

DIGITAL COMPETENCIES AND TEACHER RESILIENCE AS PREDICTORS OF ACADEMIC PERFORMANCE IN B-LEARNING ENVIRONMENTS: EMPIRICAL EVIDENCE FROM UNIVERSITY FACULTY IN PERU

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ABSTRACT

This study examines the relationship between teachers' digital competencies and resilience with academic performance in B-learning environments, adopting a quantitative, correlational, and non-experimental design. Validated instruments were administered to a sample of university faculty, assessing instrumental, didactic-methodological, and cognitive dimensions, as well as socio-emotional factors linked to resilience. The statistical models demonstrated strong goodness of fit, supporting that both variables are significantly associated with academic outcomes. Digital competencies showed a positive effect by combining technological proficiency with innovative pedagogical strategies, while resilience—particularly in areas such as prosocial bonds, clear boundaries, and institutional support—fostered student engagement and motivation. These findings underscore the importance of institutional policies that integrate continuous professional development, the strengthening of teacher resilience, and the promotion of collaborative environments in order to optimize academic performance in hybrid learning modalities.

Keywords: Digital competencies, teacher resilience, academic performance, B-learning, higher education.

INTRODUCTION

The rules governing classrooms and academic life are managed by teachers, who bear responsibility for planning and implementing educational activities, whether in traditional or virtual formats, with differentiated outcomes depending on their choice (Fahrurrozi et al., 2020). At a global scale, inequalities in the use of Information and Communication Technologies (ICT) persist; nevertheless, demonstrating proficiency in digital resources has become essential both in academic and everyday contexts. In the aftermath of the COVID-19 pandemic, the transition from face-to-face instruction to virtual modalities profoundly transformed the educational landscape, thereby consolidating digital technology as a pivotal resource for learning (Varghese & Mandal, 2020) and as a fundamental enabler of opportunities for students (Santos-Caamaño et al., 2021). However, the effectiveness of employing digital skills to migrate from in-person to remote teaching is not invariably assured (Area et al., 2020; Sánchez et al., 2021), which in turn necessitates the competent use of educational platforms (Swaminathan et al.,

2021; Fahrurrozi et al., 2020). Within this context, the development of teachers' digital competences emerges as decisive for success in non-presential modalities.

At the global level, the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2023a) reported that 94 million teachers are engaged in basic and higher education, of whom 37% express resistance to the incorporation of technological tools into their teaching practices. Each year, 28 million receive digital training; nevertheless, only 16 million effectively implement these resources in the classroom (UNESCO, 2023b). Furthermore, UNESCO and the Teacher Task Force (2024) emphasized that, in 62 countries, the lack of technological infrastructure within educational institutions exacerbates teachers' difficulties in adapting to digital demands. Likewise, UNESCO (2023c) clarified that this scenario demonstrates that resistance is not solely attributable to individual factors but is also rooted in structural conditions that constrain the digital transformation process in education (UNESCO, 2023d). In Latin America, the Economic Commission for Latin America and the Caribbean (ECLAC, 2022) underscored that 12 million teachers work across different educational levels, of whom 42% encounter difficulties in integrating technological platforms into their daily teaching practices. Within the region, 4.8 million have received training in digital competences; nevertheless, only 2.9 million effectively apply these tools in their pedagogical practice (Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura [OEI], 2022). Moreover, UNESCO (2023c) pointed out that, in 11 countries, school connectivity gaps hinder the adoption of virtual learning environments. In the same vein, UNESCO (2023d) explained that resistance to change is associated not only with insufficient training but also with perceptions of work overload and the persistence of traditional teaching models that still prevail in fragmented educational systems. In the Peruvian case, the Ministry of Education of Peru (MINEDU, 2023) reported that 620,000 teachers are part of the national education system, of whom 248,000 exhibit resistance to the use of digital resources in the classroom. Each year, 135,000 teachers participate in technological training programs; nevertheless, only 89,000 effectively succeed in incorporating these tools into their pedagogical practice (ECLAC, 2022). Furthermore, the OEI (2022) noted that, in 17 regions of the country, connectivity limitations in rural schools significantly reduce the possibility of adaptation. Consequently, MINEDU (2023) emphasized that this scenario reveals that the integration of educational technologies faces obstacles arising both from structural deficiencies and from teachers' own disposition toward change.

