

Development of Teaching Skills for the Pedagogical Integration of Artificial Intelligence Tools in Virtual University Environments

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ABSTRACT:

In the context of the digital transformation of higher education, the pedagogical integration of artificial intelligence tools in virtual university environments became a relevant element for strengthening educational innovation and improving teaching and learning processes. Within this framework, the general objective of the study was to analyze the development of teaching competencies for the pedagogical integration of artificial intelligence tools in virtual higher education environments in order to identify training and pedagogical factors that favored their effective implementation. Methodologically, the research was conducted using a quantitative approach with a non-experimental, descriptive-correlational, and cross-sectional design. The population consisted of university teachers who carried out academic activities in virtual environments, and a sample of 150 participants was selected through intentional sampling. Data collection was performed using a structured questionnaire with a Likert-type scale, which was validated through expert judgment by ten specialists considering criteria of coherence, relevance, and clarity. The results showed that teachers demonstrated a favorable perception regarding the development of digital and pedagogical competencies for the use of artificial intelligence tools, highlighting their potential for educational innovation, learning personalization, automated feedback, and analysis of academic progress through learning analytics. However, the findings also indicated the need to strengthen teacher training programs focused on the pedagogical use of emerging technologies in virtual higher education. **Keywords:** peacekeeping education; higher education strategy; DEMATEL; analytic network process; mixed methods; defence diplomacy; Indonesia **Keywords:** educational artificial intelligence; teaching competencies; virtual higher education; pedagogical innovation.

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Introduction

In the context of the digital transformation of higher education, the development of teaching competencies for the pedagogical integration of artificial intelligence tools in virtual university environments constitutes an emerging topic of significant academic and educational relevance. The incorporation of artificial intelligence–based technologies is redefining teaching, assessment, and learning support practices, particularly in virtual and blended modalities. According to Luckin et al. (2016), artificial intelligence applied to education has the potential to personalize learning processes and optimize data-driven pedagogical decision-making. Likewise, Holmes et al. (2019) argue that these technologies can transform educational systems by enabling new forms of interaction, automated feedback, and analysis of student progress.

In this sense, the pedagogical integration of artificial intelligence tools in virtual university environments is particularly relevant due to the growing expansion of online education and the need to strengthen the quality of technology-mediated teaching and learning processes. The COVID-19 pandemic accelerated educational digitalization, highlighting the importance for educators to develop advanced digital competencies to address the pedagogical challenges of the 21st century. According to Selwyn (2019), artificial intelligence is reconfiguring educational practices by introducing new forms of automation and learning analytics. Complementarily, Zawacki et al. (2019) point out that the adoption of these technologies requires educators capable of interpreting, managing, and critically applying intelligent systems in educational contexts.

However, despite the potential benefits of artificial intelligence in higher education, its effective implementation faces multiple challenges related to faculty pedagogical preparation. Many university instructors lack specific training to integrate artificial intelligence tools in a didactic and critical manner within their teaching practices. According to Mishra & Koehler (2006), the meaningful integration of

technology in education requires the development of interrelated pedagogical, technological, and content knowledge. Likewise, Redecker (2017) emphasizes that teachers' digital competencies are a key element in ensuring the effective pedagogical use of emerging technologies, especially in virtual learning environments.

From a theoretical perspective, this research is primarily grounded in the TPACK model (Technological Pedagogical Content Knowledge) and in the framework of teachers' digital competencies, approaches that enable the analysis of the interrelationship between pedagogical, disciplinary, and technological knowledge in technology-mediated educational processes. The TPACK model posits that effective technological integration in teaching requires understanding the interaction among these three types of knowledge. Piñán (2025) argues that teachers must develop competencies that integrate technology and pedagogy to design meaningful learning experiences. Complementarily, Koehler et al. (2013) highlight that this model provides a robust conceptual framework for analyzing educational innovation mediated by digital technologies.

