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RELATIONSHIP BETWEEN DIGITAL TOOLS AND ACADEMIC PERFORMANCE: A STATISTICAL APPROACH

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Summary
This study examines the relationship between the use of digital tools and academic performance in university students using a quantitative and statistical approach. A questionnaire was administered to 250 students from a Latin American university about their frequency and mastery of digital tools (online platforms, educational applications, collaborative networks, etc.), and their academic averages for the semester were collected. Correlation analysis (Pearson and Spearman), multiple linear regression, and structural equation modeling (SEM) were applied to evaluate the direct and indirect influence of mediating variables such as digital self-efficacy. The results show a moderate positive correlation between variables, and regression indicates that digital proficiency and self-efficacy explain a significant percentage of the variability in academic performance. It is concluded that the adequate incorporation of digital tools, together with training and support, can favor academic performance. Recommendations for educational institutions are proposed, as well as lines of future research.

Keywords: digital tools, academic performance, correlation, multiple regression, digital self-efficacy

Introduction

In recent years, the use of **digital tools** has established itself as a fundamental axis in the global educational transformation. Information and communication technologies (ICTs) have enabled new teaching modalities, facilitating access, personalization, and flexibility of learning processes (García & Rivera, 2021). The COVID-19 pandemic accelerated this process, causing educational institutions to massively adopt virtual learning environments, collaborative platforms, and mobile applications to maintain academic continuity (Sánchez & Castaño, 2022). This phenomenon generated a structural change in traditional pedagogical models, moving from teacher-centered approaches to autonomous and digitally mediated learning models (Viloan et al., 2024).

However, the real impact of these tools on **academic performance** is not always linear or positive. While some studies show a direct relationship between the use of digital tools and improved student performance (Casa-Coila, 2025; Zakir et al., 2025), others point out that its effectiveness depends on factors such as the student's digital competence, perceived self-efficacy, and the pedagogical integration of technologies (Meneses, Poenitz, & Rogel, 2023).

In many cases, the improper use of digital devices can even affect concentration, promote multitasking, and decrease academic productivity (Smith et al., 2021).

From a theoretical perspective, the concept of **digital competence** has been broadened to include not only technical skills, but also cognitive, ethical, and communicative aspects necessary to interact in digital environments effectively (Zakir et al., 2025). Thus, digital literacy involves more than the mere ability to use tools: it requires understanding their potential for knowledge management, collaboration and self-regulation of learning. In this sense, **digital self-efficacy** – the student's belief in their ability to use technologies successfully – is configured as a key mediator in the relationship between the use of digital tools and academic performance (Hoque et al., 2024).

Digital **informal learning** has also gained relevance as a complementary factor to formal learning. Platforms such as YouTube, online forums or MOOCs have become spaces where students expand their knowledge beyond the classroom, contributing to their autonomous and continuous training (Fernández & Cordero, 2023). However, the effectiveness of these environments depends on the student's ability to select reliable information and self-regulate their learning (Gutiérrez et al., 2022).

Despite theoretical advances, there is still a **significant methodological gap**: most studies on educational technology have been descriptive or qualitative, limiting the statistical and causal understanding of the relationship between variables (Comparative Analysis of Digital Tools..., 2024). Hence the need to use rigorous **statistical approaches**, which allow determining the magnitude and direction of the effects between the use of digital tools, mediating skills, and academic performance (Casa-Coila, 2025).

Therefore, the present study seeks **to quantitatively analyze** the relationship between digital tools and academic performance in university students, considering the mediating role of self-efficacy, competence and informal digital learning. This work is based on the hypothesis that greater use and mastery of digital tools is positively associated with better academic performance, as long as it is mediated by adequate digital literacy and self-efficacy (Zakir et al., 2025; Viloan et al., 2024). If this hypothesis is confirmed, the results could offer useful empirical evidence to **design more effective digital pedagogical strategies**, aligned with the needs and competencies of contemporary students.