At the local level, private universities continue to face limitations in the use of digital tools by faculty, largely conditioned by the availability of resources within academic institutions. Although such restrictions foster resilience to change, they simultaneously hinder instruction and compromise academic performance. The B-learning modality seeks to explore the nexus between teachers' digital competence and perseverance in teaching; nevertheless, significant challenges remain in enhancing skills and ensuring instructional quality. The efficient use of digital competence thus requires both interaction and willingness on the part of teachers and students. The analysis focuses on the relationship between technology and teaching–learning processes as reflected in student performance, thereby interpreting the barriers encountered by educational actors in the post-pandemic context and reinforcing the transition toward virtual education with positive outcomes. This study is justified by its contribution to the knowledge society and to university learning, insofar as it critically questions current theories on teachers' digital skills and perseverance, while offering practical alternatives to bridge existing gaps. Adopting a positivist, quantitative, and deductive approach, it enables the verification of significant relationships between the study variables, thereby positioning the educational community at the forefront of its formative processes.

Based on the foregoing, the following overarching research question arises: To what extent do digital competences and teacher resilience influence the teaching and learning process through the B-learning model at a university in Arequipa, Peru? Its primary purpose is to determine the degree to which digital competences and teacher resilience affect the instructional and learning process under the B-learning approach. In addition, the specific research problems are formulated as follows: To what extent do the dimensions of the variables—digital competences and teacher resilience—influence the teaching and learning process within the B-learning model?

In this case, the specific objectives are as follows: to determine the extent to which the dimensions of the variables—teachers' digital competences and teacher resilience—influence the instructional and learning process through the B-learning model. Accordingly, the general hypothesis is formulated as follows: teachers' digital competences and resilience exert a significant influence on the teaching and learning process under the B-learning approach; moreover, the particular characteristics that have a relevant impact on this process are the dimensions of digital competences and teacher resilience.

THEORETICAL FRAMEWORK

Digital competence, defined by Silva et al. (2016) as essential for twenty-first-century teachers, drives both curricular transformations and changes in students. The European Commission acknowledges eight strategic competences for the knowledge society, among which digital competence is understood as the creative, critical, and safe use of ICT for academic and professional purposes (INTEF, 2017; Council of the European Union, 2018). This framework establishes five core areas: information and information literacy, communication and collaboration, digital content creation, security, and the dissemination of educational content through virtual platforms.

Factors such as the generational gap and limited internet access condition the use of digital competences among teachers (Franky & Chiappe, 2018). Quintana's model (2000), grounded in UNESCO's (2020) criteria, distinguishes technical, methodological, and social skills. Ayala (2018) further classifies them into instrumental, cognitive, and didactic–methodological approaches, integrating strategies to foster innovation in teaching, critically assess the use of ICT, and promote more interactive learning. Instrumental competences encompass technological skills applied to academic innovation and management. Didactic–methodological competences involve the use of tools to deliver classes, exchange content, and select appropriate software, thereby implementing virtual environments and linking ICT with everyday experiences. Cognitive–attitudinal competences include the critical evaluation of technological use, methodological reflection, and the analysis of educational situations on both theoretical and practical grounds (Quintana, 2000).

Resilience is defined as the capacity to confront adversity and reorganize oneself (Anaut, 2016); although its origin lies in physics, it has been applied in psychology as the effective management of difficulties in order to prevent their recurrence (Gershon, 2021). Within Wagnild and Young's (1993) theory, salient factors include equanimity, perseverance, self-confidence, personal satisfaction, and emotional independence. Gershon (2021) further argues that resilience integrates personal competence with life acceptance. In the professional sphere, Harvard and Merino (2019) consider it a key criterion in personnel selection, whereas Dorantes (2018) underscores its strategic value for business sustainability. According to Serna et al. (2017), resilience entails adaptive renewal in the face of change. Wedell (2020) emphasizes that difficulties are not always controllable; therefore, resilience becomes a differentiating factor of success.

Henderson and Milstein (2003) identify six dimensions of resilience: strengthening prosocial bonds, establishing clear boundaries, acquiring life skills, providing affection and support, raising expectations, and fostering meaningful participation. These dimensions are assessed through indicators such as interaction, acceptance of policies, continuous training, recognition, motivation to surpass goals, and active involvement in institutional decision-making, thereby promoting innovation and teacher commitment. The teaching and learning process, according to MINEDU (2019), entails consolidating concepts and adapting them to real-world contexts. Academic performance, defined by Cano and Robles (2018), depends on factors such as family environment, economic resources, and motivation. Lamas (2015) conceives it as a multidisciplinary concept focused on evaluating student progress. The ERCE, coordinated by UNESCO, measures competences in reading, mathematics, and science across Latin America, thus providing data to strengthen educational policies (MINEDU, 2019).

