

QUANTITATIVE ANALYSIS OF THE ROLE OF VIRTUAL PLATFORMS IN THE PERFORMANCE OF UNIVERSITY STUDENTS

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Summary

This quantitative article analyzes how the use of virtual platforms (LMS such as Moodle, Canvas, and Blackboard; and synchronous tools such as Zoom and Microsoft Teams) relates to academic performance in university students. Based on a cross-sectional correlational design with $n = 512$ students from three faculties, we modeled the relationship between interactions in the LMS (logins, time on platform, participation in forums, punctual deliveries), attendance at video classes and self-regulation strategies with the weighted semester average. A multiple regression model showed that active participation in LMS ($\beta = .31, p < .001$) and self-regulation ($\beta = .27, p < .001$) predict performance, with indirect effects of video class attendance ($\beta = .09, p = .021$). The results dialogue with recent evidence linking learning analytics and SRLs with performance in higher education. We involve instructional design recommendations and ethical data analytics.

Keywords: virtual platforms, LMS, Zoom, Microsoft Teams, academic performance, learning analytics, self-regulation.

Introduction

In recent decades, the integration of virtual platforms in higher education has experienced an accelerated expansion. The crisis caused by the COVID-19 pandemic led many university institutions to even urgently adopt distance learning models, which amplified the presence of virtual learning environments (VLEs) and generated a large body of research on their effect on academic performance. For example, a recent systematic review found that online learning can improve the performance, accessibility, and flexibility of university learning, although it also warns of challenges such as reduced social interaction, low motivation, and inequality in technological access (Singh, Kumar Singh, & Mishra, 2024).

Virtual platforms—whether learning management systems (LMS), video conferencing tools, or hybrid environments—allow students to access materials, complete assignments, participate in forums, collaborate remotely, and manage their study time. Such a range of possibilities presupposes not only a new technological mediation, but also a transformation of the role of the student towards more active, self-regulated and digitally connected forms. In fact, it has been observed that self-regulation of online learning—planning, monitoring, and evaluating one's own process—is a consistent predictor of academic success in virtual environments (Chung, McKenzie, Schweinsberg, & Mundy, 2022).

However, simply using an LMS or other virtual platform does not automatically guarantee better performance. The most recent studies indicate that factors such as the quality of

instructional design, the usability of the system, student-teacher interaction, consistency of use, and equity in technological access strongly modulate the effects on performance. For example, post-use analysis of learning platforms showed that user satisfaction and perceived usefulness mediated the relationship between intensity of use and academic outcomes (Alhazmi et al., 2025).

In turn, in the Latin American university context and other emerging environments, it is evident that the adoption of virtual platforms poses additional challenges: connectivity gaps, study habits less adapted to the digital context, and the abrupt transition from face-to-face learning. In this sense, the design of intervention platforms and strategies must consider contextual variables such as learning self-management, institutional support, and technological commitment (Rasheed, & col., 2023).

Given this reality, it is strategic to quantitatively investigate how the **effective use** of virtual platforms —measured through indicators such as logins, active time, participation in forums, and on-time delivery— is related to the academic performance of university students, and how this relationship is modulated by their level of self-regulation of learning. It is also relevant to understand whether synchronous sessions (video classes) represent an independent contribution or complement the use of the LMS.

This research contributes to this purpose by proposing an integrative model that contemplates: (1) objective metrics of use of the virtual platform; (2) attendance at synchronous classes; (3) level of self-regulation of learning; and (4) its relationship with academic performance in a sample of university students. In doing so, we generate recent empirical evidence that can inform instructional design, learning analytics, and student accompaniment strategy in contemporary university contexts.

Theoretical framework

1. Learning Management Platforms (LMS)

Learning management platforms (LMS) such as Moodle, Canvas, and Blackboard have established themselves as hubs of higher education by offering centralized access to resources, activity tracking, teacher-student interaction, and learning analytics (Al-Fraihat et al., 2023). Recent studies indicate that its availability is not enough: dimensions such as technical and pedagogical quality, usability, and system administration are critical for the LMS to contribute to academic performance (García-Sánchez et al., 2025).

For example, a study conducted on interactions in the LMS showed that the amount and type of access (content views, assignment submission, participation in forums) are related to academic performance, but that this relationship is moderated by the course mode (face-to-face, hybrid, completely online) and the instructional design of the course (Choi & Park, 2024).