Consistent with this theoretical perspective, the fundamental principles of the TPACK model emphasize the need to understand technology not as an isolated resource, but as an integrated component within the pedagogical process. This approach proposes that technological knowledge must be articulated with pedagogical and disciplinary knowledge to generate contextualized and meaningful learning experiences. According to Koehler & Mishra (2009), the development of teaching competencies within this model implies the ability to select, adapt, and use technologies in accordance with specific pedagogical objectives. Likewise, Cabero & Palacios (2021) point out that teacher training in digital competencies requires systematic professional development processes that integrate pedagogical innovation and the critical use of emerging technologies.

Regarding previous studies, various investigations have analyzed the impact of artificial intelligence in higher education and the role of teaching competencies in its implementation. These studies agree that the pedagogical use of artificial intelligence tools largely depends on faculty professional preparation. According to Zaragoza (2026), research on artificial intelligence in education has mainly focused on intelligent tutoring systems, learning analytics, and the automation of educational processes. Likewise, Holmes et al. (2022) maintain that the integration of these technologies requires structural changes in teacher education and in institutional policies for educational innovation.

In the same vein, recent research has examined how educators perceive and adopt artificial intelligence technologies in virtual learning environments. The findings show that factors such as digital literacy, attitudes toward technological innovation, and institutional support significantly influence the pedagogical use of these tools. According to Bond et al. (2021), teachers with higher levels of digital competence demonstrate a greater willingness to experiment with emerging technologies in their pedagogical practices. Similarly, Chiu et al. (2021) indicate that the adoption of advanced educational technologies depends on both individual and organizational factors within higher education institutions.

Based on these antecedents, several authors have emphasized the importance of more deeply investigating the development of teaching competencies related to educational artificial intelligence. In particular, the need has been identified to explore how university instructors can integrate these tools into virtual learning environments without compromising fundamental pedagogical principles. According to Modesto et al. (2025), artificial intelligence should be used as a support for human learning rather than as a substitute for pedagogical interaction. Complementarily, Leite (2025) warns that the use of intelligent technologies in education must be critically analyzed to avoid

technocratic approaches that diminish the role of the teacher.

Consequently, this study aims to contribute to the research field through an empirical analysis of the development of teaching competencies required for the pedagogical integration of artificial intelligence tools in virtual university environments. Unlike previous research primarily focused on technological aspects, this work emphasizes the pedagogical and formative dimension of university faculty. According to Moreira (2025), the development of teachers' digital competencies constitutes a continuous process involving training, reflective practice, and institutional evaluation. Likewise, Garzón (2025) state that the effective integration of emerging technologies requires teacher training strategies oriented toward meaningful learning.

Furthermore, this research contributes to the academic debate by proposing an integrative approach that links the development of teaching competencies with educational innovation mediated by artificial intelligence. In this way, the study aims to generate empirical evidence to understand how university instructors can develop pedagogical skills to use these technologies in a critical, ethical, and contextualized manner. In this regard, Torres et al. (2025) highlight that artificial intelligence in education should be oriented toward strengthening creativity, critical thinking, and collaboration. Complementarily, Haro et al. (2025) underscore the need for empirical research analyzing the real pedagogical implementation of these technologies.

In this context, the need arises to analyze how university instructors develop pedagogical competencies to integrate artificial intelligence tools in virtual learning environments. Despite the growing institutional interest in incorporating intelligent technologies into higher education, limitations persist related to teacher training, the pedagogical appropriation of these tools, and the lack of clear models for their educational implementation. Consequently, the research question guiding this study is: How does the development of teaching competencies influence

the pedagogical integration of artificial intelligence tools in virtual university environments? The general objective of the research is to analyze the development of teaching competencies for the pedagogical integration of artificial intelligence tools in virtual university environments, with the aim of identifying formative and pedagogical factors that facilitate their effective implementation.

Based on the theoretical framework and the analyzed background, the research hypothesis proposes that the development of digital and pedagogical teaching competencies significantly influences the effective integration of artificial intelligence tools in virtual university environments. In this regard, it is expected that educators with higher levels of technological, pedagogical, and educational innovation competencies will demonstrate a greater capacity to design artificial intelligence mediated learning experiences that promote personalized learning, automated feedback, and educational data analysis. Likewise, it is proposed that continuous teacher training and institutional support act as facilitating factors in the pedagogical adoption of these technologies.

