findings about the pattern of relationships between variables.
7. Data Analysis Stage	Meta-analysis was conducted using JASP.
8. Synthesis and Reporting	The results were analyzed and narratively synthesized based on patterns of variable relationships, the mediating role of creativity, and research gaps. Reporting adheres to the PRISMA 2020 standards for transparency, accuracy, and replicability.

Data Analysis Stage

Data analysis was conducted using JASP. The meta-analysis in this study used the Random-Effects Model, recognizing that the effect sizes reported in the analyzed studies are not identical but vary due to differences in research context, sample characteristics, measurement instruments, and institutional settings. This model was chosen because it is better suited to synthesizing heterogeneous educational research results.

The main statistics extracted from each study included the correlation coefficient (r) and

sample size (N). If a study reported statistics in other formats, such as t-values, F-values, or Cohen's d, these statistics were converted to the correlation coefficient r so that all effect sizes were on the same scale and could be analyzed comparatively. The conversion procedure followed the standard formula available in the meta-analysis toolkit in JASP.

The pooled effect size was calculated by weighting each study's variance. To assess heterogeneity between studies, the Q and I^2 statistics were used, which indicate the extent to which variation in effect sizes is due to fundamental differences between studies rather than sampling error. Additionally, potential publication bias was evaluated through visual inspection of funnel plots and Egger's statistical test available in JASP.

Population and Research Sample

The population in this study comprises all international and national scientific articles that discuss teachers' digital competence, teacher creativity, and contextual teacher performance. The databases used include: Scopus, Web of Science (WoS), ERIC, DOAJ, Google Scholar, and Sprott 1–3. The sampling technique used is purposive sampling, with the following inclusion criteria: a) articles published in the 2020–2025 range b) contain the main variables of the research: digital competence, teacher creativity, and contextual performance c) type of empirical article or systematic review (not opinion/editorial) d) written in English or Indonesian e) articles are available in full text and can be accessed.

From the initial search results of 236 articles, as many as 26 articles met the inclusion criteria and were used as research samples. This number is considered representative because it reflects variations in the relevant educational context, country, and school level

Procedure Study

This research procedure follows a Systematic Literature Review (SLR) approach, with sequential steps that include establishing inclusion and exclusion criteria, determining information sources, developing a literature search strategy, screening articles, and extracting and processing data. The entire process is designed to be consistent with the PRISMA 2020 standards (Page et al., 2021).

The first stage began by establishing inclusion and exclusion criteria to ensure the selected articles were relevant to the research focus: the relationship between digital competen, teacher creativity, and contextual performance. These criteria served as the initial basis for filtering the literature before conducting a in-depth review.

The second stage is to determine the sources of information, namely credible international and national databases Scopus, Web of Science, ERIC, DOAJ, Google Scholar, and SINTA 1–3. The third stage is the literature search strategy, namely, the use of a combination of predetermined keywords.

The fourth stage is the literature selection process, which includes removing duplicates, screening titles and abstracts, and reviewing the full text of articles. The fifth stage is data extraction, using a standard format containing the author, year, research variables, methods, instruments, and main findings. The final stage is the selection of data items relevant to the *digital competence→teacher creativity →contextual performance relationship model*. A summary of the inclusion and exclusion criteria is shown in Table 2.

Table 2. Inclusion and exclusion criteria

Inclusion Criteria (IC)	Exclusion Criteria (EC)
IC1. Articles are *journal articles* or *conference papers* that have gone through a *peer-review process*.	EC1**.** Articles in the form of editorials, opinion pieces, books, unindexed proceedings, or grey literature.

IC2. Published in the period 2020–2025.	EC2**.** Published before 2020.
IC3**.** Discuss at least one of the variables: digital competence**,** teacher creativity, or contextual performance.	EC3. Does not touch on the main variables or is not relevant to the research focus.
IC4. The research subjects are teachers at primary, secondary, or higher education levels.	EC4. Subjects are not teachers (e.g., students, pupils, managers, or non-teaching staff).
IC5. The article is empirical research or **a** Systematic Literature Review (SLR).	EC5. Articles are not research-based (e.g., conceptual papers without data).
IC6**.** Available in full text and accessible.	EC6. The article is not available in full text or only displays the abstract.
IC7**.** Written in English or Indonesian**.**	EC7. Written in another language that cannot be verified.
IC8 =**.** Contains data or findings related to the relationship between digital competence, creativity, or contextual performance.	EC8. Does not contain relationships between variables or does not present empirical findings.

