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Critical thinking in digital times: the role of virtual strategies in university education

Pensamiento crítico en tiempos digitales: el papel de las estrategias virtuales en la formación universitaria

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Abstract

This study analyzes the relationship between virtual learning strategies and the development of critical thinking in university students in teacher training programs. In a context of increasing educational digitalization, it is recognized that the mere incorporation of technology does not guarantee the strengthening of complex cognitive skills, particularly in public institutions in rural areas. The research, with a quantitative approach, non-experimental design, and cross-sectional approach, was conducted with a census population of 65 third-year students in the Education program at the National University of San Agustín in Arequipa. A structured questionnaire with Likert scales was used to evaluate the informational, communicative, and tutorial dimensions of the virtual strategies, along with the dimensions of interpretation, analysis, and evaluation of critical thinking. The results showed a moderate positive correlation between virtual strategies and critical thinking ($r = 0.641$; $p < 0.05$), highlighting the communicative dimension as the one most closely linked to critical development. From a sociological perspective, it was identified that pedagogical practices centered on interaction and teacher support are more conducive to critical thinking than the isolated use of digital resources. This study concludes that the development of critical thinking in virtual environments requires intentional pedagogical interventions and cannot be limited to technological access alone. It offers theoretical and practical contributions to the redesign of university education with a critical and contextualized approach.

Keywords: higher education, critical thinking, educational technology.

Resumen

El estudio analiza la relación entre las estrategias virtuales de aprendizaje y el desarrollo del pensamiento crítico en estudiantes universitarios de formación docente. En un contexto de creciente digitalización educativa, se reconoce que la simple incorporación tecnológica no garantiza el fortalecimiento de competencias cognitivas complejas, particularmente en instituciones públicas de provincia. La investigación, con un enfoque cuantitativo, diseño no experimental y corte transversal, se realizó con una población censal de 65 estudiantes de tercer año de la carrera de Educación de la Universidad Nacional de San Agustín de Arequipa. Se aplicó un cuestionario estructurado con escalas Likert para evaluar las dimensiones informativa, comunicativa y tutorial de las estrategias virtuales, junto con las dimensiones interpretación, análisis y evaluación del pensamiento crítico. Los resultados mostraron una correlación positiva moderada entre las estrategias virtuales y el pensamiento crítico ($r = 0.641$; $p < 0.05$), resaltando la dimensión comunicativa como la más estrechamente vinculada al desarrollo crítico. Desde una perspectiva sociológica, se identificó que las prácticas pedagógicas centradas en la interacción y el acompañamiento docente favorecen más el pensamiento crítico que el uso aislado de recursos digitales. Se concluye que el desarrollo del pensamiento crítico en entornos virtuales requiere mediaciones pedagógicas intencionadas y no puede limitarse al acceso tecnológico. Este estudio ofrece aportes teóricos y prácticos para el rediseño de la educación universitaria con un enfoque crítico y contextualizado.

Palabras clave: educación superior, pensamiento crítico, tecnología educativa.

Introduction

This study addresses the structural integration of virtualization in contemporary higher education, emphasizing that this transformation goes beyond being a temporary response to the COVID-19 pandemic. In recent years, the continuous incorporation of digital platforms, asynchronous resources, hybrid modalities, and learning management systems has profoundly altered teaching, learning, and assessment practices in Latin American universities (Sabzalieva et al., 2024). While this transition has expanded access to education, it raises questions about the quality of learning, particularly concerning the development of advanced cognitive competencies such as critical thinking.

In this context, the article aims to analyze the relationship between virtual learning strategies and critical thinking among third-year education students at the National University of San Agustín of Arequipa during the year 2025. The research stems from a central concern: although digital environments have ensured pedagogical continuity, a gap persists between the use of educational technologies and the effective promotion of reflective, interpretative, and argumentative skills among students. Recent studies indicate that a transmissive approach predominates, limiting critical interaction and the collective construction of knowledge (Bezanilla et al., 2020; Vargas-Campos et al., 2024).