Siemens' (2005) connectivist theory argues that knowledge is constructed through connections between individuals and digital resources. It emphasizes that the value of knowledge lies in the relationships among nodes and that learning must be continuous, constantly adapting to social and technological changes. This approach prioritizes the ability to learn how to learn and the strategic management of information across diverse contexts, thereby complementing other learning theories. In practice, connectivism fosters collaborative virtual environments and knowledge networks that integrate both human and digital resources. Siemens (2005) further contends that education should prepare individuals to adapt to a constant flow of information, using interaction and connection as the cornerstones of learning. This theory reinforces the centrality of digital skills, resilience, and adaptive strategies in educational and professional contexts, integrating technology and collaboration as pivotal axes.

While digital competence, resilience theory, and connectivism provide distinct yet complementary perspectives, the present research integrates these frameworks into a unified conceptual model. This model assumes that teachers' digital competencies (instrumental, didactic–methodological, and cognitive) and resilience dimensions (prosocial bonds, boundaries, life skills, support, expectations, and participation) operate synergistically to influence the teaching–learning process in B-learning environments. Connectivism acts as the theoretical bridge, highlighting that knowledge construction emerges through the interaction of technological skills and socio-emotional resources. By articulating these dimensions into a single framework, the study advances beyond fragmented approaches and establishes a comprehensive basis for analyzing how technological and psychological factors jointly predict academic performance.

PREVIOUS STUDIES

Research on teachers' digital competences has progressively revealed both strengths and persistent challenges. Garzón-Artacho et al. (2021) found that, in a sample of 140 university teachers, most achieved intermediate or high levels of digital competence, although differences across knowledge fields highlighted the need for systematic training in ICT. Similarly, Smestad et al. (2023) reported that 58% of higher education teachers self-assessed their competence as intermediate and only 15% as high, with stronger skills in communication than in content creation. Both studies converge on the existence of a training gap that limits the integration of digital tools into pedagogy.

Experimental and quasi-experimental research reinforces these findings. Lan et al. (2024) demonstrated that structured online training improved digital competence scores by 25% among 300 teachers, particularly in information management and online security. In the same vein, Antonietti et al. (2022) reported a strong positive correlation ($r = 0.68$) between digital self-efficacy and ICT use, underlining the importance of confidence as a mediating factor in technology adoption. These studies indicate that effective professional development can significantly enhance digital integration in hybrid learning environments.

Theoretical perspectives also enrich this discussion. Chiu et al. (2024), drawing on self-determination theory, showed that autonomy, competence, and relatedness mediated the impact of institutional support on competence development, thereby validating an explanatory model that even included AI-related skills. Similarly, Bong and Chen (2024), through a systematic review of 16 studies, concluded that incorporating accessibility criteria into teacher training increased self-perceived digital competence by up to 72%, stressing the role of equity and inclusion. Gender differences were also documented by Guillén-Gámez et al. (2021), who found significant disparities in technological anxiety and ethics across 1,704 Spanish university teachers, pointing to the need for targeted training to reduce gaps.

Complementary strategies have been examined through micro-interventions. Trujillo-Juárez et al. (2025) revealed that microcourses improved deficient areas of digital competence by up to 30%, especially in ICT management and security. Zhao et al. (2021), in a large systematic review of 1,410 articles, found that both teachers and students maintain basic levels across several dimensions despite the adoption of frameworks such as DigComp. Together, these studies suggest that while global frameworks exist, sustained and adaptive training strategies are necessary to reach advanced levels of competence.

At the national level, Apaza (2022) evidenced a moderate yet significant relationship ($R^2 = 0.7755$) between teachers' digital competences and students' grade point averages, reinforcing their role in academic achievement. Likewise, Suárez et al. (2020), analyzing the "Beca 18" program, reported high scores in competences such as generating new content and fostering learning autonomy through ICT, supporting the contribution of digital skills to academic performance. In contrast, Rojas et al. (2020) showed deficiencies among teachers of a Peruvian public university, with only 7.1% at a high level, and identified marked differences with students' competences, suggesting the urgency of bridging this gap across faculties.

Studies on resilience also offer important insights. Segovia et al. (2020), using a qualitative approach in rural Peru, found that resilience in teaching emerges from both environmental and attitudinal conditions, shaping teachers' responses to technological change. Quantitative research aligns with this view: Rodríguez and Holguín (2018) found moderate to strong correlations between resilience dimensions such as goal orientation ($r = .778$) and mathematics performance, while González (2021) highlighted uneven ICT competences, stressing the need for innovation in transitional contexts. However, Morgan (2021) reported no significant association between resilience factors and academic achievement, suggesting that resilience may operate differently depending on context. In contrast, Santiago et al. (2020) observed positive correlations between resilience-related motivation and academic performance, though with limited explanatory power (5.39%).