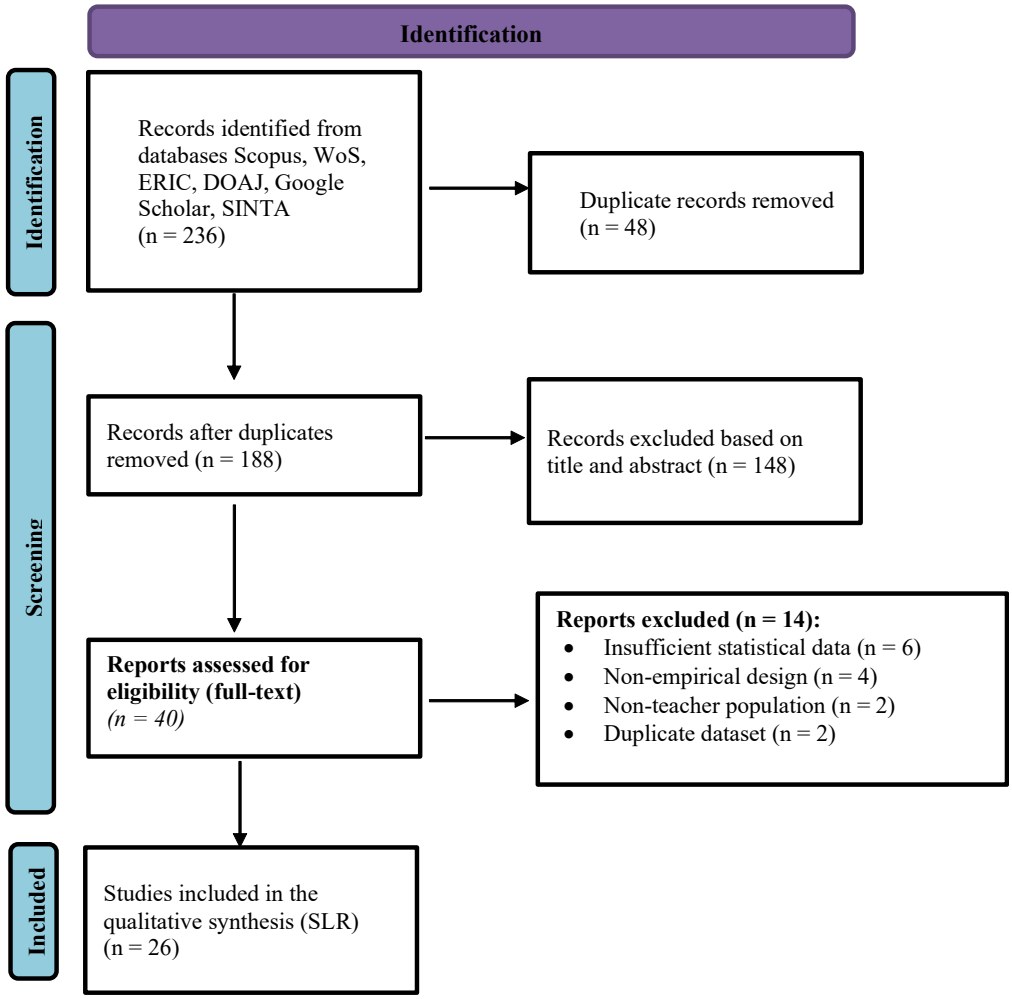


Figure 1. PRISMA flowchart

The identification, screening, and selection of articles in this study followed the PRISMA guidelines, an international standard for conducting transparent, structured systematic reviews (Elsman et al., 2024). Each stage of the process, from the initial search of multiple databases through the removal of duplicate articles, title and abstract screening, and a complete eligibility assessment, was systematically conducted and documented in accordance with the principles of systematic reporting (Haddaway et al., 2022). Figure 1 summarizes the overall data collection flow, including the number of articles identified, screened, excluded, and ultimately included in the final synthesis. This flow ensured that only articles meeting methodological quality and substantive relevance were used in this study (Q. Yang et al., 2024).