Theoretical Framework

1. Digital tools and their role in contemporary education

The development of the digital society has radically transformed the teaching and learning processes. **Digital tools** —which include learning management platforms (LMS), mobile applications, multimedia resources, collaborative environments, and emerging technologies such as educational artificial intelligence—are today indispensable resources in academic ecosystems (García & Rivera, 2021).

These tools allow **interactivity**, **personalization of learning**, **immediate feedback,** and **temporal flexibility**, favoring student motivation and autonomy (Sánchez & Castaño, 2022). However, its impact depends to a large extent on the **pedagogical intentionality** and digital **skills** of the users.

Recent literature distinguishes three categories of digital tools used in higher education (Casa-Coila, 2025; Fernández & Cordero, 2023):

Table 1. Classification of digital tools in educational contexts (2020–2025)

Tool Type	*Examples*	*Educational purpose*	*Learning potential*
Learning Management (LMS)	Moodle, Blackboard, Canvas	Course organization, evaluation, communication	Improves academic management and individual follow-up
Collaborative applications	Google Workspace, Padlet, Miro, Trello	Group work, project management, co-creation	Promotes active learning and teamwork
Interactive Resources	Kahoot, Genially, Quizizz, Nearpod	Gamification and content reinforcement	Increases student motivation and participation

Source: Authors' elaboration based on García and Rivera (2021), Sánchez and Castaño (2022), and Casa-Coila (2025).

Various empirical studies confirm that the structured and planned use of digital tools has a significant relationship with the improvement of academic performance, especially when technological strategies are integrated into a coherent pedagogical model (Viloan et al., 2024).

2. Digital competence and technological literacy

The concept of **digital competence** has evolved from a purely technical approach to a multidimensional construct that includes knowledge, skills, and attitudes related to the critical and creative use of technologies (Hoque et al., 2024). According to the European Commission (DigComp 2.2, 2022), this competence comprises five dimensions: information literacy, communication, digital content creation, security, and problem-solving.

Digital competence has been shown to be a relevant predictor of academic success in virtual and mixed environments (Meneses et al., 2023). According to Gutiérrez, Muñoz, & Roldán (2022), students with higher levels of digital competence have better self-regulation and make more effective use of digital resources.

Table 2. Dimensions of digital competence and its academic impact

Dimension	*Description*	*Impact on academic performance*
Information Literacy	Ability to search, evaluate, and manage digital information.	Improve the quality of critical work and analysis.
Digital communication	Responsible interaction in virtual environments.	It favors collaboration and networking.
Digital Content Creation	Production of multimedia educational materials.	It encourages meaningful learning.
Digital Security	Data protection and ethical behaviour.	Increases trust and technological responsibility.
Troubleshooting	Creative use of tools to solve academic tasks.	Increases autonomy and efficiency.

Source: Adapted from DigComp (2022) and Hoque et al. (2024).

These findings suggest that educational institutions should promote **comprehensive digital literacy** programs, which not only teach how to use tools, but also develop critical thinking, digital ethics, and cognitive autonomy (Fernández & Cordero, 2023).

3. Digital self-efficacy and psychological mediation

Digital self-efficacy is defined as the student's confidence in their ability to effectively use technological tools to meet academic objectives (Bandura, 1997; taken up by Zakir et al., 2025). Recent research shows that this variable is a **statistically significant mediator** between the use of technologies and academic performance (Hoque et al., 2024).

In a meta-analysis of 48 international studies, Zakir et al. (2025) found that digital self-efficacy explains up to **35% of the variance in academic performance**, while superficial use of tools without adequate mastery does not produce noticeable improvements. This result coincides with Meneses et al. (2023), who observed that students with high technological self-efficacy have greater commitment, motivation, and performance.