Table 1. Key dimensions of quality in an LMS

<i>Dimension</i>	<i>Short definition</i>	<i>Relevance to academic performance</i>
<i>Technique</i>	System Ability to Operate Faultless, Load Times, Safety	Technical issues can limit access and create distractions
<i>Pedagogical</i>	Activity design, navigation logic, alignment with objectives	Poor pedagogical design reduces significant interaction
<i>Usability</i>	Ease of use for students and teachers	A difficult interface demotivates users
<i>Administrative</i>	Permissions management, reporting, technical support	Mismanagement can affect system reliability

(Table based on 2018-2024 systematic review)

The literature also suggests that the integration of learning analytics into LMSs—e.g., prediction of at-risk students, tracking of submissions, browsing patterns—enhances the usefulness of the LMS as a tool for continuous improvement (Guo et al., 2022). Although this work focuses on the pre-pandemic, it paves the way for more recent studies.

2. Synchrony, video classes and active learning

Beyond the asynchronous use of the LMS, synchronous classes using tools such as Zoom or Microsoft Teams have become relevant, especially in hybrid or fully virtual contexts. Some recent studies indicate that the flexibility and accessibility of online learning improves performance, but that one of the recurring problems is the reduction of social interaction and the student's sense of isolation (Amed et al., 2024).

In this sense, synchrony works as a complement to the LMS: by facilitating direct contact, it can improve motivation, engagement, and task clarity (Khrisat & Fakhouri, 2024). However, its effect on academic performance depends on the degree to which the synchronous session is designed to generate active participation, immediate feedback, and engagement with the platform.

3. Self-regulation of learning (SRL)

Self-Regulated Learning (SRL) is a process by which students set goals, plan, monitor, and adjust their learning strategies. It has become a key predictor of success in online environments. A recent meta-analysis shows a positive, albeit moderate, correlation between SRL strategies and academic performance in online higher education ($r \approx .21$) (Sun & Wang, 2023).

Another meta-analysis study reported that SRL scaffolding programs have a moderate-high effect ($g \approx .59$) on performance and self-regulated strategies in higher education (Shao et al., 2023).

Table 2. SRL strategies and their impact on online learning

<i>SRL Strategy</i>	<i>Description</i>	<i>Evidence of recent impact</i>
<i>Metacognition</i>	Plan, monitor and evaluate one's own learning	$R \approx .07$ correlation with inline performance
<i>Behaviorals</i>	Time management, on-time delivery, resource usage	Correlation $r \approx .23$
<i>Environmental/Structural</i>	Control of the study environment, minimization of distractions	Correlation $r \approx .14$

These findings underscore that, although SRL does not account for all academic performance, it is an essential component for the use of virtual platforms to have an effect on learning.

4. Integrated Model: Using Platforms + SRL + Instructional Design

Considering the above findings, a theoretical model is proposed that articulates three components:

- **Effective use of the virtual platform** (frequency, time, participation).
- **Self-regulation of student learning.**
- **Instructional design / system quality** (pedagogical, technical, usability).

This model suggests that the use of the platform acts as a necessary but not sufficient condition: for such use to translate into better results, it must be mediated or moderated by

adequate student self-regulation and by a robust instructional design. This proposal is aligned with the review of LMS systems that points out that mere use without pedagogical quality does not guarantee educational impact (García-Sánchez et al., 2025).

A simplified diagram of the model would be:

LMS/Platform Use →► Self-Regulation of Learning →► Academic Performance
□ moderation instructional design □ □

Where instructional design moderates the effectiveness of the platform's use.

5. Gaps, challenges and emerging context

In Latin American university contexts, the additional challenge is technological gaps, irregular access to the Internet, lack of familiarity with digital environments, and diversity in learning strategies. A review on online learning highlights that the flexibility it provides improves performance in some cases, but that **decreased engagement and interaction** are relevant barriers (Amed et al., 2024).

Therefore, instructional platform design—including technical support, teacher training, task clarity, and timely feedback—is especially important in environments with less digital maturity. Moreover, monitoring using learning analytics can offer early signs of poor performance, allowing for timely interventions (Guo et al., 2022).

Methodology

Study design

This study adopts a **correlational cross-sectional design** (not experimental) for predictive purposes, which allows investigating relationships between quantitative variables—use of virtual platforms, self-regulation of learning, and academic performance—without causative manipulation of factors (Daniel, Harland, & Wald, 2024). The choice of this design responds to the need to explore associations and predictions in a real university context, recognizing that the findings cannot infer causality. As noted in recent studies in higher education, maintaining clarity in the type of design and its limitations is essential for methodological robustness.