RESULT AND DISCUSSION

Digital Competence towards Contextual Performance

This meta-analysis is based on 14 studies that met all inclusion criteria and reported empirical relationships between digital competence and teachers' contextual performance, expressed as correlation coefficients (r). All studies used a uniform effect size reporting format, allowing effect sizes to be used directly without requiring transformation from other statistics, such as t- or F-values. The initial inspection indicated that all reported correlation values were consistent with meta-analysis reporting standards and warranted further analysis.

The results of the inter-study heterogeneity test are presented in Table 3. Subsequently, residual heterogeneity estimates and the pooled effect size calculated using the random-effects model are reported in Table 4. These results serve as the basis for assessing both the magnitude and consistency of the relationship between digital competence and contextual performance.

The results of the inter-study heterogeneity test are presented in Table 3. The omnibus test of model coefficients indicates that the overall model is statistically significant. In contrast, the test for residual heterogeneity yields a Q value of 0.875 (p = 1.000), suggesting no significant residual heterogeneity among the included studies.

Table 3. Heterogeneity test

	Q	df	p
Omnibus test of Model Coefficients	13.140	1	< .001
Test of Residual Heterogeneity	0.875	13	1.000

Table 4. Residual heterogeneity estimate

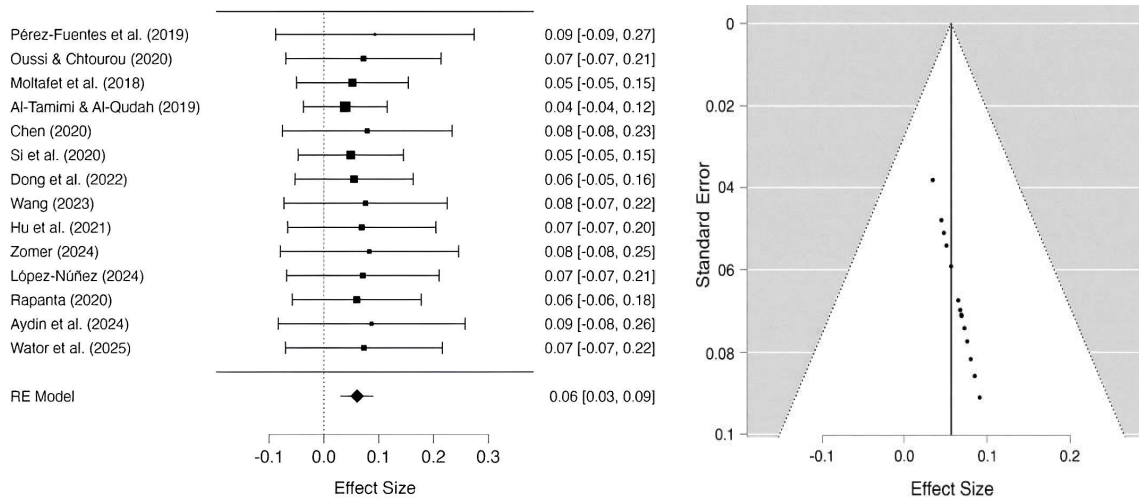
					95% Confidence Interval	
	Estimate	Standard Error	z	p	Lower	Upper
intercept	0.061	0.017	3.625	< .001	0.028	0.094

The results of the random-effects model are reported in Table 4. The analysis reveals a significant positive relationship between digital competence and teachers' contextual performance (Z = 3.625; p < .001), with the 95% confidence interval entirely above zero. This finding confirms that digital competence makes a statistically significant contribution to contextual performance, particularly in relation to adaptability, collaboration, initiative, and prosocial behavior in the workplace.

The resulting combined effect size (ES = 0.061) was low but statistically significant. Although the effect size was relatively small, the consistent positive direction of the relationship across research contexts suggests that digital

competence serves as an important foundation for teachers' contextual performance. The practical impact of digital competence can be even stronger when supported by other factors, such as creativity, professional motivation, and a collaborative work climate.

