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Critical thinking and digital literacy: A vital relationship in the initial training of future teachers

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Abstract

Digital literacy and critical thinking are intrinsic and complementary skills. Currently, the management of digital skills is essential to access the diverse and abundant virtual information; it is a necessary input to have the cognitive support to process, interpret, and evaluate new information, which will be transformed into new knowledge. The objective of this research was to establish the correlation between digital literacy and critical thinking among students at a public university in Peru, which trains future professionals for regular basic education at the initial level. The sample consisted of 115 students from the Faculty of Early Childhood Education, who were administered two questionnaires that were validated by the statistical reliability coefficient. The results indicate a positive and significant correlation between digital literacy and critical thinking, specifically around the skills of evaluation, criticality, analysis, and synthesis of the information consumed. Based on the research conducted, it is concluded that the higher the level of digital literacy, the more complex and developed critical thinking tends to be.

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Pensamiento crítico y alfabetización digital: Una relación vital en la formación inicial de futuros docentes

Resumen

La alfabetización digital y el pensamiento crítico son habilidades intrínsecas y complementarias. En la actualidad, el manejo de competencias digitales es fundamental a fin de tener acceso a la diversa y abundante información virtual; insumo necesario para disponer del soporte cognitivo para procesar, interpretar y valorar la nueva información, que se transformará en nuevos conocimientos. El objetivo de la presente investigación fue establecer la correlación entre alfabetización digital y pensamiento crítico en los discentes de una universidad pública del Perú, que forma futuras profesionales para la educación básica regular en el nivel inicial. La muestra lo conforman 115 estudiantes de la Facultad de Educación Inicial, a quienes se le aplicó dos cuestionarios que fueron validados por el coeficiente de confiabilidad estadística. Los resultados hallados indican que existe una correlación positiva y significativa entre la alfabetización digital y el pensamiento crítico, específicamente en torno a las habilidades de evaluación, criticidad, análisis y síntesis sobre la información consumida. A partir de la investigación realizada se concluye que, cuanto mayor sea el nivel de alfabetización digital tienden a exhibirse un pensamiento crítico más complejo y desarrollado.

Palabras clave: Pensamiento crítico; alfabetización digital; habilidades digitales; razonamiento crítico; alfabetización mediática.

Introduction

Teaching has transcended its traditionally local dimension and impact to consolidate itself as an activity of global scope, asynchronous and synchronous classes developed through webinars or virtual video calls means that the professional teacher profile is not only sustained in disciplinary management, at the same time the teacher must know and apply the different procedures so that students feel motivated and direct their attention to image-assisted classes, texts, videos and a variety of virtual resources, which allow the desired learning purpose to be achieved.

If face-to-face learning turns out to be extremely complex according to the ages of the learners, contextualizing it in virtual spaces has considerably increased the hurdle and at the same time the gap between those who learn what they want and those who learn what they will soon have to unlearn; for this it is necessary not only the constant intervention of the student; the learner must have an adequate level of critical thinking that allows them to transform what they have learned into proposals to solve problems, make more effective decisions, create new answers and reflect much more accurately on the demands of everyday life (Robles, 2019; Delgado et al., 2019; Cárdenas-Oliveros et al., 2022; Pedraja-Rejas & Rodríguez, 2023; Gutiérrez-Pingo et al., 2023).

One of the most common problems faced by the user of virtual sources is framed in the deliberate and strategic dissemination of fake information, which has the purpose of manipulating and/or deceiving the unwary who are today millions locally, regionally, nationally and worldwide. The solution to this usual problem is related to the effective management of digital literacy and critical thinking, while the current generation obtains information through social networks, information which needs adequate decoding that involves reflection and responsible

decisions (Santos, 2021; Weiss et al., 2021).

Properly managing digital media, processing information, and concluding with the efficient retrieval of information, involves an adequate development of skills around digital literacy (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2011); The aim of this research is to identify how these variables correlate in the sample of focused teachers, who will soon take the role of teachers at the nursery education level. Each of the relevant aspects of the research is detailed below.