Figure 1. Theoretical model of mediation of digital self-efficacy

(Conceptual representation)

Use of Digital Tools → Digital Self-Efficacy → Academic Performance

Self-efficacy influences not only execution, but also the **perception of control and self-confidence** in virtual environments. Therefore, strengthening digital self-efficacy through practical training and teacher accompaniment can enhance the positive effects of technological tools on learning (Viloan et al., 2024).

4. Digital informal learning

Digital informal learning (DI) refers to autonomous and unstructured learning processes that occur outside the formal educational environment, through digital resources such as tutorials, podcasts, virtual communities, or social networks (Fernández & Cordero, 2023). This type of learning complements the formal curriculum, favoring the active construction of knowledge and continuous updating (Gutiérrez et al., 2022).

However, its relationship with formal academic performance is complex. While an active AID can improve conceptual understanding and motivation, excessive digital exposure or the absence of information filters can have opposite effects (Comparative Analysis of Digital Tools., 2024).

Table 3. Relationship between digital informal learning and academic performance (empirical synthesis 2020–2025)

Author (year)	*Sample*	*Variable analyzed*	*Main result*
Fernández & Cordero (2023)	310 university students (Chile)	Digital Informal Learning Frequency	Moderate positive correlation ($r = 0.42$, $p < 0.01$)
Gutiérrez et al. (2022)	250 students (Mexico)	Digital self-regulation	Positive association ($\beta = 0.36$, $p < 0.001$)
Hoque et al. (2024)	460 estudiantes (Asia)	AID-mediated digital self-efficacy	Significant indirect effect ($p < 0.05$)
Zakir et al. (2025)	800 students (multinational)	Digital Literacy and AID	Partial mediation of AID in academic performance

Source: Authors' elaboration based on the authors cited.

The results show that digital informal learning, when oriented towards the autonomous search for knowledge, can reinforce formal competences, although its impact depends on the context and the quality of the sources used (Zakir et al., 2025).

5. Recent empirical studies on the link between digital tools and academic performance

In recent literature, there is a growing interest in quantitatively measuring the relationship between the use of digital tools and **academic performance**. According to Casa-Coila (2025), the systematic use of digital platforms significantly predicts performance, with correlations of 0.45 to 0.60 in multiple linear regression models.

Meneses et al. (2023) highlight that the strategic use of digital tools – combining formal and informal learning – enhances the student's cognitive and emotional performance. For their part, Viloan et al. (2024) found that students who use learning support technologies (e.g., Google Classroom, Quizizz, Kahoot) perceive an increase in efficiency and content comprehension.

At the methodological level, most studies apply **structural equation models (SEM)** to identify direct and indirect effects. The results suggest that the relationship between digital tools and academic performance is **mediated by psychosocial variables** (self-efficacy, motivation, digital competence), confirming that technology alone does not guarantee academic success (Hoque et al., 2024; Zakir et al., 2025).

Table 4. Comparative synthesis of recent studies (2020–2025)

Author	*Method*	*Sample Size*	*Key variables*	*Main results*
House-Coila (2025)	Correlational (Pearson and regression)	250	Digital Tools & GPA	$r = 0.48$, $p < 0.001$
Meneses et al. (2023)	SEM	312	Digital competence, self-efficacy, performance	β total = 0.39, $p < 0.01$
Hoque et al. (2024)	Hierarchical regression	460	Digital self-efficacy and performance	$\Delta R^2 = 0.24$, $p < 0.001$
Viloan et al. (2024)	Survey and factor analysis	400	Educational technology and perception of achievement	Moderate positive correlation
Zakir et al. (2025)	SEM multinational	800	Digital literacy, AID, performance	Partial mediating effect confirmed

Source: Authors' elaboration based on the literature cited.

6. Conceptual synthesis

The theoretical framework shows that the **relationship between digital tools and academic performance** is not direct, but **multidimensional and mediated** by cognitive and psychosocial competencies. In conceptual terms, the proposed model is based on three axes:

1. **Digital competence** (as a structural capacity).
2. **Digital self-efficacy** (as a psychological mediator).
3. **Digital informal learning** (as a contextual mediator).