Finally, research linking resilience and digital competences shows their joint impact on educational processes. Revelo et al. (2019) demonstrated that ICT use alone does not guarantee improvements, as institutional policies and strategies are equally decisive. Vargas (2019) further confirmed a strong correlation ($R = 0.889$) between digital competences and their integration with teaching practices in higher education. Together, these findings emphasize that both technological and socio-emotional factors—when adequately supported institutionally—are crucial for optimizing academic outcomes in hybrid environments.

METHODOLOGY

This research is classified as basic in nature and aimed at generating new knowledge, adopting a quantitative approach under the hypothetico-deductive method. It achieved an explanatory scope by analyzing the statistical associations among digital competencies, teacher resilience, and academic performance, and was conducted through a non-experimental, cross-sectional design. The study population consisted of 250 faculty members from a private Peruvian university during the 2023 summer cycle, of whom 152 were selected through probabilistic sampling to ensure representativeness across academic areas.

Digital competencies were measured with 40 Likert-type items distributed in three dimensions—instrumental, didactic–methodological, and cognitive—while teacher resilience was assessed through 17 items covering six dimensions, including prosocial bonds, clear limits, autonomy, expectations, institutional support, and self-efficacy. Academic performance was operationalized using the institutional grading record, specifically the weighted average of students' final course grades under each teacher's responsibility, thus providing an objective measure independent of self-reported data.

The instruments underwent content validation by five expert judges, and construct validity was confirmed through exploratory factor analysis with adequate sampling adequacy indices (KMO) and significant Bartlett's tests of sphericity. Reliability was assessed using Cronbach's alpha and McDonald's omega, both of which yielded coefficients above 0.93, supporting high internal consistency.

The research procedure involved sensitizing participants, administering the questionnaires, tabulating the data in Excel, and processing them using SPSS v.27. Descriptive statistics such as means, standard deviations, and frequency distributions were generated, followed by correlational and multivariate analyses. When academic performance was treated as a continuous outcome, multiple linear regression was applied, reporting standardized coefficients, standard errors, significance levels, and adjusted R^2 . When categorized into high versus low performance, binary logistic regression was employed, reporting odds ratios, 95% confidence intervals, and pseudo- R^2 values (Nagelkerke and Cox & Snell). In all cases, results were interpreted as statistical associations rather than causal effects. Finally, the study complied with ethical principles related to responsible authorship,

confidentiality of academic records, and respect for intellectual property, with institutional authorization obtained and originality verified through similarity-detection software.

RESULTS

Subsequently, the descriptive results of both variables are presented.

Table 1 Overall teachers' digital competence

Competencies	Never	Almost Never	Sometimes	Almost Always	Always
Technological Tools (Instrumentals)	0 (0%)	11 (7%)	35 (23%)	85 (56%)	22 (14%)
Didactic–methodological	2 (1%)	19 (12%)	39 (25%)	47 (31%)	46 (30%)
Cognitive	4 (3%)	18 (12%)	36 (24%)	50 (33%)	45 (29%)
Teachers' digital Overall	0 (0%)	15 (10%)	35 (23%)	73 (48%)	30 (20%)

The analysis of the results reveals that the assessed teaching competencies exhibit a favorable trend, since the majority of respondents place them within the categories of almost always and always. In the case of instrumental competencies, more than half of the participants (56%) reported that they are frequently manifested, while 14% affirmed that they are always evident, thereby reflecting an acceptable performance, although 30% still perceive occasional limitations. With regard to didactic–methodological competencies, the results are distributed more evenly: 31% and 30% acknowledged their presence almost always or always, respectively. Nevertheless, 25% associated them with an intermediate frequency, and 12% reported a low recurrence. This suggests that, although a solid pedagogical management is generally observed, consistency in its application is not always fully achieved. With respect to cognitive competencies, the overall perception is likewise positive: 33% reported that they are present almost always and 29% that they are always observable, thereby accounting for 62% of favorable responses. Nevertheless, 36% identified them as sporadic or infrequent, which highlights the need to strengthen consistency in conceptual mastery and in teachers' reasoning capacity. Finally, digital competencies emerged as the most highly valued dimension, with 48% indicating their presence almost always and 20% recognizing them as always present, thus amounting to 68% positive appraisal. This finding demonstrates an adequate adaptation of teachers to the use of technological tools in teaching–learning processes, although 33% still perceive limitations in their application.