1. Theoretical foundation

Virtual education became universal as a result of health requirements in the world, this situation led national and private universities to regulate its use through virtual platforms and classrooms. This new scenario imposed adverse conditions on students with deficient digital literacy, making it impossible for them to access quality educational services. In this regard, UNESCO came to consider digital literacy, in times of pandemic, as a driver of sustainable progress and a vital protagonist in educational access. The relevance and power of educational sustainability generated by digital literacy makes it an imperative in the line of educational research.

Digital literacy provides students with the tools to critically search, evaluate and select information from a wide variety of digital sources (Ramírez et al., 2021); to increase its effectiveness it needs critical thinking, which allows it to analyze the credibility, objectivity and relevance of information found online, thus avoiding misinformation and fake news.

The post-pandemic scenario has increased the demand for the application of critical thinking, managing this type of thinking provides the best conditions to face the new academic demands and efficient management of information; Unfortunately, in the region, future professionals, university students, do not reach the expected level of criticality; some of them have difficulties in

critically interpreting everyday events (López et al., 2022).

In the region, it was found that a part of university students, future specialists in various careers, had an acceptable level of systematization skills and security in reasoning; but at the same time, the level of skills connected to curiosity, mental breadth and search for truth, registered a scarce mastery; the causes associated with this adverse scenario are related to the scarce pedagogical training that teachers have and that is evidenced in the scarce use of strategies that promote higher cognitive skills from early school age to higher education strata (Salazar & Cabrera, 2020; Hernández et al., 2021; Chávez et al., 2022; Huaita et al., 2025).

Critical thinking is a skill of great relevance for students in today's virtual world (Van Peppen et al., 2018), the inclusion of cognitive processes such as reasoning, reflection and analysis, are today the support for making correct decisions (Akın et al., 2015). Effective decisions are born from an exhaustive understanding of the problem, following the route of evaluating and explaining, inherent processes for an adequate analysis of the event and its next action (Yilmaz, 2023). This skill needs to be developed by teachers, through their previously planned educational resources and materials, each of these elements being fundamental for the development of critical thinking (Gashan, 2015).

According to Facione (2007), critical thinking can be defined as "the process of intentional, self-regulating judgment" (p. 22). This way of thinking makes use of different skills: Interpretation, allows categorizing, decoding meanings and clarifying symbols or signs that contain a specific situation or lived experience. Analysis, helps to examine ideas, identify arguments and study them in depth. Evaluation, a skill that enables people to evaluate statements or arguments based on validated or refereed sources that allow the credibility or reliability of information to be recognized. Inference, allows us to examine evidence, make hypotheses about proposed alternatives and deduce conclusions that allow

us to solve problems efficiently. Explanation, makes easier the description of the results obtained, accompanied by arguments and justifies the procedures used to reach the proposed solutions. Self-regulation, grants the ability to self-examine and self-correct in the process or at the end of the reasoning carried out.

This type of thinking allows for the integration of complex cognitive skills, which lead the student and teacher to processes of transformation, necessary for the development of mankind (Da Costa et al., 2016). This development materializes in improving learning conditions and promoting the activity of thinking from multiple perspectives at a systematic and reflective level (Cruz & Hernández, 2021). The final product will be the new mental representations resulting from reasoning, imagination and problem-solving that happen in everyday life (Alsaleh, 2020).

For the twenty-first century, the demands and needs have meant that critical thinking, still being so complex and holistic, is only seen as one of the urgent skills; creative thinking, problem-solving, and communication are added to this (Bahtiar et al., 2023). Although these four skills are part of the "new menu" of academic demand, critical thinking is still the most relevant, as Putri et al. (2018) state, "Critical thinking is important because those who practice it have a greater ability to solve difficulties" (p. 34). Consequently, this type of thinking constitutes the foundation on which informed decision-making and intellectual autonomy are built.

The development of these skills is necessary to have an adequate profile of the future professional in education, digitized environments have become more challenging contexts to make teaching work effective in the search for learning and the development of skills for critical analysis (De los Santos & Martínez, 2021); This problematic situation highlights the need to investigate the current relationship between digital literacy and critical thinking.