Methodology

Research Approach and Design

The present study was conducted under a quantitative approach, aimed at systematically examining the relationship between the development of teaching competencies and the pedagogical integration of artificial intelligence tools in virtual university environments. This approach allowed for the measurement of educational variables through structured instruments and the statistical analysis of factors influencing the pedagogical adoption of emerging technologies. According to Creswell and Creswell (2018), quantitative studies are characterized by the collection of numerical data that enable hypothesis testing and the establishment of relationships between variables through statistical procedures.

The research design was non-experimental, correlational, and cross-sectional, as the variables were observed in their natural context without

direct manipulation by the researchers. Likewise, the study was conducted at a single point in time, which allowed for the analysis of the current state of the development of teaching competencies related to the integration of artificial intelligence tools in virtual higher education. This type of design was appropriate for identifying associations between educational variables and understanding behavioral patterns in specific institutional contexts.

Type and Scope of the Study

The research was classified as empirical with a descriptive-correlational scope, since, on the one hand, it described the level of development of teaching competencies related to the pedagogical use of artificial intelligence and, on the other hand, it analyzed the relationship between these competencies and the effective implementation of technological tools in virtual university environments. The descriptive scope allowed for the characterization of teachers' digital and pedagogical competencies, while the correlational scope enabled the identification of significant relationships among formative, technological, and pedagogical variables.

This approach was appropriate for studying emerging educational phenomena such as the integration of artificial intelligence in university teaching, as it allowed for the generation of empirical evidence on the factors influencing the pedagogical adoption of innovative technologies.

Population and Sample

The study population consisted of university instructors who carried out academic activities in virtual environments or hybrid modalities within higher education institutions. These instructors participated in teaching processes mediated by digital technologies and used virtual learning platforms for course management, assessment, and student support.

A non-probabilistic purposive sampling method was used to select the sample, considering as the main criterion the participation of instructors with experience in virtual education or in the use of technological tools in university teaching. The sample consisted of 200 university instructors, a

number considered adequate for conducting correlational statistical analyses and exploratory factor analysis in educational research.

The participants belonged to diverse fields of knowledge, which allowed for obtaining an interdisciplinary perspective on the development of teaching competencies related to artificial intelligence in higher education.

Study Variables

The research was structured around two main variables:

1. Development of Teaching Competencies for Educational Artificial Intelligence.

This variable referred to the set of knowledge, skills, and attitudes that enabled instructors to understand, select, and integrate artificial intelligence tools within teaching and learning processes. It included dimensions such as:

- Teaching digital competence
- Pedagogical technological knowledge
- Educational innovation
- Artificial intelligence literacy

2. Pedagogical Integration of Artificial Intelligence Tools in Virtual Environments.

This variable referred to the extent to which instructors used artificial intelligence-based tools to design, implement, and evaluate learning experiences in virtual university environments. It included dimensions such as:

- Use of AI tools for content design
- Personalization of learning
- Automated feedback
- Learning analytics

Additionally, control variables such as years of teaching experience, disciplinary area, level of academic training, and prior experience in virtual education were considered.

Data Collection Techniques and Instruments

The primary data collection technique was the survey, due to its effectiveness in gathering standardized information on perceptions, competencies, and teaching practices in educational contexts.

The instrument used was a structured Likert-type questionnaire, specifically designed to measure the level of development of teaching competencies and the degree of pedagogical integration of artificial intelligence tools. The questionnaire consisted of approximately 30 to 40 items, organized into two main sections:

Teaching competencies related to educational artificial intelligence

Pedagogical integration of artificial intelligence tools in virtual environments

Responses were measured using a five-point Likert scale: Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree.

This type of scale allowed for the reliable quantification of perceptions and attitudes and facilitated the application of inferential statistical analyses.

Validity and Reliability of the Instrument

In order to ensure the methodological rigor of the data collection instrument, validation procedures were applied through expert judgment, aimed at evaluating the scientific quality and relevance of the items included in the questionnaire. This process made it possible to verify the correspondence between the instrument's indicators and the study variables related to the development of teaching competencies and the pedagogical integration of artificial intelligence tools in virtual university environments.