Taken together, the results make it possible to assert that the competencies under analysis are situated at intermediate to high levels, with digital competencies emerging as the most consolidated, followed by cognitive and didactic–methodological ones, whereas instrumental competencies, although positively evaluated, display a greater proportion of intermediate responses. These findings suggest that, although teachers demonstrate a solid competency profile, it remains essential to promote continuous training strategies aimed at strengthening cognitive and didactic–methodological competencies, thereby ensuring a more homogeneous and sustained pedagogical practice over time.

Table 2 Teachers' Overall Resilience

Dimensions of Resilience	Never	Almost Never	Sometimes	Almost Always	Always
Overall Resilience	2 (1%)	13 (8%)	34 (22%)	65 (42%)	39 (25%)
Prosocial Bonds	0 (0%)	8 (5%)	49 (32%)	63 (41%)	33 (22%)
Clear and Firm Boundaries	8 (5%)	21 (14%)	35 (23%)	42 (27%)	47 (31%)
Life Skills	1 (1%)	11 (7%)	21 (14%)	44 (29%)	76 (50%)
Affection and Support	2 (1%)	6 (4%)	57 (37%)	50 (33%)	38 (25%)
High Expectations	8 (5%)	21 (14%)	35 (23%)	42 (27%)	47 (31%)
Meaningful Participation	9 (6%)	11 (7%)	39 (25%)	44 (29%)	50 (33%)

The analysis of the variable Resilience makes it possible to identify a predominantly favorable pattern across the evaluated dimensions, with the categories almost always and always prevailing, thereby reflecting the presence of relevant protective factors within the analyzed population. In the case of prosocial bonds, 41% of respondents indicated that these are almost always present and 22% affirmed that they are always evident, reaching a 63% positive appraisal. Nevertheless, 32% reported that such bonds are manifested only sometimes, which underscores that the construction of supportive social relationships has not yet been uniformly achieved.

With regard to clear and firm boundaries, the results reveal that 27% of respondents identified them as almost always present and 31% as always evident, amounting to 58% positive perceptions. However, 37% perceived them with lower frequency, which indicates that not all environments foster consistent and shared norms. In terms of life skills, the findings are the most noteworthy: half of the respondents (50%) considered that these are always manifested and 29% that they are almost always present, reaching a 79% positive appraisal. This suggests that participants possess significant abilities to cope effectively with everyday life situations.

In turn, the dimension of affection and support exhibits a more heterogeneous distribution, with 37% perceiving its presence sometimes, 33% almost always, and 25% always. This implies that, although favorable emotional environments do exist, intermediate perceptions persist that may hinder the full development of resilience. With respect to high expectations, the data reveal that 27% reported them as almost always present and 31% as always evident, totaling 58% positive responses; nevertheless, 37% perceived them as irregularly manifested, thereby underscoring the need to strengthen both confidence and expectations regarding individual performance. Finally, meaningful participation recorded 29% in the category almost always and 33% in always, which together amount to a 62% favorable appraisal. However, 25% reported that it occurs only sometimes, thus highlighting that opportunities for active involvement are not yet fully consistent.

Overall, the variable Resilience reached 42% of responses in the almost always category and 25% in the always category, with 67% reporting favorable outcomes. These results support the assertion that resilience is situated at an intermediate-to-high level within the analyzed population, with clear strengths in life skills, although challenges remain in consolidating prosocial bonds, fostering affection and support, and establishing high expectations. Such findings suggest that the development of intervention programs aimed at reinforcing social networks, promoting active participation, and cultivating supportive emotional environments may significantly contribute to the comprehensive strengthening of resilience.

Subsequently, the inferential results are presented:

Table 3 Inferential Analysis

Hypothesis	Model	Log-Likelihood	Chi2	Degrees of Freedom	p-value
General Hypothesis	Intercept only	384.785	384.79	8	1.0322E-75
Specific Hypothesis 01	Intercept only	465.5818	465.58	11	8.9362E-93
Specific Hypothesis 02	Intercept only	482.2209	482.22	19	2.98E-90

General Hypothesis

Null Hypothesis: teachers' digital competencies (X1) and teachers' resilience (X2) do not exert a significant influence on the instruction and learning process (Y) through the B-learning model.

Alternative Hypothesis: Teachers' digital competencies (X1) and teachers' resilience (X2) exert a significant influence on the instruction and learning process (Y) through the B-learning model.