Critical thinking, understood as a transversal competency that enables individuals to analyze, question, and substantiate ideas in complex contexts, is essential in today's digital society, characterized by information overload, misinformation, and automation. Its development is particularly relevant in teacher training programs, given the multiplier effect of future educators. Therefore, it is crucial to explore how virtual strategies—informational, communicative, and tutorial—facilitate or hinder critical thinking in university practice (Baloa & Navas, 2024; Ennis, 2011).

This study is supported by the theories of Ennis (2011), who posits that critical thinking is a deliberate and reflective process guiding decision-making, and by Baloa and Navas (2024), who connect it with complex cognitive skills such as observation, analysis, interpretation, and argumentation. Flores-Rivera & Meléndez-Tamayo (2024) highlight that digital learning strategies require pedagogical adaptation from both educators and students, particularly in university virtual environments. Recent research emphasizes that critical thinking in higher education can be strengthened through intentional instructional strategies, such as debate, problem-based learning, or peer evaluation (Andreucci-Annunziata et al., 2023).

Within the Peruvian context, studies such as that by Gonzales-Ttito et al. (2025) have shown that the integration of emerging technologies like artificial intelligence, when appropriately incorporated into the pedagogical process, can enhance the development of complex cognitive skills, including computational thinking, which is closely linked to critical thinking. However, this connection can only be solidified through meaningful teacher mediation and an institutional environment that fosters autonomy. Conversely, other studies suggest that students' attitudes toward virtual education may negatively impact their engagement with learning if factors such as motivation, anxiety, and confidence are not addressed. For instance, Gonzales-Ttito et al. (2024) found that a

majority of university students expressed attitudes of rejection or indifference toward virtual activities, hindering their active and critical participation in these environments.

Consequently, the overarching objective of this work is to analyze the relationship between virtual learning strategies and the development of critical thinking in education students. Specifically, it aims to determine the correlation between each dimension—informational, communicative, and tutorial—and critical thinking. The initial hypothesis posits that there is a significant relationship between the use of virtual strategies and the enhancement of critical thinking among the analyzed university students.

Methodology

The methodology employed in this study was based on a quantitative approach, allowing for the objective collection and analysis of data to identify relationships between observable and measurable variables (Hernández Sampieri et al., 2014). Within this framework, the primary goal was to determine the degree of association between the use of virtual learning strategies and the level of critical thinking among students.

A relational or correlational design was utilized, as it sought to detect significant links between variables without establishing direct causality. According to Tamayo and Tamayo (2011), this type of research permits analysis of the intensity of relationships among two or more variables within a specific group. Additionally, a non-experimental, cross-sectional and correlational design was applied, as no variables were manipulated and information was collected at a single point in time (Hernández Sampieri et al., 2014).

The study population consisted of 65 students from the Education program at the National University of San Agustín of Arequipa during the academic year 2025. Due to the limited and accessible number of students, a census sampling approach was chosen, allowing for the inclusion of all enrolled students in the relevant semester.

Data collection was conducted using a structured survey comprising a validated questionnaire with two Likert-type scales. The first evaluated virtual learning strategies in their informational, communicative, and tutorial dimensions; the second assessed the level of critical thinking. Both instruments underwent expert review to ensure content validity and reliability testing using Cronbach's alpha, yielding results exceeding 0.80, indicating high internal consistency.

In terms of inclusion criteria, students officially enrolled in their third year who were taking at least three courses in virtual modality were considered. Those who did not complete the questionnaire or lacked significant experience in virtual environments during the assessed semester were excluded.

From an ethical perspective, confidentiality and anonymity of participants were ensured. All participants were informed of the study's purpose and participated voluntarily, providing informed consent prior to instrument application. The study adhered to ethical principles established by institutional regulations for educational research.

Finally, it is acknowledged that a limitation of this research is that the results are confined to a public university in southern Peru, and thus not generalizable without methodological adjustments or comparative studies in similar contexts.