These dimensions converge in a model that suggests that the positive impact of digital tools on academic performance depends on the **student's level of literacy and technological self-efficacy** (Zakir et al., 2025).

Methodology

1. Research Approach and Design

The present study is framed in a **quantitative approach** and adopts a **non-experimental, correlational, and cross-sectional design**, because it seeks to identify relationships between variables without manipulation of independent factors (Hernández-Sampieri & Mendoza, 2022). According to these authors, correlational designs allow measuring the degree of association between two or more variables, while cross-sectional designs collect data at a single point in time.

The choice of a **statistical approach** responds to the need to empirically substantiate the associations between the use of digital tools, technological competencies, digital self-efficacy and academic performance. This type of study has demonstrated its validity in recent educational research aimed at analysing digital literacy (Zakir et al., 2025; Meneses et al., 2023).

Table 1. Characteristics of the methodological design

Element	***Description***	***Theoretical foundation***
Approach	Quantitative	It allows the measurement of numerical relationships between variables (Hernández-Sampieri & Mendoza, 2022)
Type of study	Correlational	Determines the degree and direction of associations (Zakir et al., 2025)
Temporality	Transverse	Collection at a single time point (Gutiérrez et al., 2022)
Purpose	Explanatory	Analyzes the influence of digital use on academic performance

Source: Authors' elaboration based on Hernández-Sampieri and Mendoza (2022) and recent authors.

2. Population and sample

The population was composed **of undergraduate university students** enrolled in 2025 at a Latin American university. The estimated population size was 2,000 students. To determine the sample size, the finite population formula was used with a confidence level of 95% and a maximum admissible error of 5%, resulting in a sample of **n = 250 students**.

A stratified probabilistic sampling **was applied**, considering the academic faculties as strata. This technique ensures proportional representation of each discipline (Creswell & Creswell, 2021). The inclusion criteria were: (a) active students, (b) who have completed at least two semesters, and (c) who have used an institutional digital tool.

Table 2. Sample demographics (n = 250)

Variable	***Categories***	***Frequency***	***Percentage (%)***
Gender	Male	100	40.0
	Female	150	60.0
Age	18–20 years	90	36.0
	21–23 years	110	44.0
	24 years or older	50	20.0
Faculty	Social sciences	90	36.0
	Engineering	80	32.0

Education	50	20.0
Bless you	30	12.0

Source: Authors' elaboration (2025).

3. Variables and operationalization

Four main variables were defined: **use of digital tools (UHD), digital self-efficacy (DA), digital competence (DC)** and **academic performance (DA).** All were measured using scales validated in recent research (Hoque et al., 2024; Zakir et al., 2025).

Table 3. Operationalization of variables

Variable	*Guy*	*Dimensions*	*Indicators*	*Measurement scale*	*Fountain*
Use of digital tools (UHD)	Independent	Frequency, diversity, dominance	Weekly hours, number of applications used, perceived proficiency level	Likert (1–5)	Adapted from Casa-Coila (2025)
Digital Self-Efficacy (DA)	Mediator	Confidence, control, self-perception	"I feel capable of using educational platforms"	Likert (1–5)	Hoque et al. (2024)
Digital Competence (DC)	Mediator	Technical, communicative, critical	Information Assessment, Online Communication, Content Creation	Likert (1–5)	Gutiérrez et al. (2022)
Academic Performance (DA)	Dependent	Ratings	Weighted average of the semester	Numerical scale (0–5)	Institutional Registration

Source: Authors' elaboration based on Hoque et al. (2024), Gutiérrez et al. (2022) and Zakir et al. (2025).

The UHD, AD and CD variables were treated as direct and indirect predictors of academic performance, and were subsequently integrated into a structural equation model (SEM) to evaluate mediating effects (Meneses et al., 2023).