Specific Hypothesis 01

Null Hypothesis: The dimensions of the variable teachers' digital competencies (X1) do not exert an influence on the instruction and learning process (Y) through the B-learning model, Arequipa–2023.

Alternative Hypothesis: The dimensions of the variable teachers' digital competencies (X1) exert an influence on the instruction and learning process (Y) through the B-learning model.

Specific Hypothesis 02

Null Hypothesis: The dimensions of the variable teachers' resilience (X2) do not exert an influence on the instruction and learning process (Y) through the B-learning model, Arequipa–2023.

Alternative Hypothesis: The dimensions of the variable teachers' resilience (X2) exert an influence on the instruction and learning process (Y) through the B-learning model.

The results obtained indicate that, across the three hypotheses evaluated, the chi-square statistic presented high values (384.7850, 465.5818, and 482.2209, respectively), while the p-values were extremely small, all below 0.05 (1.0322E-75, 8.9362E-93, and 2.98E-90). Consequently, the null hypotheses were rejected in all cases. This outcome demonstrates that both teachers' digital competencies and teachers' resilience exert a significant influence on the instruction and learning process within the B-learning model in Arequipa–2023. Regarding the general hypothesis, evidence shows that the combination of both variables jointly explains a relevant proportion of the variability in academic outcomes. In Specific Hypothesis 01, it was confirmed that the dimensions of digital competencies alone produce significant changes in learning, which suggests that training and the effective use of technologies constitute a key factor for educational improvement. In Specific Hypothesis 02, the dimensions of teacher resilience displayed a statistically significant impact, reflecting that the faculty's ability to adapt and face challenges directly influences learning success. Taken together, these findings reinforce the need to strengthen

both technological competencies and socio-emotional skills among teachers in order to enhance academic outcomes in B-learning environments.

Table 4 Hypothesis Verification

Hypothesis	Cox y Snell	Nagelkerke	McFadden
General Hypothesis	0.9078	0.9313	0.6478
Specific Hypothesis 01	0.9523	0.9769	0.8298
Specific Hypothesis 02	0.9572	0.982	0.8583

The results of the correlation indicators for the three hypotheses evaluated provide evidence of a high level of model adjustment. In the general hypothesis, the values of Cox and Snell (0.9078) and Nagelkerke (0.9313) suggest strong predictive capacity when jointly considering teachers' digital competencies (X1) and resilience (X2). The McFadden value (0.6478) further supports the robustness of the model in educational contexts mediated by B-learning. In Specific Hypothesis 01, the coefficients are particularly elevated, with Cox and Snell at 0.9523, Nagelkerke at 0.9769, and McFadden at 0.8298, indicating that teachers' digital competencies are strongly associated with students' learning outcomes. Likewise, in Specific Hypothesis 02, which examines the dimensions of resilience, the results remain consistently high—Cox and Snell (0.9572), Nagelkerke (0.9820), and McFadden (0.8583)—suggesting that resilience shows a significant statistical association with academic performance, particularly by enabling teachers to adapt and respond to challenges in hybrid contexts. Taken together, these results point to statistically robust models with high levels of predictive association, underscoring the relevance of both digital competencies and resilience in optimizing learning within B-learning environments.

DISCUSSION

The overall analysis of the results confirms that teachers' digital competencies and resilience function as robust predictors of academic performance in B-learning environments, as evidenced by the high chi-square values ($X^2 = 384.7850$; $X^2 = 465.5818$; $X^2 = 482.2209$; $p < 0.05$) and Nagelkerke pseudo- R^2 coefficients exceeding 0.93. This explanatory power indicates that the simultaneous integration of technological and socio-emotional skills within the teaching profile substantially increases the likelihood of achieving improved outcomes in the teaching-learning process, thereby validating the general hypothesis of the study. These findings directly align with the claims of Garzón-Artacho et al. (2021), who documented that the presence of intermediate and high digital competencies—although still uneven across fields of knowledge—requires systematic reinforcement to optimize pedagogical impact. Along the same lines, Smestad et al. (2023) identified that teachers' self-perception of digital proficiency tends to cluster at intermediate levels, with stronger skills in communication than in content creation, which coincides with local evidence showing that, although instrumental and cognitive competencies reach modal frequencies of almost always, there remains significant room for development in dimensions related to didactic methodologies and digital production. The convergence of these results underscores the pressing need for continuous and differentiated training plans tailored to the specific competency dimensions.