Results

The findings, analyzed from a critical sociological perspective, reveal that the teaching and learning process in virtual university environments is undergoing a transitional phase, characterized by tensions among technological availability, teaching practices, and students' cognitive dispositions. Firstly, the analysis of virtual learning strategies indicates a generally moderate use of these tools, with an overall mean of 3.42. This usage is predominantly concentrated in dimensions that favor social interaction, particularly the communicative dimension, which has a mean of 3.56. In contrast, the appropriation of autonomous digital resources, reflected in the informational dimension, is lower, with a mean of 3.29. This pattern is illustrated in the following table:

Table 1

Virtual learning strategies

Dimension	Mean	Standard deviation	Low level (%)	Medium level (%)	High level (%)
Informational	3.29	0.65	17.5	66.7	15.8
Communicative	3.56	0.62	9.2	60.8	30
Tutorial	3.41	0.61	13.3	68.3	18.4

Note. Compiled by the authors based on survey implementation

This finding suggests that virtual strategies are primarily employed to maintain interpersonal connections in technologically-mediated educational environments. This supports the assertion of Bourdieu (1997) that cultural and social capital conditions the appropriation of institutional resources. In this context, students appear more reliant on interaction with teachers and peers than on independent access to digital resources, reflecting potential pre-existing inequalities in informational and digital skills.

Moreover, in the tutorial dimension, which involves more structured teacher support, perceptions are positive yet moderate (mean: 3.41). This indicates that pedagogical mediation in virtual environments does not consistently prove effective in fostering critical thinking, often reducing to superficial and instrumental feedback. This situation gains relevance when considering Basil Bernstein's perspectives on pedagogical control, where the deconstruction of educational time and space—much like what occurs in virtual settings—demands greater symbolic and affective mechanisms to sustain learning.

Regarding critical thinking, students demonstrate moderate performance (overall mean: 3.35), with significant differences among its dimensions. The lowest score corresponds to analysis (mean: 3.21), while evaluation (mean: 3.43) and interpretation (mean: 3.40) achieve relatively higher levels. Details are presented below:

Table 2
Critical thinking

Dimension	Mean	Standard deviation	Low level (%)	Medium level (%)	High level (%)
Interpretation	3.40	0.57	19.2	59.2	21.6
Analysis	3.21	0.61	26.7	60.0	13.3
Evaluation	3.43	0.53	14.2	56.7	29.1

Note. Compiled by the authors based on survey implementation

This pattern reveals a significant limitation: while students are capable of understanding and even formulating judgments about information, they struggle to decompose arguments, detect fallacies, or analyze complex logical structures, essential components of critical thinking.

From a sociological perspective, this difficulty can be understood as a structural deficit in critical cognitive training, resulting from an educational system that has historically favored rote and reproductive learning over reflective thinking. In the words of Paulo Freire (1970), this reflects a "banking education" that restricts individuals' critical consciousness. Virtuality, far from altering this paradigm on its own, may even reinforce it if intentional and transformative didactic strategies are not incorporated.

At a relational level, the fact that the communicative dimension (in strategies) and evaluative dimension (in critical thinking) are the highest can be interpreted as an indication that dialogue and social interaction continue to drive reflective thinking, even in technologically mediated environments. This aligns with interactionist approaches, such as that of Vygotsky (1979), which emphasizes the role of significant others in the development of higher cognitive functions.

Finally, it is crucial to highlight that the data also reflect an unequal distribution of technological and pedagogical capital, which cannot be explained solely by access to devices or connectivity but also by educators' competencies to create truly meaningful virtual environments. As education sociologists, these findings invite us to reflect on how the design of virtual strategies can either reproduce or transform conditions of cognitive inequality in contemporary university classrooms.