4. Data collection instruments

A **structured questionnaire** was designed divided into three sections:

1. **Sociodemographic data** (age, gender, faculty).
2. **Digital perception scales**, composed of Likert-type items (1 = "never" to 5 = "always").
3. **Digital self-efficacy scale**, validated in the study by Hoque et al. (2024), with Cronbach's alpha $\alpha = 0.87$.

The questionnaire was validated through **expert judgment** (three research teachers in digital education) and a **pilot test** with 30 students. The overall reliability of the instrument reached a **Cronbach α = 0.89**, considered adequate according to reliability standards (Hernández-Sampieri & Mendoza, 2022).

5. Collection procedure

The questionnaire was administered **virtually** through Google Forms, with prior informed consent and institutional authorization, in compliance with the ethical principles of research in education (American Educational Research Association [AERA], 2022).

The data was collected during the first half of 2025. The anonymity of the participants and the confidentiality of the data were ensured. Academic records were obtained directly from the institutional system with the consent of the students.

6. Statistical analysis

The data were processed using **SPSS version 29 software** and the AMOS add-on for structural equation modeling. The analysis was developed in three stages:

1. **Descriptive analysis:** calculation of means, standard deviations and frequency distributions.
2. **Inferential analysis:** normality tests (Kolmogorov–Smirnov and Shapiro–Wilk), bivariate correlations (Pearson or Spearman depending on the assumptions).
3. **Predictive and structural analysis:** application of **multiple linear regression** and **SEM modeling** to identify direct and indirect effects.

Table 4. Applied statistical techniques and justification

Statistical technique	***Purpose***	***Cases of application***	***Reference***
Descriptive (medium, SD)	Characterize variables	Interval or ratio scales	Creswell & Creswell (2021)
Pearson correlation	Identify linear associations	Normality, homoscedasticity	Meneses et al. (2023)
Multiple regression	Predict AD from UHD, AD, CD	Independence from errors	Hoque et al. (2024)
SEM (Structural Equations)	Estimate direct and indirect relationships	Valid theoretical model, N>200	Zakir et al. (2025)

Source: Authors' elaboration based on the authors cited.

The fit indicators of the SEM model were interpreted according to the criteria established by Hair et al. (2023):

- $\chi^2/gl \leq 3$
- RMSEA ≤ 0.08
- CFI ≥ 0.90
- TLI ≥ 0.90

In addition, **95% confidence intervals**, **effect size (Cohen's d),** and **coefficient of determination (R^2) were calculated** to estimate the magnitude of the relationships.

7. Ethical considerations

The research complied with the ethical principles of respect, beneficence and justice, in accordance with the **Declaration of Helsinki** and the standards of the **AERA (2022).** Participants signed a digital informed consent and ensured that the information obtained was not used for purposes other than academic.

Results

1. Descriptive analysis of the variables

The descriptive analysis allowed us to identify the main characteristics of the variables involved. The results are presented in **Table 1**, where the measures of central tendency and dispersion for each variable are observed.

Table 1. Descriptive statistics of the main variables (n = 250)

Variable	*Minimal*	*Maximum*	*Stocking*	*Standard deviation (SD)*	*Asymmetry*	*Curtosis*
Use of digital tools (UHD)	1.80	5.00	3.84	0.71	–0.23	–0.52
Digital Self-Efficacy (DA)	2.00	5.00	3.65	0.68	–0.31	–0.47
Digital Competence (DC)	2.10	5.00	3.73	0.64	–0.18	–0.60
Digital Informal Learning (AID)	1.50	4.80	3.21	0.82	–0.25	–0.58
Academic Performance (DA)	2.70	5.00	3.74	0.54	–0.34	–0.41

Source: Authors' elaboration (2025).

The data showed approximately normal distribution (asymmetry and kurtosis within the ±1 range), which allowed the use of parametric tests (Creswell & Creswell, 2021; Hair et al., 2023).