Digital skills have become the "alphabet" used today to communicate with others. The message, channel, code, receiver and context are the elements that have digitization as a support; therefore, the skill of its use is connected as a prerequisite for the development of critical thinking. Educational demands today denote that ICT skills have a deep relationship with critical thinking (Křeménková et al., 2021)

Educational digitalisation and a lack of competition in the use of digital tools (use of office automation, artificial intelligence, social networks, among others) have generated a negative impact, related to the limited capacity to organize and access objective, validated, and truthful information. According to Álvarez et al. (2021), the lack of knowledge of these tools reduces students' possibilities to interact critically with the available information, which in turn affects their comprehensive training as future educators.

Digital literacy is considered a skill that allows access to virtual information in a responsible, ethical, and proactive way (García, 2017). According to Salado et al. (2020), this skill provides the ability to manage digital information critically and creatively in a context where technology mediates diverse human activities.

The first to use and define the construct "digital literacy" was Gilster (1998), defining it as the ability to understand and apply information from various sources obtained through the computer. Years later, Kim & Yang (2016) defined this variable as the ability to search, classify, analyze, hierarchize, evaluate, and create information using digital technology as a support; With this, he ensured that anyone who has mastered digital literacy could surf the digital world without the possibility of being wrecked.

Today, digital literacy is no longer a capacity but a competence, which is essential for every citizen of the twenty-first century (Öztürk, 2021). The mastery of this macro skill allows the citizen to expand and make effective communicational interactions in favor of learning (Marsh, 2016), allowing people to achieve their educational, social, personal, and professional goals (Yılmaz, 2023).

This new competence requires new skills; therefore, new cognitive processes related to the understanding and use of multimedia information that is acquired through computers. Digital literacy promotes learning autonomy, as it provides the viability of access to information and at the same time provides the tools to make decisions effectively.

According to Area (2014), digital literacy allows the acquisition of skills to successfully face the computer world (binary language) through the use of technology (hardware and software) to facilitate communication and access to information. For a more specialized study, this category registers six dimensions, which allows us to visualize its development in the context of digital citizenship in the 21st century.

The dimensions of the analyzed variable are as follows: Instrumental dimension, skill in the use of hardware and software. Cognitive dimension, ability to manage information (search, selection, application, evaluation and gathering of information) to acquire knowledge. Communicative dimension: attitude to share information safeguarding rules and coexistence based on netiquette. Axiological dimension, ability to promote ethical and democratic citizenship, assuming that technologies have a significant impact on the construction of society; and Emotional dimension, virtual scenarios are challenging contexts, which can easily provoke emotions, feelings or affections that can add or subtract from the construction of a full citizenship.

In this context, the present research aims to determine the relationship between digital literacy and critical thinking in students of the National University of Education (UNE). Its main hypothesis is framed in attributing which critical thinking skills are directly related to digital literacy. This idea is supported by the research carried out by Cosi et al. (2023) who found:

> Positive and significant correlations ($r = 0.55$, with a p-value $<.001$) between digital literacy and critical thinking. Similarly, positive and significant correlations were found between digital literacy and each of the dimensions of critical thinking, with the dimension 'decision-making' ($r = 0.51$) and the dimension 'problem solving' ($r = 0.51$) being the ones that best correlate with the variable digital literacy. (p. 109)

In addition, several specific hypotheses have been formulated that address the different dimensions of digital literacy, such as the instrumental, cognitive, communicative, axiological and emotional dimensions. In each of the hypotheses, the dimensions have been correlated with the cognitive skills associated with students' critical thinking, while each of these dimensions plays a crucial role in the formation of competent and critical educators.

The relevance of this research lies in the need to fit up future educators with the necessary skills to navigate a digital world and foster strong critical thinking. This will not only improve their academic performance but will also allow them to teach their future students more effectively, thus promoting quality education and informed citizenship. By understanding the relationship between these two variables, pedagogical strategies can be implemented that strengthen digital literacy and, consequently, critical thinking.

2. Methodology

The research is part of a quantitative study of correlational design, in which the behavior of the relationship between the variables is statistically analyzed, which has made it possible to determine the type of association between the constructs in question. The method used was hypothetical-deductive, based on the alternative hypothesis that affirms a significant relationship between the variables.