Content validity was established through the evaluation carried out by ten specialists with academic and professional experience in the fields of higher education, educational technology, teachers' digital competencies, and artificial intelligence applied to education. The experts analyzed each of the instrument's items considering criteria such as semantic clarity, conceptual coherence, theoretical relevance, and methodological pertinence, in order to determine their suitability for measuring the dimensions proposed in the research.

An evaluation matrix was used to assess the items, in which the specialists expressed their judgments through an ordinal scale that allowed

for identifying the degree of relevance and comprehension of each statement. Based on the observations made by the experts, adjustments were made to the wording of some items and to the organization of certain dimensions of the instrument, with the aim of improving its conceptual precision and its correspondence with the theoretical constructs analyzed in the study.

Likewise, the reliability of the instrument was supported by the level of consensus reached among the specialists during the validation process, which made it possible to verify the conceptual consistency of the items and their capacity to adequately represent the variables under study. This procedure ensured that the questionnaire demonstrated theoretical coherence, methodological relevance, and clarity in its structure, thus guaranteeing its suitability for collecting empirical data in the context of research on teaching competencies and the pedagogical use of artificial intelligence in virtual higher education.

Data Collection Procedure

The data collection process was carried out in several stages.

First, the instrument was adapted and validated, incorporating the observations made by the experts. Subsequently, the questionnaire was digitized using an online form platform to facilitate its distribution among participants.

In a second stage, university instructors were contacted through institutional emails and academic networks, inviting them to voluntarily participate in the study. Each participant was provided with information about the objectives of the research, and the confidentiality of the collected data was guaranteed.

Finally, the responses obtained were downloaded and organized into a database for subsequent statistical analysis.

Data Analysis Techniques

Data analysis was conducted using descriptive and inferential statistics, employing specialized software such as SPSS.

First, descriptive statistics were applied to analyze the distribution of variables, including measures of central tendency (mean and median) and measures of dispersion (standard deviation).

Subsequently, correlational analyses were conducted, specifically using Pearson's correlation coefficient, in order to identify the relationship between the development of teaching competencies and the pedagogical integration of artificial intelligence tools.

Likewise, linear regression analyses were performed to determine the extent to which teaching competencies predicted the effective implementation of artificial intelligence tools in virtual university environments.

Ethical Considerations

The study was conducted in accordance with the fundamental ethical principles of scientific research in education. The participation of instructors was voluntary, ensuring their right to withdraw from the study at any time.

Likewise, the confidentiality and anonymity of the information provided by the participants were ensured, and the data were used exclusively for academic and research purposes. The results were analyzed in aggregate form, avoiding the individual identification of participating instructors.

Similarly, the study adhered to the principles of scientific integrity, transparency, and responsible use of information, contributing to the advancement of knowledge in the field of educational innovation and the pedagogical integration of emerging technologies.

Results

This section presented the results obtained from the application of the questionnaire administered to university instructors who carried out academic activities in virtual environments. The analysis was aimed at examining the level of development of teaching competencies related to educational artificial intelligence and its relationship with the pedagogical integration of artificial intelligence tools in virtual university

environments. To this end, responses collected באמצעות a five-point Likert scale were analyzed, allowing for the identification of trends in instructors' perceptions and practices regarding the pedagogical use of these emerging technologies.

Results of the Survey Administered to Instructors

The results of the survey administered to university instructors made it possible to identify

perceptions, levels of knowledge, and pedagogical practices related to the use of artificial intelligence tools in virtual learning environments. Based on the responses obtained through a five-point Likert scale, various aspects associated with the development of teaching competencies and the pedagogical integration of emerging technologies were analyzed.

Table 1. Level of teaching digital competence for the use of artificial intelligence tools.

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	6	4%	4%
Disagree	18	12%	16%
Neither agree nor disagree	30	20%	36%
Agree	60	40%	76%
Strongly agree	36	24%	100%
Total	150	100%	

Note: Results on the level of teaching digital competence for the educational use of artificial intelligence tools. **Source:** Author's own elaboration.