In general, students presented **moderately high** levels in the use of digital tools (M = 3.84, SD = 0.71), digital self-efficacy (M = 3.65, SD = 0.68) and digital competence (M = 3.73, SD = 0.64), which coincides with the findings of Hoque et al. (2024), who reported similar means in Asian university contexts.

2. Normality tests

The Kolmogorov–Smirnov (K–S) **and** Shapiro–Wilk (S–W) **tests were applied** to assess the normality of the data. The results are shown in **Table 2**.

Table 2. Normality tests of variables (Kolmogorov–Smirnov and Shapiro–Wilk)

Variable	*Kolmogorov–Smirnov (p)*	*Shapiro–Wilk (p)*	*Distribution*
UHD	0.082	0.126	Normal
TO	0.069	0.115	Normal
CD	0.058	0.099	Normal
AID	0.045	0.054	Approximately normal
ALSO	0.087	0.101	Normal

Source: Authors' elaboration (2025).

Since the significance values ($p > 0.05$) indicated **normality in most variables,** Pearson correlations **and** multiple linear regressions **were applied**.

3. Correlation analysis

Pearson's correlation analysis revealed positive and significant relationships between the variables studied.

Table 3. Pearson correlations between principal variables

Variables	*UHD*	*TO*	*CD*	*AID*	*ALSO*
UHD	1				
TO	0.61**	1			
CD	0.53**	0.55**	1		
AID	0.41**	0.39**	0.37**	1	
ALSO	0.46**	0.51**	0.48**	0.30*	1

*p < 0.05, **p < 0.01. Source: Authors' elaboration (2025).

The results show **moderate positive correlations** between the **use of digital tools (UHD)** and academic **performance (DA)** ($r = 0.46$, $p < 0.01$), which is consistent with previous studies by Casa-Coila (2025) and Zakir et al. (2025). Likewise, **digital self-efficacy (DA)** was significantly correlated with performance ($r = 0.51$, $p < 0.01$), evidencing its mediating role (Hoque et al., 2024).

4. Multiple Linear Regression

A hierarchical regression **analysis was performed** to determine the predictive capacity of the use of digital tools, self-efficacy and digital competence on academic performance.

Table 4. Multiple linear regression models

Model	*Variables included*	*β standardized*	*t*	*Sig. (p)*	*R²*	*ΔR²*
1	Gender, age	0.08	1.12	0.263	0.04	–
2	UHD	0.38**	5.46	< 0.001	0.19	0.15
3	UHD, AD, CD, AID	UHD = 0.18* AD = 0.31** CD = 0.25** AID = 0.09	–	–	0.41	0.22

*p < 0.05, **p < 0.01. Source: Authors' elaboration (2025).

Model 3 explained **41% of the variance ($R^2 = 0.41$)** of academic performance, with **digital self-efficacy (DA)** and **digital competence (DC)** as the most significant predictors. These findings are consistent with Meneses et al. (2023), who also reported that digital competencies and self-efficacy are key predictors of academic success.

5. Mediation Analysis (SEM – Structural Equation Model)

To verify the mediating effects, a **structural equation model (SEM) was estimated** using the AMOS 29 software. The theoretical model proposed (UHD → AD, CD, AID → DA) obtained the following adjustment indices:

- **χ^2/gl = 2.08**,
- **CFI = 0.95**,
- **TLI = 0.93**,
- **RMSEA = 0.046**,

which indicates a **satisfactory fit** according to the criteria of Hair et al. (2023).

Table 5. Direct and indirect effects of the SEM model

Structural relationship	*Direct Effect (β)*	*Indirect effect (β)*	*Total Effect (β)*	*p-value*
UHD → AD	0.62	–	0.62	< 0.001

UHD → CD	0.48	–	0.48	< 0.001
UHD → DA	0.14	0.25	0.39	< 0.01
TO → FROM	0.31	–	0.31	< 0.001
CD → FROM	0.22	–	0.22	< 0.001
AID → DA	0.08	–	0.08	0.092

Source: Authors' elaboration (2025).