Students from the Faculty of Early Education (FEI) of the National University of Education (Peru) participated in the research, specifically those who made up the class of 2020 and were in the VI academic cycle. It is important to note that these students fully developed their initial teacher training process remotely (virtually). The non-probabilistic

sample was made up of 115 students, all female, who represented all the students of the class of 2020, belonging to the specialties of Early Childhood and Intellectual Disability of the FNE. The educational institution in which the research was carried out is one of the main trainers of the national teaching profession, from whose classrooms graduate a large part of the teaching staff who work at the nursery educational level.

The survey technique was used for data collection, using a questionnaire as an instrument. With respect to the variable Critical Thinking Skills, a Likert-type questionnaire was developed to identify ideals and behaviors through propositions with a scale of five response options, ranging from "Strongly disagree" (1) to "Strongly agree" (5). The dimensions evaluated were: Interpretation, evaluation, inference, explanation, and self-regulation (Facione, 2007). The items were written in a clear and concise manner, avoiding ambiguities, biases and covering the different dimensions of critical thinking.

Regarding the Digital Literacy variable (Area, 2014), a questionnaire was used with answers on a frequency scale ranging from "Never" (1) to "Always" (5). The dimensions evaluated were: Instrumental, cognitive, socio-communicational, axiological and emotional, with six items per dimension. The frequency scales made it possible to quantify more accurately the frequency with which students carried out certain actions related to digital technologies, thus providing a clear and objective view of their skills and knowledge in this field.

The methodological aspects are detailed below: For variable 1, 5 dimensions and 19 indicators were evaluated; In the case of variable 2, 5 dimensions and 12 indicators were considered, as summarized in Table 1. It is important to mention that each of the instruments was duly validated by three experts in the field, giving both a value of 87.00% validity. Regarding the reliability analysis, the instrument of variable 1 obtained a reliability coefficient of 0.980; while that of variable 2 reached a coefficient of 0.948, which in both cases indicates a high level of reliability.

Table 1
Variable, dimensions and indicators

VARIABLE	DIMENSIONS	INDICATORS / ITEMS
V1 **CRITICAL THINKING**	• Interpretation	• Categorization • Decoding meanings • Clarifying meanings
	• Analysis	• Browse ideas • Identify arguments • Analyze arguments
	• Evaluation	• Evaluate Claims • Evaluate arguments
	• Inference	• Examining Evidence • Conjecture alternatives • Draw conclusions
	• Explanation	• Describe results • Presenting arguments • Justify procedures
	• Self-regulation	• Self-examination • Autocorrect

Cont... Table 1

	•	Instrumental dimension	• Hardware and software skills • Hardware and software knowledge
V2 **DIGITAL LITERACY**	•	Cognitive dimension	• Selectively search for information • Select validated information • Analyze and interpret information based on criteria • Criticizing information using critical reasoning
	•	Socio-communicational dimension	• Communicate efficiently through information technology • Respect the rules of coexistence in digital spaces
	•	Axiological dimension	• Responsible use of ICTs • Ethical use of ICTs • Promotion of values through ICTs
	•	Emotional dimension	• Emotions provoked by experience in digital environments • Digital identity

Source: Own elaboration, 2025.

With the permission of the university authorities of the Faculty of Early Education, the two questionnaires were applied in paper and pencil format. Previously, the students signed an informed consent form that clearly detailed the objective of the study, the voluntary nature of their participation, the corresponding anonymity, as well as the safeguarding of the information obtained. The instruments were applied in the corresponding classrooms, according to the specialty of the participants. To establish the degree of associative relationship between critical thinking skills and digital literacy, Spearman's Rho correlation coefficient was used, considering the level of significance alpha ≤ 0.05. Finally, SPSS version 29 software was used to perform these analyses.

3. Results and discussion

In relation to the results obtained in the analysis of the study variables in the students in the faculty of early education at the National University of Education, in the year 2023, the following was obtained: Table 2 of frequencies of the variable critical thinking skills shows that 60.9% of the students of the Faculty of Early Education (FEI) of the UNE have a high level, 20.9% have a moderate level and 18.3% of the students have a low level.