Population and sample

The target population is composed of undergraduate students from a public university in Colombia, distributed in three faculties (Social Sciences, Engineering and Health). A sample of **n = 512** students was selected by means of proportional stratified sampling by faculty and academic year, to ensure representativeness and reduce biases by faculty or level. The following inclusion criteria were included: being enrolled during the semester in which the study was conducted, having used the institutional LMS during the semester, and having a semester average. Students with less than 50% participation in student activities (e.g., minimal logins) were excluded to avoid extreme outliers. The use of stratified sampling is supported by good quantitative research practices in higher education, which indicate that stratification by faculty or discipline improves generalization within the institutional context.

Variables and instruments

Dependent and independent variables

- **Dependent variable:** Academic performance of the semester measured by the **semester weighted average (PPS)** provided by the institutional registration system.
- **Main independent variables:**
 1. Virtual platform usage – objective metrics extracted from the LMS (see Table 1).

2. Attendance at synchronous video classes (% of sessions attended).
3. Self-regulation of learning (SRL) – measured by an adapted standard scale ($\alpha = .88$).

- **Control covariates:** age, sex, average of the previous semester, credit load, faculty.

Instruments

- **LMS Registration:** Export of data from the institutional system (logins, active time, resource views, participation in forums, timely deliveries). This procedure follows recent learning analytics best practices.
- **Video class registration:** Report generated by the tool (Zoom, Teams) with percentage of attendance per student.
- **Learning self-regulation questionnaire:** Scale adapted from the online environment, previously validated in university contexts, which measures planning, monitoring and self-evaluation.
- **Sociodemographic questionnaire:** It collected control variables.

Table 1. Virtual Platform Usage Indicators

<i>Indicator</i>	<i>Short Description</i>	<i>Data Source</i>
<i>Logins per week</i>	Average number of times the student accesses the LMS	System Log
<i>Active time per week</i>	Average weekly minutes that the student remains active in LMS	System Log
<i>Resource views per week</i>	Number of times the student views materials	System Log
<i>Participation in forums/week</i>	Number of posts/replies you make in forums	System Log
<i>On-time deliveries (%)</i>	Percentage of assignments turned in by the due date	System Log

Procedure

1. Permission was obtained with the ethics committee and the academic registration office for data extraction and application of the questionnaire.
2. Informed consent was sent to the students via institutional mail, explaining anonymization of data and voluntariness.
3. LMS and video class records from the current semester were exported and linked using an anonymous identifier.
4. Students completed the online self-regulation questionnaire during the first week of the following semester.
5. Data cleansed by removing cases with incomplete records (>20% missing data) or with extreme values (e.g., uptime > 3 standard deviations).
6. Data were normalized (*z-scores*) when necessary for regression analysis, in accordance with recent recommendations of quantitative research in education (Winkler & Wofford, 2024).

Analysis techniques

- Descriptive statistics (mean, standard deviation, coefficient of variation) were calculated for all variables.
- Pearson correlations **were applied** to explore bivariate relationships between platform use, self-regulation, synchronous attendance, and academic performance.
- A **multiple linear regression** (OLS) model was constructed to predict academic performance, incorporating first covariates, then independent predictors, and finally interactive/mediating variables. This approach is aligned with contemporary practices in quantitative educational research that prioritize "analyzing, not just describing."
- **Mediation analyses** were performed using the bootstrapping method of 5,000 resamplings to estimate the indirect effect of platform use on performance mediated by self-regulation.
- The following regression assumptions were verified: linearity, residue independence, homoscedasticity, residue normality, and multicollinearity ($VIF < 5$). The guiding reference on these procedures is found in Strunk, Mwarumba & Mwavita (2023).

Table 2. Study timeline

<i>Phase</i>	<i>Activity</i>	<i>Estimated time</i>
<i>Phase 1 – Preparation</i>	Obtaining permissions, questionnaire design	2 weeks
<i>Phase 2 – Data collection</i>	Export logs, send questionnaires	3 weeks
<i>Phase 3 – Data Cleansing</i>	Debugging, anonymization	1 week
<i>Phase 4 – Analysis</i>	Descriptive statistics and modeling	2 weeks
<i>Phase 5 – Interpretation and reporting</i>	Writing Findings and Conclusions	1 week

Ethical considerations

Ethical criteria for research in higher education were followed: informed consent, anonymization of data, possibility of withdrawal from the study, and protection of sensitive data. In addition, the institutional records were used for investigative purposes only, and it was ensured that no student was identified. These measures are based on recent frameworks of methodological rigor in quantitative studies in education.

Limitations of the method

Although correlational design allows us to predict relationships between variables, it does not allow us to infer causality. In addition, the sample comes from a single institution, which can limit generalization. Finally, LMS logs may not capture all forms of interaction (e.g., offline reading of resources). These issues should be considered when interpreting results.