To clarify the results of the combined effect size estimation and potential publication bias evaluation, the meta-analysis results are also presented as graphical visualizations in the form of forest and funnel plots (Figure 2).



(a) (b)

Figure 2. (a) The forest plot of meta-analysis and (b) The funnel plot after trim-fill diagnostic

Figure 2(a) presents a meta-analysis forest plot used to visualize the pooled effect estimates and the variation in effect sizes across studies. This forest plot shows that most studies have a positive directional relationship between digital competence and contextual performance, with effect sizes scattered around the pooled estimate. This pattern indicates consistency in the direction of the relationship across studies and strengthens the reliability of the meta-analysis findings.

Next, Figure 2(b) displays the funnel plot used to evaluate potential publication bias. The distribution of points on the funnel plot shows a relatively symmetrical pattern around the pooled estimate, indicating no tendency to report only studies with large or significant effect sizes selectively. To verify this visual finding, an Egger regression test was performed as an additional diagnostic step. Therefore, Egger's regression test was performed as an additional verification step. The results are presented in Table 5 below.

Table 5. Regression test for funnel plot asymmetry ("egger's test")

	z	p
sei	0.936	0.350

The Egger test results are presented in Table 5 and show a *p -p-value* of 0.350, which is above the 0.05 significance threshold. This finding indicates the absence of significant publication bias in the meta-analysis of the relationship between digital competence and teachers' contextual performance. The relatively small *z-value*, close to zero, also supports the symmetry pattern observed in the funnel plot.

Overall, the consistent direction of the effects in the forest plot and the absence of any indication of publication bias suggest that the pooled effect size estimates are stable and reliable. Thus, the results of this meta-analysis provide strong empirical support for the claim that digital

competence positively influences teachers' contextual performance. Although the effect size is relatively small, these findings confirm the role of digital competence as an important foundation that can potentially be strengthened through other mediating factors, such as creativity, self-efficacy, and professional motivation.

Moderator Analysis of Digital Competence on Contextual Performance

Although the heterogeneity test results indicated that between-study variation was not statistically significant, these findings should be interpreted with caution, given the relatively limited number of studies. Therefore, an exploratory moderator analysis was conducted to explore possible sources of variation in effect sizes not captured by the global heterogeneity test.

Moderator analysis was conducted by grouping studies based on four categorical characteristics, namely: (1) subject education level (primary/secondary education versus higher education), (2) geographic context of the study (Asia versus Europe/America), (3) type of digital competency measurement instrument (multidimensional versus non-multidimensional framework-based instrument), and (4) year of publication. Grouping publication years into the categories d"2021 and e"2022 is intended as an analytical approach to distinguish studies in the early phase of the digital transformation of education from those in the post-pandemic phase, without changing the research inclusion range, which still covers the period 2020–2025. A summary of the moderator analysis results is presented in Table 6.

Table 6. Summary of moderator analysis for digital competence on contextual performance

Moderator Variable	Subgroup Comparison	Direction of Effect	Statistical Significance
Education Level	Elementary/Intermediate vs. High	Positive in both groups	Not significant
Geographical Context	Asia vs. Europe/America	Positive in both groups	Not significant
Instrument Type	Multidimensional vs. Non-multidimensional	Higher on multidimensional instruments	Not significant
Publication Year	≤2021 vs. ≥2022	Relatively stable	Not significant

The results of the moderator analysis indicate that there were no statistically significant differences in effect sizes between moderator subgroups. Across all moderator categories, the relationship between digital competence and contextual performance remained positive, although the effect sizes were relatively small and showed limited variation.

Descriptively, effect sizes tended to be higher in studies conducted in higher education and in studies using measurement instruments based on a multidimensional framework. This pattern indicates that the complexity of the institutional context and the depth of operationalization of digital competence can strengthen the observed relationships. However, the differences did not reach statistical significance.

The insignificance of these moderator results is likely due to low statistical power, given the limited number of studies in each subgroup. Therefore, these results are more appropriately interpreted as indicating the stability of the relationship between digital competence and contextual performance across contexts, rather than as evidence of an absence of contextual variation between studies.