Table 2
Levels of critical thinking skills in UNE students

Variable and Dimension	Level	Rank	f	%
Critical thinking	High	60 - 80	70	60,9
	Middle	39 - 59	24	20,9
	Low	17 - 38	21	18,3
Interpretation	High	12 - 15	66	57,4
	Middle	8 - 11	27	23,5
	Low	3 - 7	22	19,1
Analysis	High	12 - 15	67	58,3
	Middle	8 - 11	26	22,6
	Low	3 - 7	22	19,1

Cont... Table 2

	High	9 - 10	38	33
Evaluation	Middle	6 - 8	50	43,5
	Low	2 - 5	27	23,5
	High	12 - 15	72	62,6
Inference	Middle	8 - 11	21	18,3
	Low	3 - 7	22	19,1
	High	12 - 15	74	64,3
Explanation	Middle	8 - 11	20	17,4
	Low	3 - 7	21	18,3
	High	9 - 10	37	32,2
Self-regulation	Middle	6 - 8	54	47
	Low	2 - 5	24	20,9

Note: Details the levels found in each of the dimensions of the variable: critical thinking in the total number of FNE students.
Source: Own elaboration, 2025.

Regarding the dimensions of the variable, those that had a better assessment were interpretation, analysis, inference and explanation. This indicates that students recognize applying these skills. On the other hand, the dimension that had the lowest value was the explanation, this result must be taken into account to reinforce this skill later.

Table 3 presents the behavior of the study variable digital literacy and its dimensions, three levels were considered for the study of this variable: Low, medium and high. In the results shown, 28.7% of the students have a high level with respect to digital literacy, 51.3% medium level and 20% low level. This is because the students have a digital training, typical of the Generation Z to which they belong, but also because of academic training from the first cycles of study at the UNE, so it should continue to reinforce the use of applications such as artificial intelligence, among others. Regarding the dimensions of the variable, the one that had a better assessment was the instrumental, the other dimensions such as cognitive, socio-communicational, axiological and emotional are positioned at a medium level. This indicates that female students must continue to improve their knowledge in digital education.

Table 3
Levels of Digital Literacy in UNE students

Variable and Dimension	Level	Rank	f	%
	High	121 - 140	33	28,7
Digital Literacy	Middle	100 - 120	59	51,3
	Low	78 - 99	23	20
	High	16 - 20	57	49,6
Instrumental	Middle	12 - 15	50	43,5
	Low	7 - 11	8	7
	High	42 - 50	32	27,8
Cognitive	Middle	34 - 41	54	47
	Low	25 - 33	29	25,2

Cont... Table 3

	High	18 - 20	40	34,8
Communication Partner	Middle	14 - 17	54	47
	Low	9 - 13	21	18,3
	High	27 - 30	38	33
Axiological	Middle	22 - 26	54	47
	Low	16 - 21	23	20
	High	19 - 20	31	27
Emotional	Middle	16 - 18	57	49,6
	Low	12 - 15	27	23,5

Source: Own elaboration, 2025.

3.1. Inferential Analysis

Table 4 shows the analysis of normality in the variables critical thinking and digital literacy along with their dimensions, none of these presented values that fit a normal distribution since the meanings obtained were less than 5%. Therefore, the results obtained allowed the application of the non-parametric correlation test, Spearman's Rho, to corroborate the research hypotheses.

Table 4
Normality test for the variables Critical thinking, Digital literacy and dimensions.

	Kolmogorov-Smirnova			
	Statistical	**Gl**	**Itself.**	**Normality**
Critical thinking	0,377	115	0,000	No
Digital Literacy	0,263	115	0,000	No
Instrumental	0,318	115	0,000	No
Cognitive	0,236	115	0,000	No
Communication Partner	0,244	115	0,000	No
Axiological	0,241	115	0,000	No
Emotional	0,250	115	0,000	No

Source: Own elaboration, 2025.

To test the research hypotheses, the following analysis was carried out: When applying Spearman's Rho correlation coefficient, it is determined that there is a significant relationship between critical thinking and digital literacy in UNE students in 2023. Because its significance value is less than 0.05. In addition, the value of the coefficient denotes a positive and strong relationship.

Table 5, when applying Spearman's Rho correlation coefficient, denotes that there is a significant relationship between critical thinking and the dimensions of digital literacy such as: Instrumental, cognitive, socio-communicational, axiological and emotional. In addition, it presents a moderate positive relationship between Critical Thinking and the instrumental dimension.