Correlation between virtual learning strategies and critical thinking

The results of the correlational analysis reveal a positive and significant relationship between the use of virtual learning strategies and the development of critical thinking among university students ($r = 0.641$; $p < 0.05$). This coefficient, indicating moderate intensity, signifies that as students perceive a more frequent and effective use of these strategies, they tend to exhibit higher levels of critical thinking.

This finding supports the assertions made by Bezanilla et al. (2020), who emphasize that critical thinking in higher education can be effectively promoted through methodologies that include structured feedback, real case analysis, and interaction spaces. Similarly, it aligns with the observations of Vargas-Campos et al. (2024), who argue that university virtualization following the pandemic has involved methodological and pedagogical changes that demand new strategies to enhance students' critical thinking.

Relationship by dimensions

When breaking down the variable "virtual strategies" into its three dimensions, it is evident that all maintain positive and statistically significant correlations with critical thinking:

- **Informational dimension: r = 0.582 (p < 0.05):** This moderate correlation suggests that the autonomous use of resources such as readings, videos, and interactive materials contributes to the development of critical skills, albeit with a lesser impact than the more social dimensions.
- **Communicative dimension: r = 0.693 (p < 0.01):** This dimension shows the highest correlation of the study, highlighting the importance of peer and instructor interactions. Interaction through forums, chats, and synchronous classes significantly enhances skills in analysis, argumentation, and evaluation, aligning with socioconstructivist approaches.
- **Tutorial dimension: r = 0.624 (p < 0.05):** Also moderate and significant, this relationship indicates that consistent and formative teacher support provides essential guidance that strengthens reasoning and metacognitive processes. This confirms Bezanilla et al. (2020), who emphasize the role of planned pedagogical strategies in fostering critical thinking.

From a sociological perspective, these results show that critical thinking is not merely developed through exposure to content but rather through the quality of educational interactions and the social context of learning. Therefore, virtual environments designed with inclusive and participatory pedagogical criteria can foster the development of more critical, reflective, and autonomous individuals.

Discussion

The findings of this research confirm the existence of a positive and significant relationship between virtual learning strategies and critical thinking among university students in teacher training. From a sociological perspective, this relationship is not only statistically relevant but also offers interpretative insights into the transformation processes occurring in higher education within post-pandemic and digital contexts.

Firstly, the results support the study's overarching hypothesis: the effective use of virtual strategies is associated with a greater development of critical thinking. However, this assertion should not be interpreted in a linear or deterministic manner. As evidenced in the analyses, the dimensions related to social interaction—the communicative and tutorial dimensions—exhibited the highest correlation coefficients (r = 0.693 and r = 0.624, respectively), while the informational dimension showed a moderate relationship (r = 0.582). This difference underscores that critical thinking is not activated solely by exposure to digital content but primarily through processes of dialogue, feedback, and collaborative meaning-making.

From the theoretical framework of the structuration theory by Giddens (1984), this phenomenon can be interpreted as the simultaneous reproduction and transformation of learning structures. Thus, virtual platforms, as mediating tools, acquire pedagogical agency only when appropriated by individuals (teachers and students) through reflective social practices. In this sense, technology alone does not change educational practices; it is the structured interactions that can foster the development of critical dispositions among students.

Secondly, the descriptive analysis revealed that the dimension of critical analysis is the least developed among students (mean = 3.21). This weakness is concerning, especially in fields such as Education, which bear the responsibility of training professionals capable of questioning, arguing, and constructing knowledge in various educational contexts. This limitation can be understood as a consequence of the traditional educational model, focused on content transmission and rote evaluation, even when transitioned to digital formats. We concur with Freire (1970) that critical literacy requires pedagogical conditions that destabilize cultural passivity and promote a problematizing reading of the world.

On the other hand, a more favorable performance was noted in the dimensions of interpretation and evaluation, which may be explained by the inclusion of activities that require text comprehension, case analysis, and responses to open-ended questions, common practices in virtual environments. However, without dialogical components and teacher guidance, these tasks risk becoming routine exercises lacking critical depth. Therefore, the role of the teacher must be understood not as a mere transmitter of knowledge but as a facilitator of spaces that encourage critical thinking.