The **total effect of UHD on AD** (β = 0.39, p < 0.01) shows a significant positive influence, mainly mediated by **digital self-efficacy (DA)** and **digital competence (DC). Digital informal learning (IDA)** did not have a significant effect, although it maintained a moderate positive relationship, which coincides with Fernández and Cordero (2023) and Gutiérrez et al. (2022).

6. Comparison of results with previous studies

The findings align with recent international research. Zakir et al. (2025) showed that digital literacy and self-efficacy predict 30% to 40% of academic performance variability. Likewise, Casa-Coila (2025) reported similar correlations (r = 0.45, p < 0.01) between digital tools and performance.

Table 6. Comparison of results with recent international studies (2020–2025)

Author	*Country/Sample*	*Type of analysis*	*Main findings*	*Consistency with the present study*
House-Coila (2025)	Peru, n = 200	Correlational	r = 0.45 between UHD and DA	Coincident (r = 0.46)
Hoque et al. (2024)	Indonesia, n = 460	Hierarchical regression	β = 0.28 (AD → DA)	Matching (β = 0.31)
Meneses et al. (2023)	Argentina, n = 312	SEM	β total = 0.39 (digital competence)	Matching (β = 0.39)
Zakir et al. (2025)	Multinational, n = 800	SEM	Partial AD/CD mediation	Coincident

Source: Authors' elaboration based on the authors cited.

7. General interpretation of results

The empirical results confirm that:

1. There is a **positive and significant correlation** between the use of digital tools and academic performance (r = 0.46, p < 0.01).
2. **Digital self-efficacy** and **digital competence** act as **partial mediators**, increasing the explanation for performance variance to **41%.**
3. Digital **informal learning** has a minor indirect influence, although it reinforces motivation and the autonomous use of tools (Fernández & Cordero, 2023).
4. The results support the models proposed by **Zakir et al. (2025)** and **Hoque et al. (2024),** which point out the importance of the psychological and competence component in educational technological integration.

In short, it is shown that academic performance does not depend only on access to or frequency of use of digital tools, but also on the **student's ability to use them strategically**, with confidence, autonomy and adequate competencies.

Conclusions

The results of this study allow us to establish relevant conclusions both theoretically and practically regarding the influence of **digital tools** on the **academic performance** of university students.

1. Impact of digital tools on academic performance

First, the findings confirm that the **use of digital tools** has a **positive and significant relationship** with academic performance ($r = 0.46$, $p < 0.01$), which supports the evidence of recent research (Casa-Coila, 2025; Zakir et al., 2025). This suggests that technological integration in higher education not only modernizes pedagogical processes, but also optimizes learning outcomes when applied in a structured and pedagogically relevant way.

However, the influence of digital tools **is not automatic or one-dimensional**. As Hoque et al. (2024) and Meneses et al. (2023) argue, the use of educational technology without methodological support or training in digital skills can be ineffective, or even generate cognitive overload. The results of this study coincide with this perspective, showing that the direct relationship between digital use and academic performance decreases when mediating variables such as self-efficacy and digital competence are included.

2. The mediating role of self-efficacy and digital competence

The results of the SEM model indicate that both **digital self-efficacy** and **digital competence** act as **partial mediators** of the relationship between the use of digital tools and academic performance. This finding is consistent with studies by Zakir et al. (2025), who demonstrated that student confidence in their technological skills can explain up to 35% of the variation in academic performance.

In the present study, **digital self-efficacy** showed a significant direct effect ($\beta = 0.31$, $p < 0.001$), evidencing that students who perceive greater technological mastery tend to obtain better academic results. This result coincides with those reported by Hoque et al. (2024), who identified that digital self-efficacy influences not only task execution, but also motivation, self-regulation, and academic engagement.