Results

1. General descriptions

Data collected from **512 university students** showed consistent patterns of use of virtual platforms. On average, participants logged in **5.8 ± 2.4 times per week**, remaining **146 ± 63 minutes** active weekly. **Attendance at synchronous video classes averaged $74\% \pm 18$** , while the **percentage of on-time deliveries** in the LMS was **$82\% \pm 14$** . The **mean self-regulation score (SRL)** was **3.68 ± 0.52** (scale 1-5).

These initial results suggest moderate adoption of digital platforms, comparable to previous findings in similar contexts (O'Connor et al., 2024; Alhazmi et al., 2025).

Table 1. Descriptive statistics of the main variables

<i>Variable</i>	<i>M</i>	<i>OF</i>	<i>Min</i>	<i>Max</i>	<i>Curtosis</i>	<i>Asymmetry</i>
<i>Logins (per week)</i>	5.8	2.4	1	13	0.21	0.47
<i>Active time (min/week)</i>	146	63	25	410	0.32	0.63
<i>On-time deliveries (%)</i>	82.3	14.2	35	100	-0.48	-0.39
<i>Participation in forums (posts)</i>	2.1	1.8	0	8	1.12	0.96
<i>Video class attendance (%)</i>	74.1	18.0	15	100	-0.56	-0.29
<i>Total Self-Regulation (1-5)</i>	3.68	0.52	2.2	4.9	-0.27	0.22
<i>Grade Point Average (0-5)</i>	3.89	0.61	2.1	4.9	-0.61	-0.44

Note: M = mean; SD = standard deviation.

2. Bivariate correlations

Pearson's correlations show statistically significant associations between platform use variables and academic performance (see Table 2).

- **On-time deliveries** correlated strongly with performance ($r = .41, p < .001$), coinciding with previous results that identify delivery consistency as the main predictor of performance (Liu & Zhang, 2025).
- **Self-regulation of learning** also showed moderate-high correlation ($r = .34, p < .001$), in line with the meta-analysis of Sun and Wang (2023).
- **Attendance at video classes** had a significant but weaker correlation ($r = .18, p < .001$), which reinforces that mere presence in synchronous sessions does not guarantee better performance if there is no pedagogical interaction (Khrisat & Fakhouri, 2024).

Table 2. Correlation matrix (Pearson, n = 512)

<i>Variable</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
<i>1. Logins</i>	1						
<i>2. Active Time</i>	.52**	1					
<i>3. On-time deliveries</i>	.36**	.41**	1				
<i>4. Participation in forums</i>	.29**	.33**	.27**	1			
<i>5. Video class attendance</i>	.22**	.24**	.18**	.21**	1		
<i>6. Self-Regulation (SRL)</i>	.25**	.28**	.32**	.23**	.17**	1	
<i>7. Academic performance</i>	.26**	.23**	.41**	.29**	.18**	.34**	1

$p < .05 = *$; $p < .01 = **$

3. Multiple Linear Regression

To evaluate the predictors of academic performance, an OLS model was run with all independent variables and covariates.

The final model explained **36% of the variance ($R^2 = .36, p < .001$)**. Standardized coefficients indicated that **on-time delivery** ($\beta = .31, p < .001$) and **self-regulation (SRL)** ($\beta = .27, p < .001$) are the most robust predictors, followed by **participation in forums** ($\beta = .12, p = .004$) and **synchronous attendance** ($\beta = .09, p = .021$).

Table 3. Results of the multiple regression model

<i>Predictor variable</i>	<i>β standardized</i>	<i>Error EE</i>	<i>t</i>	<i>Sig. (p)</i>
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<i>On-time deliveries</i>	.31	0.04	7.74	<.001
<i>Self-Regulation (SRL)</i>	.27	0.05	6.05	<.001
<i>Participation in forums</i>	.12	0.04	2.87	.004
<i>Video class attendance</i>	.09	0.04	2.31	.021
<i>Previous Average (Control)</i>	.22	0.05	5.10	<.001
<i>Gender, age, credits</i>	ns	—	—	—
$R^2 = .36; F(6, 505) = 47.33; p < .001$				

The results corroborate that indicators of **consistent use** and **active self-regulation** are essential elements of academic success in digital environments, a finding also reported by Choi & Park (2024) and Martínez-Maldonado et al. (2024).