In terms of the scientific novelty of this study, particularly in technology-mediated environments, it lies in its ability to empirically articulate the relationship between specific dimensions of educational virtuality and higher cognitive competencies within the context of a teacher training university program. Unlike other research that

addresses critical thinking in a general fashion, this work specifies which forms of virtual interaction hold the most potential for its development, a fundamental aspect for the redesign of curricula in Peruvian higher education.

Additionally, this study is positioned within an emerging line of research in the country: the sociology of digital education. By providing evidence from a public provincial university, it highlights dynamics often absent in the literature, which tends to focus on large capital universities. This decentralized perspective facilitates understanding how institutional conditions, technological culture, and student profiles shape differentiated educational scenarios that require contextualized pedagogical responses.

On a more contentious note, this study challenges the belief that digitalization alone improves learning quality. On the contrary, it demonstrates that, without intentional pedagogical strategies, virtualization can reproduce the passive logics of the traditional educational system. This necessitates a critical reevaluation of innovative educational policies in public universities, which often focus more on acquiring technological platforms than on strengthening teaching capacities and transforming pedagogical practices.

From a theoretical and prospective perspective, a promising pathway emerges that integrates sociological approaches with critical pedagogical frameworks to understand how educational technologies impact the development of reflective, autonomous, and socially committed subjectivities, whether positively or negatively. In this context, critical thinking cannot be conceived as an isolated individual skill but as a situated social practice that requires structural conditions for its emergence and sustainability.

Finally, in practical terms, this study offers guidance for educational institutions to design more effective virtual strategies, prioritizing participatory methodologies, critical teacher support, and genuine interaction spaces. Likewise, its results can be useful for continuous teacher training programs, university pedagogy courses, and educational quality self-evaluations, particularly within the context of public universities in the country.

Conclusions

This research concludes that virtual learning strategies play a fundamental role in shaping critical thinking within university contexts, provided they are activated through intentional, interactive pedagogical practices aimed at fostering reflective cognitive development. Rather than being considered neutral tools, these strategies function as social devices whose efficacy relies on how students and educators appropriate them in specific contexts.

Firstly, it is evident that social interaction—particularly through communicative and tutorial resources—constitutes the most influential component in promoting critical thinking, surpassing mere access to digital information. This finding underscores the necessity to reconceptualize virtuality not merely as a transmission channel but as a relational space where meanings are constructed, knowledge is negotiated, and critical dispositions are generated.

Additionally, it was found that skills associated with argumentative analysis remain the weakest aspect of critical thinking among university pedagogy students. This limitation challenges educational institutions to redesign their teaching strategies, not only to incorporate technology but also to promote structured reasoning, informed questioning, and critical reading of the social environment.

From a structural perspective, the results indicate that educational virtualization processes in Peru—especially in provincial public universities—still operate within traditional frameworks, where digital tools have been integrated for operational purposes without transforming the underlying pedagogical logic. Thus, the study demonstrates that critical thinking does not arise merely from the presence of technologies, but rather from the pedagogical and sociocultural significance of their implementation.

As part of a sociological line of inquiry in education, this research contributes evidence on how technological mediations influence the configuration of cognitive subjectivities, shaped by institutional structures, teacher dispositions, and student trajectories.

However, several open questions remain that need to be addressed in future research: What institutional, political, and cultural conditions either facilitate or hinder a transformative implementation of virtual strategies? How do digital inequalities interact with the real possibilities of developing critical thinking in virtual classrooms? What influence do teacher profiles and their sociocultural capital have on the critical orientation of virtual teaching?

Consequently, this research invites other scholars to delve deeper into these aspects, complementing this study with qualitative, longitudinal, or comparative approaches to further expand the understanding of the relationship between digital pedagogy, cognitive development, and educational justice in contemporary higher education.

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