The results indicated that the majority of instructors considered themselves to possess sufficient digital competencies to use artificial intelligence tools in educational contexts. In particular, 64% of participants fell within the "agree" and "strongly agree" categories, indicating a favorable perception of their level of technological literacy. However, 16% expressed

disagreement, suggesting the existence of gaps in the development of teaching digital competencies. These findings reflected the need to strengthen training programs focused on the pedagogical use of emerging technologies, especially in institutions promoting virtual education.

Table 2. Pedagogical-technological knowledge for integrating artificial intelligence in teaching.

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	8	5%	5%
Disagree	20	13%	18%
Neither agree nor disagree	32	21%	39%
Agree	58	39%	78%
Strongly agree	32	22%	100%
Total	150	100%	

Note: Instructors' perception of the pedagogical-technological knowledge required to integrate artificial intelligence into virtual university teaching processes. **Source:** Author's own elaboration.

The data showed that pedagogical-technological knowledge constituted a relevant component in the development of teaching competencies related to educational artificial intelligence. A total of 61% of instructors stated that they possessed knowledge enabling them to integrate technological tools into their pedagogical practices. However, a considerable proportion of participants (39%) fell within neutral or

disagreement positions, suggesting that limitations still existed in understanding how to link technology with effective pedagogical strategies. These findings indicated the need to promote training programs that integrate pedagogical and technological approaches to strengthen the educational implementation of artificial intelligence.

Table 3. Educational innovation through the use of artificial intelligence tools

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	5	3%	3%
Disagree	16	11%	14%
Neither agree nor disagree	28	19%	33%
Agree	62	41%	74%
Strongly agree	39	26%	100%
Total	150	100%	

Note: Results related to educational innovation through the use of artificial intelligence tools in virtual university environments. **Source:** Author's own elaboration.

The results indicated a positive trend toward educational innovation through the use of artificial intelligence tools. A total of 67% of instructors considered that these technologies contributed to improving teaching and learning strategies in virtual environments. This finding reflected a favorable attitude toward the adoption

of emerging technologies within the academic context. However, 33% of participants expressed neutrality or disagreement, indicating that barriers to technological adoption still existed, such as lack of specialized training or institutional limitations in access to advanced digital tools.

Table 4. Level of artificial intelligence literacy applied to education

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	10	7%	7%
Disagree	24	16%	23%
Neither agree nor disagree	34	23%	46%
Agree	52	35%	81%
Strongly agree	30	19%	100%
Total	150	100%	

Note: Level of instructors' literacy in artificial intelligence applied to virtual educational contexts in higher education. **Source:** Author's own elaboration.

Regarding artificial intelligence literacy, the results showed that 54% of instructors considered themselves to possess basic knowledge of the educational use of these technologies. However, the remaining 46% fell within neutral or disagreement positions, indicating that a significant proportion of faculty still demonstrated limitations in the conceptual

and technical understanding of artificial intelligence applied to education. This finding suggested the need to strengthen teacher training programs specifically focused on educational artificial intelligence, in order to enhance instructors' capacity to integrate these tools into virtual teaching processes.

Table 5. Use of artificial intelligence tools for the design of educational content

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	7	5%	5%
Disagree	22	15%	20%
Neither agree nor disagree	31	21%	41%
Agree	56	37%	78%
Strongly agree	34	22%	100%
Total	150	100%	

Note: Use of artificial intelligence tools by instructors for the design of educational content in virtual university environments. **Source:** Author's own elaboration.

The results showed that a significant proportion of instructors used artificial intelligence tools for the design of educational content in virtual environments. In particular, 59% of participants reported agreement or strong agreement with the use of these technologies to develop instructional materials. This finding reflected a growing trend

toward the incorporation of advanced digital tools in virtual course planning. However, the remaining 41% expressed neutral or negative positions, suggesting that challenges still existed related to teacher training and the availability of adequate technological resources.

Table 6. Personalization of Learning through Artificial Intelligence

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	9	6%	6%
Disagree	21	14%	20%
Neither agree nor disagree	29	19%	39%
Agree	58	39%	78%
Strongly agree	33	22%	100%
Total	150	100%	

Note: Instructors' perception of learning personalization through artificial intelligence tools in virtual higher education. **Source:** Author's own elaboration.