Creativity towards Contextual Performance

This meta-analysis of the relationship between creativity and contextual performance

was based on 12 studies that met the inclusion criteria and reported the empirical relationship between the two variables as a correlation coefficient (r). All studies used a uniform effect size reporting format, so no conversion from other statistics was required. Preliminary checks ensured that all correlation values were consistent with meta-analysis reporting standards.

The results of the inter-study heterogeneity test and the corresponding random-effects model estimates are presented in Table 7 and Table 8, respectively. Table 7 reports the omnibus test of model coefficients and the test of residual heterogeneity to assess the consistency of effect sizes across studies. In contrast, Table 8 presents the pooled effect estimate and confidence interval from the random-effects model, which serve as a basis for evaluating the strength and stability of the relationship between creativity and contextual performance.

Table 7. Heterogeneity test

	Q	df	p
Omnibus test of Model Coefficients	10.924	1	< .001
Test of Residual Heterogeneity	1.059	11	1.000

Table 8. Residual heterogeneity estimate

					95% Confidence Interval	
	Estimate	Standard Error	z	p	Lower	Upper
intercept	0.067	0.020	3.305	< .001	0.027	0.107

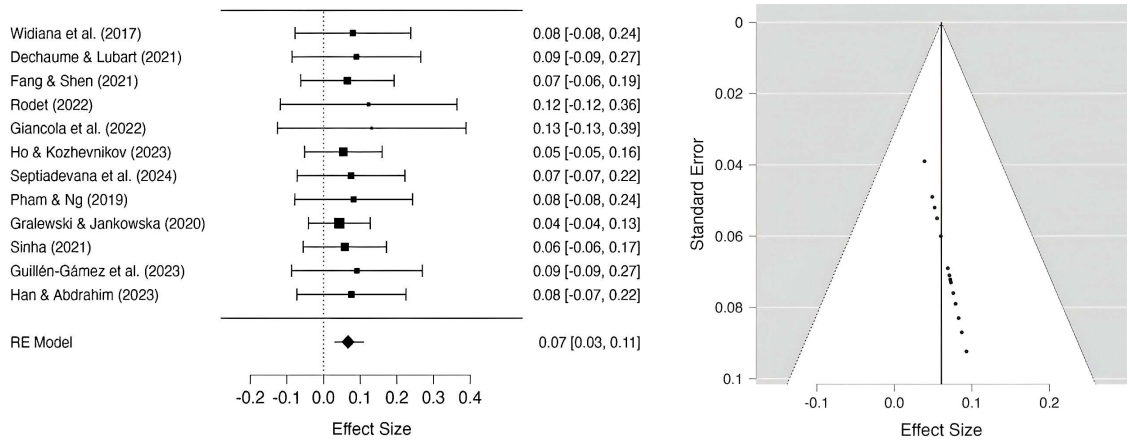
The results of the inter-study heterogeneity test are presented in Table 7. This test was conducted to assess the consistency of effect sizes across the analyzed studies. The omnibus test of model coefficients indicates that the overall model is statistically significant, while the test of residual heterogeneity yields a Q value of 1.059 ($p = 1.000$), indicating no significant residual heterogeneity across studies.

The residual heterogeneity estimates calculated using the random-effects model are presented in Table 8 and serve as the basis for evaluating the strength and stability of the relationship between creativity and contextual performance.

The random-effects model results in Table 8 indicate a significant positive relationship between creativity and contextual performance ($Z = 3.305$; $p < .001$), with the 95% confidence interval entirely in the positive direction. These findings confirm that creativity significantly improves teachers' contextual performance, including adaptability, cooperation, initiative, and prosocial behavior within the organization.

The pooled effect size (ES = 0.067) indicates a positive relationship in the low category and is statistically significant. This result suggests that teacher creativity is consistently associated with contextual performance across studies, although the magnitude of the association remains modest. The statistical significance primarily reflects the consistency of a small effect across multiple samples rather than a large substantive effect within any single context.