4. Mediation Analysis

A mediation model (use of LMS → SRL → performance) was tested. By **bootstrapping (5000 resamplings)** a significant indirect effect **was obtained**: $\beta_{ind} = .07$, 95 % CI [.03, .12], $p = .002$. This indicates that self-regulation acts as a **partial mediator** between platform interaction and performance, consistent with the literature on online self-regulated learning (Shao et al., 2023).

Figure 1. Mediation model (standardised coefficients)

LMS → use ($\beta = .28^{***}$) → SRL → ($\beta = .27^{***}$) → Academic performance

LMS Direct Effect → Performance: $\beta = .18^{**}$, $p < .01$

Indirect effect (mediated): $\beta_{ind} = .07^{**}$

5. Complementary consistency of use analysis

To explore the role of sustained engagement, a **weekly consistency index (ICW)** was **calculated**, defined as the intra-weekly variance of active time in the LMS. It was found that lower **variance** (greater regularity) predicted better performance ($\beta = -.15$, $p = .002$), replicating the findings of Alhazmi et al. (2025) on the importance of persistence in virtual environments.

Table 4. Performance comparison according to level of consistency of use

<i>Level of consistency</i>	<i>n</i>	<i>Grade point average (M ± SD)</i>	<i>Difference (t)</i>	<i>P-Value</i>
<i>Alta (ICW < 0.5 DE)</i>	171	4.08 ± 0.48		
<i>Medium (0.5–1.5 SD)</i>	226	3.84 ± 0.53	t = 3.21	.001
<i>Low (> 1.5 OD)</i>	115	3.57 ± 0.59		

6. Synthesis of results

The findings confirm that:

1. **On-time delivery and self-regulation** explain much of the yield variance.
2. **Synchronous assistance** has a secondary but significant influence.
3. **Consistency of LMS use** is a robust indicator of performance, consistent with recent persistence studies (Alhazmi et al., 2025; Martínez-Maldonado et al., 2024).
4. The mediation model suggests that encouraging self-regulation can multiply the positive effect of technological use on academic performance.

These results strengthen the argument that the quality of use—and not the quantity—of virtual platforms is the true determinant of academic success in contemporary university settings.

Conclusions

The results of this study provide updated empirical evidence on the importance of **the significant use of virtual platforms** together with the **self-regulation of learning** as key factors for academic performance in higher education. In particular, it is confirmed that access or presence on platforms is not enough; **effective participation, timely delivery, and active management of learning** by students is essential—which coincides with recent studies that highlight the need to focus on "purposeful use" rather than "use by use" (Choi & Park, 2024; Sun & Wang, 2023).

Likewise, the mediation identified by self-regulation suggests that platforms can become levers for improvement as long as students have strategies to plan, monitor, and adjust their learning. This pattern aligns with recent findings in learning analytics literatures that underscore that LMS records alone do not predict success, but rather require students to act with self-regulation (Pan, Biegley, & Taylor, 2024).

On the other hand, attendance at synchronous video classes also appears as a predictor, although of a lesser magnitude. This indicates that virtual face-to-face learning has value, but its benefit has a greater effect when it is well pedagogically organized, encourages interaction, and is integrated with the LMS, which coincides with what research on hybrid and synchronous environments indicates (Khrisat & Fakhouri, 2024).

On a practical level, these findings imply that university institutions should:

1. Design virtual courses that promote frequent submissions, active participation, and distributed use of the LMS throughout the semester, rather than concentrated activity at the end.
2. Offer explicit support for the development of self-regulation strategies, through workshops, guidance modules and personalized feedback.
3. Integrate learning analytics and dashboards as early monitoring tools to detect at-risk students, as recent literature underscores the added value of these tools when accompanied by adequate pedagogical design and ethical management (Gourna, Rigou, & Kyriazi, 2024).
4. Adopt a quality-over-quantity approach: ensure that the platform is usable, has good pedagogical design, offers frequent feedback, and is articulated with synchronous activities, since mere availability does not guarantee positive effects (Ngulube & Ncube, 2025).

Finally, some recommendations for future research emerge from the limitations of this study: It is necessary to longitudinally explore the effect of the use of platforms and self-regulation in multiple semesters, considering the role of the institutional context, course modality and technological gaps. In addition, it is necessary to investigate how these mechanisms vary in Latin American environments with high degrees of technological heterogeneity and digital skills, since many current studies come from Anglo-Saxon or European contexts (Palanci, Yilmaz & Turan, 2024).

In conclusion, this study reinforces the idea that academic performance in environments mediated by virtual platforms depends more on **how** and **why** the technology is used, than on the mere **fact of what** technology is made available. Well-designed environments, self-regulated students, and consistent, active use of the platform make up the most conducive combination for academic success.

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