The relevance of online training as a pathway for technological strengthening is reflected in the work of Lan et al. (2024), who demonstrated a 25% increase in overall digital competency scores following structured virtual courses. This pattern is consistent with the finding that the instrumental, didactic-methodological, and cognitive dimensions in the present study showed a high level of model fit (pseudo- $R^2 = 0.9769$), suggesting a strong statistical association between technological proficiency and learning achievements. Likewise, Antonietti et al. (2022) evidenced a strong positive correlation ($r = 0.68$) between digital self-efficacy and the use of ICT resources, which connects with the behavior observed in the dimensions of instrumental and cognitive competencies, whose coefficients in the model display significant influences at all levels. This parallel suggests that merely having access to technological tools is insufficient; rather, teachers' perceived mastery and confidence are decisive for their effective integration into pedagogical practice.

In this study, the didactic-methodological dimension presents significant coefficients at all levels, indicating that its reinforcement contributes both to the diversification of strategies and to the improvement of academic outcomes. From a theoretical perspective, Chiu et al. (2024) argue that the development of digital competencies is mediated by the fulfillment of needs for autonomy, competence, and relatedness within a framework of institutional support. The validity of this claim is reflected in the fact that, within the evaluated B-learning contexts, the impact of X1 on Y depends not only on technical ability but also on the presence of organizational environments that actively encourage its use.

In the field of inclusive education, Bong and Chen (2024) demonstrated that the integration of accessibility criteria into teacher training enhances the self-perception of digital competence by up to 72%, thereby reinforcing the idea that the quality of technological proficiency should be assessed not merely by the number of tools mastered but by their alignment with pedagogical principles of equity and inclusion. This perspective aligns with the findings of Guillén-Gámez et al. (2021), who identified significant gender-based differences in skills and resource quality, suggesting that training must incorporate equity-oriented approaches to close internal gaps. The effectiveness of

short and targeted interventions is further supported by Trujillo-Juárez et al. (2025), who reported a 30% improvement in deficient digital competencies through micro-courses. Given that the dimensions evaluated in the present study display frequency patterns in which almost always constitutes the modal category, the implementation of focused programs could consolidate the transition toward an always domain in a greater number of cases.

With respect to international trends, Zhao et al. (2021) cautioned that, in higher education, both teachers and students maintain only basic levels across several dimensions, even under widely recognized frameworks such as DigComp. This underscores that, despite high levels of statistical fit, such as those achieved here, the challenge of consolidating digital competencies in the long term through progressive training strategies remains unresolved. Regarding national antecedents, Apaza (2022) reported a significant relationship ($R^2 = 0.7755$) between digital competencies and academic performance, reinforcing the notion that ICT integration not only modernizes teaching but also renders it more effective. The results obtained in this study, with even higher pseudo- R^2 values, could be attributed to the joint incorporation of teachers' resilience as an explanatory factor. Suárez et al. (2020) demonstrated that competencies such as using information to generate new content, managing office software tools, and fostering learning autonomy contribute directly to academic performance, which corresponds to the statistical significance found in the three dimensions of Teachers' Digital Competencies. Rojas et al. (2020) complement this perspective by identifying discrepancies between teachers' and students' levels of mastery, a phenomenon that, if left unaddressed, could limit the full potential of the B-learning model.

With respect to resilience, the study found that its dimensions showed a high level of model fit (pseudo- $R^2 = 0.9820$), suggesting strong statistical associations with academic performance. Among them, prosocial bonds, clear and firm boundaries, affection and support, and opportunities for meaningful participation emerged as the most relevant predictors. This pattern mirrors the findings of Rodríguez and Holguín (2018), who reported moderate to high correlations between resilience factors and performance in mathematics. The absence of significance in life skills and high expectations may be related to what Morgan (2021) observed, as no significant correlations were found between resilience factors and university performance, although other studies, such as Santiago et al. (2020), argue otherwise, demonstrating positive associations between resilience and achievement, particularly when linked to motivation and task engagement. Segovia et al. (2020) provide a qualitative perspective, emphasizing that resilience also develops as a response to contextual conditions, ranging from socioeconomic factors to attitudes toward technological change. This perspective helps explain why dimensions such as prosocial bonds and clear and firm boundaries exert significant weight in the model, as they represent behavioral adaptations to a dynamic educational environment.