To further illustrate the distribution of effect sizes and assess the robustness of the findings, Figure 3(a) presents the forest plot of the meta-analysis, while Figure 3(b) displays the corresponding funnel plot used to examine potential publication bias.



(a) (b)

Figure 3. (a) The forest plot of meta-analysis and (b) The funnel plot after trim-fill diagnostic

The forest plot in Figure 3(a) visualizes variation in effect sizes across studies in a meta-analysis of the relationship between creativity and contextual performance. This visualization shows that most studies have a consistent, positive effect direction and do not deviate significantly from the pooled estimate. This pattern indicates that creativity's contribution to contextual performance is relatively stable across contexts and sample characteristics.

To assess potential publication bias, a funnel plot is presented in Figure 3(b). The scatterplot shows a relatively symmetrical distribution, indicating that study results are not dominated by reports of large or significant effect sizes alone. This visual finding was then statistically confirmed using Egger's regression test.

Table 9. Regression test for funnel plot asymmetry regression test for funnel plot asymmetry

	z	p
sei	1.029	0.304

The Egger test results in Table 9 show a p-value of 0.304, which is greater than the 0.05 significance threshold. This value indicates the absence of significant publication bias in the analyzed study set. The relatively small *z-value*, close to zero, also supports the conclusion that the funnel plot regression follows a symmetrical pattern.

The funnel plot's symmetry and the consistent direction of the effects in the forest plot indicate that the variation in effect sizes across studies is reasonable and representative. Thus, the estimated joint effect size between creativity and contextual performance can be considered reliable. Overall, these results support the conclusion that creativity has a positive and significant influence on teachers' contextual performance, although the strength of this influence is relatively small. This finding confirms that creativity is more appropriately understood as a supporting factor that complements other individual and organizational conditions.

Moderator Analysis of Creativity on Contextual Performance

As with the digital competency analysis, an exploratory moderator analysis was conducted for the relationship between creativity and contextual performance. Studies were categorized by educational level, geographic context, type of creativity measurement instrument, and year of publication (d"2021 versus e"2022) to explore possible variations in effect sizes across contexts. A summary of the moderator analysis results is presented in Table 10.

Table 10. Summary of moderator analysis for creativity on contextual performance

Moderator Variable	Subgroup Comparison	Direction of Effect	Statistical Significance
Education Level	Elementary/Intermediate vs. High	Positive in both groups	Not significant
Geographical Context	Asia vs. Europe/America	Positive in both groups	Not significant
Instrument Type	Multidimensional vs. Non-multidimensional	Higher on multidimensional instruments	Not significant
Publication Year	≤2021 vs. ≥2022	Relatively stable	Not significant

The results of the moderator analysis indicate that there are no statistically significant differences in effect sizes between moderator subgroups. Across all moderator categories, the relationship between creativity and contextual performance remains positive, although the effect sizes are relatively small.

Descriptively, effect sizes tend to be higher in higher education studies and in studies using creativity instruments based on a multidimensional framework. This pattern suggests that creativity functions as a stable supporting factor, but its influence on contextual performance depends heavily on contextual conditions and accompanying organizational support.

The meta-analysis results indicate that digital competence is positively associated with teachers' contextual performance. Although the effect size was small (ES = 0.061), the consistency of findings across studies indicates that digital competence remains an important foundation for the emergence of prosocial, adaptive, and collaborative behaviors in school settings. This small effect size may be explained by the complex nature of contextual performance, as teachers' extra-role behaviors are influenced by numerous other factors, such as professional motivation, organizational support, and collaborative school culture variables that are not always present simultaneously across studies. Thus, digital competence plays a role more as a fundamental prerequisite than as a primary determinant of contextual performance.

These findings provide an important contribution to the existing literature. Previous studies have emphasized that digital competence supports teacher collaboration and innovation, but most have only described the relationship conceptually (Gámez et al., 2024). This meta-analysis strengthens the empirical evidence that digital competence is indeed related to contextual behavior, although the effect is not significant in practical terms. This small but significant effect suggests that digital competence serves as a foundation for positive teacher behavior, especially when combined with other factors such as creativity, self-efficacy, or school leadership support. Therefore, these results deepen our understanding that strengthening digital competence needs to be placed within a more holistic framework to significantly improve its impact on contextual performance.