Regarding learning personalization, 61% of instructors acknowledged that artificial intelligence could significantly contribute to adapting educational processes to students' individual needs. This finding demonstrated a positive perception of the potential of these technologies to enhance the learning experience

in virtual environments. However, the remaining 39% expressed neutral or disagreement positions, which could have been associated with limitations in technical knowledge about how artificial intelligence systems operate or with the lack of institutional tools enabling the practical application of personalization strategies.

Table 7. Use of Artificial Intelligence for Automated Feedback

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	11	7%	7%
Disagree	23	15%	22%
Neither agree nor disagree	30	20%	42%
Agree	54	36%	78%
Strongly agree	32	22%	100%
Total	150	100%	

Note: Use of artificial intelligence to generate automated feedback in assessment and learning monitoring processes. **Source:** Author's own elaboration.

The results indicated that 58% of instructors acknowledged the value of artificial intelligence in providing automated feedback to students in virtual environments. This functionality could significantly contribute to optimizing formative assessment processes and improving interaction between instructors and students. However, 42% of participants expressed neutral or negative

positions, suggesting that challenges still remained in the adoption of these tools. Among the factors that may have influenced this situation were the lack of technical training and the need to develop institutional policies promoting the use of intelligent technologies in educational assessment.

Table 8. Use of Artificial Intelligence-Based Learning Analytics

Options	Frequency	Percentage	Cumulative Percentage
Strongly disagree	12	8%	8%
Disagree	25	17%	25%
Neither agree nor disagree	33	22%	47%
Agree	50	33%	80%
Strongly agree	30	20%	100%
Total	150	100%	

Note: Application of artificial intelligence-based learning analytics to analyze academic progress in virtual environments. **Source:** Author's own elaboration.

Regarding the use of artificial intelligence-based learning analytics, the results showed that 53% of instructors recognized its usefulness for analyzing students' academic progress and improving pedagogical decision-making. This trend reflected a growing interest in the use of educational data to optimize teaching processes in virtual environments. However, the remaining 47% fell within neutral or negative positions, indicating that learning analytics had not yet been fully integrated into teaching practices. This finding suggested the need to strengthen teacher training in educational data analysis and artificial intelligence tools applied to education.

Results of the Questionnaire Validity

In order to ensure the methodological consistency of the instrument used in the study, a validation process was conducted through expert judgment. This procedure made it possible to analyze the clarity, coherence, theoretical relevance, and methodological pertinence of the items comprising the questionnaire administered to university instructors. The evaluation was carried out by ten specialists in higher education, educational technology, and artificial intelligence applied to education, who assessed the correspondence between the instrument's indicators and the study variables, thereby ensuring the scientific quality and validity of the results obtained.