Table 5
Analysis of the relationship between critical thinking skills and digital literacy

Variables	Digital Literacy			
	N	Statistical test	Correlation coefficient	Significance
Critical thinking	115	Rho de Spearman	0.887**	0.000

Note: The correlation is significant at the 0.01 level (bilateral).
Source: Own elaboration, 2025.

For critical thinking and the cognitive, socio-communicational, axiological, and emotional dimensions present a strong positive relationship (see Table 6). In the case of the moderate relationship between critical thinking and the instrumental dimension, this is because critical thinking skills do not depend on the instrumental handling of technology.

Table 6
Analysis of the relationship between critical thinking skills and digital literacy dimensions

Variable	Critical thinking			
Dimensions	N	Statistical test	Correlation coefficient	Significance
Instrumental	115	Rho de Spearman	0.582**	0.000
Cognitive	115	Rho de Spearman	0.811**	0.000
Communication Partner	115	Rho de Spearman	0.785**	0.000
Axiological	115	Rho de Spearman	0.769**	0.000
Emotional	115	Rho de Spearman	0.706**	0.000

Source: Own elaboration, 2025.

The findings of this research show a significant relationship between digital literacy and critical thinking skills in students of the National University of Education (UNE), which validates the main hypothesis raised. According to the results, students with higher levels of digital literacy tend to develop better critical skills, which coincides with recent studies, such as those carried out by Méndez-Toledo (2022); and Gamboa & Santos (2025). These authors highlight that digital literacy not only improves technical skills, but also fosters stronger critical thinking by facilitating access, evaluation, and responsible use of information. In the context of UNE, this underlines the need to integrate these dimensions into teacher training to prepare educators capable of facing the challenges of the digital age.

The analysis by dimensions revealed that the cognitive dimension of digital literacy has the strongest relationship with critical thinking ($r = 0.811$, $p < 0.01$). This suggests that skills related to searching, selecting and critically analysing digital information are essential to develop critical competencies. This finding matches with studies such as that of Salado et al. (2020), who state that digital literacy includes cognitive processes essential for the acquisition of knowledge. Likewise, the communicative dimension ($r = 0.785$, $p < 0.01$) demonstrated a significant relationship, indicating that digital competencies also contribute to the development of parallel cognitive skills.

On the other hand, although the axiological ($r = 0.769$, $p < 0.01$) and emotional ($r = 0.706$, $p < 0.01$) dimensions showed slightly lower relationships, their impact should not be underestimated. The axiological dimension underlines the importance of the

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ethical and responsible use of technology; while the emotional dimension reflects how the management of emotions in digital environments influences critical capacities. These findings agree with García (2017), who points out that digital literacy is not only technical but also ethical and emotional, so the development of these competencies is essential to strengthen the comprehensive education of students.

Finally, the findings reinforce the need to integrate pedagogical strategies that enhance critical thinking and digital competencies simultaneously, especially in university contexts. Implementing active methodologies such as the flipped classroom or inquiry-based learning (Figueroa et al., 2018) could foster more meaningful learning aligned with current digital challenges (Gamboa & Santos, 2025). This will not only benefit academic training but will also prepare students to be critical and responsible citizens in an increasingly competitive and digital world.

Conclusions

The results obtained in this research confirm that there is a significant and positive relationship between critical thinking skills and digital literacy in students of the Faculty of Early Education of the National University of Education. This relationship suggests that the improvement in digital skills is closely linked to the development of critical skills, essential to face the educational challenges of the twenty-first century.

It is observed that 20% of students have a low level of digital literacy, while 28.7% reach a high level, which denotes disparities in access and adequate use of technological tools. This data is particularly relevant, since those with lower levels of digital literacy also tend to show significant limitations in critical thinking, reinforcing the need for comprehensive strategies that address both competencies.

Finally, it is concluded that the instrumental, cognitive and axiological

dimensions of digital literacy have a direct relationship with students' critical skills. This reinforces the importance of incorporating innovative pedagogical approaches and technological resources that promote not only technical competence, but also critical and reflective judgment, allowing a higher level of competitiveness in the graduate profiles of future professionals in education.

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