These findings align with Redecker (2020) definition of digital competence, which emphasizes teachers' ability to use technology effectively, critically, and ethically in professional contexts. Teachers with high digital competence are better able to integrate technology into learning activities and professional collaboration, thus supporting contextual behaviors such as sharing learning resources, assisting colleagues, and supporting school policies and programs.

Research by Suzer & Koc (2024) and Aydin et al. (2024) also confirms that digital competence is not only technical, but also pedagogical and collaborative. This means that

mastery of technology allows teachers to be more involved in socio-organizational activities, which are the core of contextual performance as formulated by (Pischetola et al., 2023), Panakaje et al. (2024), and Rohaeni & Aulia (2024). Digitally proficient teachers are more likely to adapt to curriculum changes, participate in school initiatives, and demonstrate dedication to developing the learning environment.

Consistent with global findings, Momdjian et al. (2025) demonstrated that digital competencies strengthened through ongoing training can enhance collaboration between teachers. Núñez (2024) also confirmed that digital competency is positively correlated with teachers' social participation. In the post-pandemic context, these findings are relevant to (Rapanta, 2020) research, which shows that digital aspects are now an integral part of contextual behaviors, such as sharing online resources, providing emotional support within professional networks, and maintaining digital learning communities.

Integrating the meta-analysis results with the literature reveals a consistent pattern: digital competence strengthens contextual performance by enhancing teachers' ability to collaborate, take initiative, and adapt. Thus, these findings support the conclusion that digital competence positively influences teachers' contextual behavior.

A second meta-analysis evaluating the relationship between creativity and teacher contextual performance showed that, although the combined effect size was very small (ES = 0.067), creativity still contributed to variations in contextual behaviors such as initiative, collaboration, and work dedication. This suggests that creativity functions as a supporting factor rather than a primary determinant, as teachers' contextual performance is also shaped by other variables, such as professional competence, motivation, school leadership, and a supportive work environment. This finding aligns with empirical studies showing that creativity does have a positive relationship with teacher performance, but the effect tends to be moderate and often requires contextual support to be practically meaningful (Serang et al., 2023).

Despite its small contribution, creativity still plays a role in shaping teachers' prosocial and professional behaviors, such as adaptability and the development of innovative learning methods. This small effect size indicates that creativity does not operate independently but requires additional support, including ongoing training, a collaborative culture, and teacher well-being, to contribute optimally to contextual performance. Thus, strategies to improve teacher performance in schools should combine creativity development with strengthening the work environment and supporting professional policies (Ferawati & Purba, 2024). This integrated approach aligns with the literature, which confirms that teacher creativity is multidimensional and heavily influenced by the school's social, organizational, and cultural contexts.

Theoretically, creativity in the educational context serves as a key driver of pedagogical innovation (Han & Abdrahim, 2023). Sanchis et al. (2025) emphasize that creativity encompasses originality and effectiveness, enabling teachers to develop engaging, meaning learning experiences. Creative teachers are better able to create new learning strategies, solve problems flexibly, and adapt teaching approaches to students' needs, all of which are concrete forms of contextual performance as described by Da'as (2023), Geel et al. (2023), and Rohaeni & Aulia (2024).

In a micro context, Novak et al. (2024) introduced the concept of *mini-c creativity,* which shows that everyday creativity in classroom routines has a significant impact on teachers' adaptive and collaborative behavior. This is in line with the findings of Juliadi et al. (2023) who showed that creativity strengthens teachers' ability to collaborate, adapt, and demonstrate concern for colleagues and students.

Maor et al. (2025) research confirms that creativity can be approached in two ways: *teaching creatively* and *teaching for creativity*, both of which enhance teacher engagement in school social activities. Furthermore,Hämäläinen (2024) emphasizes digital creativity as a new form of creativity that emerges from the integration of technological capabilities with pedagogical innovation. In this context, digital creativity enables teachers to engage more actively in online professional communities, sha learning resources, and initiate cross-platform collaborations.