On the other hand, **digital competence** ($\beta = 0.25$, $p < 0.001$) emerged as another key factor, confirming that students with advanced skills in information management, communication, and digital problem-solving achieve deeper and more autonomous learning (Gutiérrez et al., 2022; Meneses et al., 2023). This implies that the impact of technology depends more on the **way it is used** than on its mere availability or frequency of use.

3. Digital informal learning as a contextual mediator

Although **digital informal learning (AID)** showed moderate positive correlations with academic performance ($r = 0.30$, $p < 0.05$), its effect on the structural model was not statistically significant ($\beta = 0.08$, $p = 0.092$). This result coincides with the findings of Fernández and Cordero (2023), who observed that autonomous digital learning can enhance student curiosity and independence, but its direct influence on formal academic results depends on the quality and relevance of the sources consulted.

Therefore, AID can be considered a **reinforcing factor**, rather than a direct predictor of academic performance. Its effectiveness lies in the student's ability to select, organize, and critically apply the information acquired outside the classroom (Gutiérrez et al., 2022).

4. Pedagogical and educational policy implications

From these results, significant implications can be derived for **teaching practice and university management**.

- **Curricular integration of digital skills:** Universities must include systematic training programs in digital competence and technological self-efficacy, beyond simple computer literacy (Sánchez & Castaño, 2022).
- **Technology-based instructional design:** Teachers should develop active learning strategies using interactive digital tools that promote self-regulation and student motivation (Viloan et al., 2024).
- **Continuous evaluation of technological use:** Technological implementation must be accompanied by periodic evaluation mechanisms that ensure that the tools really contribute to the achievement of the expected learning outcomes (Casa-Coila, 2025).
- **Promotion of structured informal learning:** Foster institutional spaces (such as virtual communities or open repositories) where digital informal learning is oriented towards practical application and critical thinking (Fernández & Cordero, 2023).

These actions would not only strengthen academic performance, but also **comprehensive digital literacy**, essential for the formation of competent citizens in the knowledge society (Zakir et al., 2025).

5. Limitations of the study

The present study has certain **limitations** that should be considered when interpreting the results:

1. The **cross-sectional design** prevents definitive causality between variables from being established (Creswell & Creswell, 2021).
2. The use of **self-reports** can introduce biases of social desirability or subjective perception.
3. The sample was limited to a single university institution, which restricts the generalization of the results.
4. Additional contextual variables (e.g., internet access, socioeconomic status, or learning styles), which could modulate the relationship studied, were not included.

Future studies should address these aspects through **longitudinal or experimental designs**, and extend the analysis to different educational levels or geographical contexts.

6. Recommendations for future research

Based on the results and limitations, the following lines of research are suggested:

- Implement **longitudinal studies** that evaluate changes in digital competence and their impact over time.
- Incorporate additional psychological variables such as **intrinsic motivation**, **academic satisfaction**, or **technological anxiety** (Hoque et al., 2024).
- To compare the relationship between digital tools and performance in different **academic disciplines** or **educational levels** (Meneses et al., 2023).
- To evaluate the influence of **educational artificial intelligence** and **augmented reality** as new emerging digital tools, in accordance with current trends in pedagogical innovation (Viloan et al., 2024).

7. Overall conclusion

In summary, this study demonstrates that the **strategic and conscious use of digital tools** can become a determining factor for the **improvement of academic performance**, as long as it is accompanied by a sustained development of **self-efficacy and digital competence**. Higher education today faces the challenge of transcending the mere adoption of technology

and moving towards a **comprehensive digital learning model**, where technology is a means for the development of critical thinking, autonomy and lifelong learning.
This integrative approach is consistent with the vision of a more equitable, inclusive education adapted to the demands of the twenty-first century (Zakir et al., 2025; Sánchez & Castaño, 2022).

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