Revelo et al. (2019) emphasized that digital competence alone does not guarantee substantive improvements in learning without coherent policies and strategies, an observation that is particularly relevant for interpreting that, although teachers' digital competencies and resilience demonstrate high statistical significance, their effect is amplified in institutional environments that foster both dimensions in an integrated manner. Conversely, Vargas (2019) reaffirmed the significant relationship between digital competencies and learning in higher education, a finding that aligns with the core of this research and suggests that the current challenge is not merely to demonstrate correlation but to sustain it through continuous training programs that combine technological development with teacher resilience. Taken together, the discussion highlights that the effectiveness of the B-learning model does not depend solely on technological infrastructure but rather on the comprehensive preparation of teachers in both digital competencies and resilience, supported by institutional policies that promote pedagogical innovation, equity, and adaptability to changing environments.

Beyond statistical confirmation, the relationship between digital competencies and teacher resilience in B-learning environments can be understood as a synergistic interaction in which each dimension reinforces the other. In the post-pandemic context, technological proficiency not only enables access to and use of platforms but also functions as a catalyst for teachers' self-confidence and adaptability in the face of rapidly changing scenarios. Thus, a teacher with high digital competence is better equipped to transform unforeseen events into pedagogical opportunities, while a resilient teacher is more likely to explore and adopt new tools with greater agility, thereby reducing resistance to technological change. This interconnection acquires particular relevance in hybrid environments, where uncertainty regarding teaching conditions demands flexibility and immediate responsiveness. Resilience operates as a socio-emotional buffer that prevents exhaustion in the face of technological overload and the demands of asynchronous learning, whereas digital competencies provide the concrete means to sustain educational quality and continuity. Consequently, the joint impact observed in this study should not be interpreted merely as the sum of independent effects, but rather as the outcome of a reciprocal relationship that shapes a more robust teaching profile, better prepared to confront the educational challenges of the twenty-first century.

CONCLUSIONS

The findings of this study suggest that teachers' digital competencies and resilience are important predictors associated with academic performance in B-learning environments. The statistical models exhibited high levels of adjustment, as indicated by pseudo- R^2 values exceeding 0.90, which point to strong predictive associations rather than direct causal effects. In particular, the instrumental, didactic-methodological, and cognitive

dimensions of digital competence were positively and significantly related to academic outcomes, underscoring the relevance of training strategies that integrate both technological proficiency and innovative pedagogical use adapted to students' needs. Teacher resilience—understood as the capacity to adapt and cope with educational challenges—also emerged as a relevant construct, especially in dimensions such as prosocial bonds, clear boundaries, affection and support, and opportunities for participation. These aspects appear to foster a more favorable learning climate and are associated with greater student engagement and motivation. Conversely, the limited significance of life skills and high expectations points to the need to reconsider how these factors are developed and assessed within the studied context. Overall, the results highlight that the quality of teaching in B-learning environments cannot be reduced to the availability of technology alone but depends on the strategic interplay of digital competencies and socio-emotional skills. This integrated approach calls for institutional policies that prioritize continuous professional development, promote resilience, and encourage inclusive and collaborative environments, thereby enhancing learning opportunities and contributing to the sustainability of academic achievements.

Limitations and Future Research

This study presents certain limitations that should be taken into account when interpreting the results. First, the research was conducted in a specific geographical context—Arequipa—which may restrict the generalization of the findings to other regions with different socio-educational and technological characteristics. Likewise, the non-experimental design employed precludes the establishment of absolute causal relationships, limiting the conclusions to highly significant statistical associations. Another aspect concerns the use of self-reported instruments for the measurement of variables, which could introduce perception biases into the responses. With regard to future research, it would be pertinent to expand the sample to diverse regions and educational levels in order to assess the consistency of the results across heterogeneous contexts. Longitudinal designs are also recommended, as they would allow the analysis of the evolution of digital competencies and resilience over time, as well as their sustained influence on academic performance. Equally, the incorporation of mixed methods that combine quantitative measurements with qualitative analyses would be valuable, as this would deepen understanding of the perceptions, motivations, and barriers experienced by teachers when integrating technologies and resilience strategies. Finally, exploring the relationship between these variables and other factors—such as educational leadership, curricular innovation, or digital inclusion—could broaden the scope and applicability of the findings.

Based on the results, it is recommended that national and regional education policies prioritize the integration of teacher training programs that combine the development of digital competencies with strategies to strengthen resilience. For universities, this implies designing continuous professional development plans that include practical modules on technological tools, innovative didactic methodologies, and socio-emotional classroom management. Similarly, the implementation of institutional mentoring systems and teacher collaboration networks is suggested, as these would foster the exchange of best practices in B-learning environments. Such actions, supported by regulatory frameworks and specific budgets, would not only optimize academic performance but also consolidate an educational culture that is flexible, inclusive, and adapted to the challenges of the twenty-first century.

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