From an organizational perspective, Kaya (2024) and McChesney & Cross, (2023) assert that teacher creativity strengthens a collaborative and innovative culture in schools. Creative teachers demonstrate high levels of organizational loyalty, a willingness to help colleagues, and enthusiasm for implementing school programs, hallmarks of contextual performance.

The link between creativity and contextual performance is fully reinforced by the *Componential Theory of Creativity (Salinas et al., 2025)*, which explains that creativity emerges from a combination of expertise, intrinsic motivation, and environmental support. Meanwhile, Fischer & Barabasch (2023) emphasize that creativity is a multidimensional phenomenon that interacts with the school's culture and organizational structure, thereby significantly influencing teachers' contextual behavior.

Overall, the results of the quantitative meta-analysis and qualitative literature review indicate that creativity not only influences learning but also shapes teachers' broader behavioral patterns within the school organization. Thus, creativity is shown to be a statistically significant but practically limited contributor to contextual performance, indicating that creativity should be positioned as a supporting component within broader teacher professional development efforts rather than as a primary determinant

Research Implications

The meta-analysis findings indicate that digital competence and creativity play a crucial role in improving teachers' contextual performance. The primary implication for education is the need to strengthen teachers' digital literacy through ongoing training and adequate technological support. Mastery of technology has been shown not only to improve learning effectiveness but also to encourage teachers to be more collaborative, adaptive, and to actively contribute to various social and organizational school activities.

Furthermore, teacher creativity needs to be facilitated through school policies that support innovation, pedagogical freedom, and a collaborative work culture. Creativity has been proven to strengthen teachers' initiative, collaboration, and ability to respond to the dynamics of the work environment. Therefore, educational institutions need to build an ecosystem that encourages the integration of digital competencies and creativity to improve teachers' professional performance in the digital education era.

■ CONCLUSION

The meta-analysis results indicate that digital competence has a positive, statistically significant relationship with teachers' contextual performance, based on 14 studies ($Z = 3.625$; $p < .001$; $ES = 0.061$). Although the observed effect size is small, this finding suggests that teachers' ability to use technology effectively continues to play a meaningful role in fostering contextual behaviors, such as professional collaboration, work initiative, and support for organizational goals within schools. Accordingly, digital competence can be understood as a professional foundation that reinforces teachers' extra-role behaviors, even though it does not function as a dominant factor that directly determines the level of contextual performance.

The meta-analysis also demonstrates that creativity is positively and statistically significantly associated with teachers' contextual performance, albeit with a very small effect size. This finding confirms that creativity contributes to variations in contextual behavior, particularly in terms of adaptability, pedagogical innovation, and teachers' engagement in non-instructional activities. However, the small effect size indicates that creativity does not operate as an independent or primary predictor. Rather, it functions as a supporting factor whose influence becomes more meaningful when combined with positive psychosocial conditions, supportive school leadership, and a collaborative work culture.

The consistency of measurement indicators across studies shows that digital competence is generally operationalized through DigCompEdu domains, including professional engagement, the use of digital resources, and teaching and learning practices. Creativity is commonly measured along the dimensions of fluency, flexibility, and originality, while contextual performance is characterized by interpersonal facilitation and job dedication. Variations in findings across studies indicate the presence of mediating and moderating factors, such as intrinsic motivation, leadership, collaborative culture, and organizational support, that may strengthen or weaken the relationships among the examined variables.

Publication bias assessments using Egger's test yielded p-values of 0.350 and 0.304, indicating no significant evidence of publication bias. These results further support the statistical stability of the meta-analysis findings. Overall, both digital competence and creativity contribute significantly to teachers' contextual performance; however, their practical significance remains limited. Consequently, neither variable should be positioned as the sole strategic focus in efforts to enhance contextual performance.

Based on these findings, improving teachers' contextual performance requires a more comprehensive approach. The development of digital competence and creativity should be integrated with initiatives to strengthen teachers' intrinsic motivation, foster a collaborative work culture, and promote visionary instructional leadership. Teacher professional development programs, therefore, should not focus exclusively on individual skill acquisition, but also on creating supportive work environments that encourage extra-role behaviors as a foundation of 21st-century teacher professionalism.

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