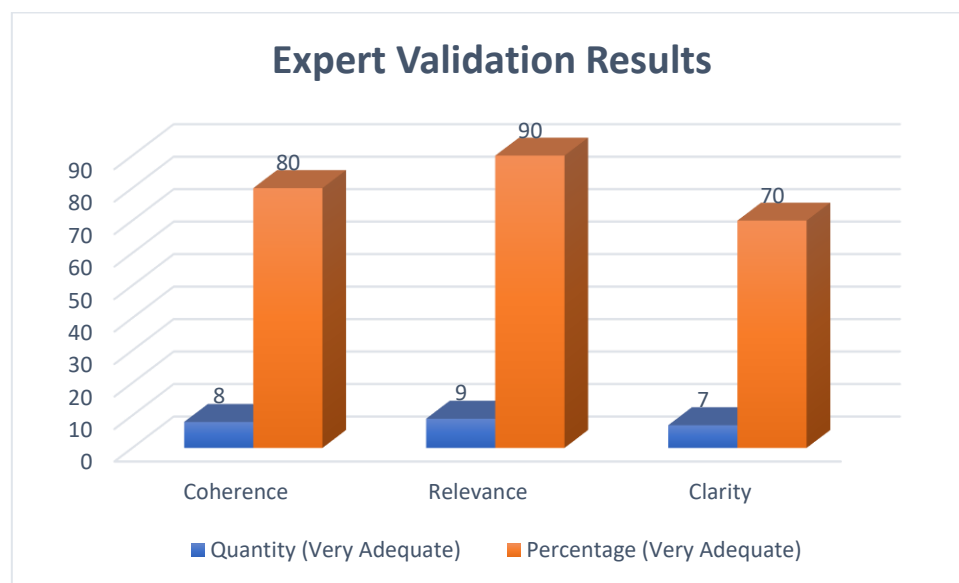


Fig. 1. Validation of the instrument using expert judgement

Note: Instrument validation results based on the evaluation of ten experts considering coherence, relevance, and clarity of the items. **Source:** Author's own elaboration.

The results of the instrument validation showed a highly positive assessment by the participating specialists. Regarding the coherence criterion, eight experts rated the items as very adequate and two as adequate, indicating that the questionnaire demonstrated a clear correspondence between the indicators and the theoretical variables of the study. In terms of relevance, nine specialists considered the items to be very adequate for

measuring the phenomenon under investigation, while one rated them as adequate, confirming the methodological relevance of the instrument. Finally, for the clarity criterion, seven experts indicated that the items were very adequately worded and three rated them as adequate, demonstrating that the questions were understandable and appropriate for the study participants. Overall, these results indicated a

high level of acceptance of the instrument, confirming its validity for data collection in the research.

Discussion

The results obtained evidenced that the development of instructors' digital competencies constituted a determining factor for the pedagogical integration of artificial intelligence tools in virtual university environments. The majority of participating instructors reported favorable levels of digital competence and a positive disposition toward the educational use of these technologies, which aligns with research emphasizing the importance of digital competencies in contemporary educational transformation. In this regard, Cabero & Palacios (2021) argued that strengthening instructors' digital skills is fundamental to ensuring the quality of educational processes mediated by emerging technologies.

Similarly, the results related to pedagogical-technological knowledge indicated that instructors recognized the importance of integrating technology into their teaching strategies. This finding confirmed that the adoption of educational technologies does not depend solely on access to digital resources but also on the development of pedagogical competencies that allow meaningful use. Previous studies have shown that the adoption of educational technologies is influenced by pedagogical, organizational, and attitudinal factors of instructors (Chiu et al. 2021), reaffirming the relevance of teacher training in contexts of educational innovation.

Additionally, the results regarding educational innovation through the use of artificial intelligence reflected a positive perception among instructors regarding the potential of these technologies to enhance teaching and learning processes. This finding aligns with recent research indicating that artificial intelligence can contribute to generating more dynamic, interactive, and personalized educational experiences. In this regard, Torres Pineda et al. (2025) maintained that artificial intelligence represents a significant innovation that enables

the optimization of learning personalization and strengthens student autonomy in digital educational environments.

On the other hand, the results related to artificial intelligence literacy showed that, although there was a favorable perception of these technologies, gaps still existed in instructors' conceptual and technical knowledge. This finding is consistent with studies reporting that the development of instructors' digital competencies remains a challenge in many higher education institutions. According to Piñán et al. (2025), teacher training in digital competencies is a key element to strengthen academic performance and improve student learning outcomes in technology-mediated educational contexts.

Regarding the pedagogical integration of artificial intelligence tools for the design of educational content, the results indicated that a significant proportion of instructors used these technologies to support planning and the creation of instructional materials. This outcome aligns with research highlighting the role of artificial intelligence in generating innovative educational resources. According to Saborío Taylor & Álvarez Chaves (2025), generative artificial intelligence tools can facilitate the creation of adaptive instructional materials, although they also pose pedagogical challenges related to their responsible and critical use in university teaching.

Likewise, the results concerning learning personalization reflected that instructor acknowledged the potential of artificial intelligence to adapt educational processes to students' individual needs. This finding aligns with recent studies emphasizing the capacity of these technologies to analyze educational data and generate more flexible and personalized learning experiences. In this context, Zaragoza (2026) noted that artificial intelligence allows for optimizing learning personalization by analyzing student behavior patterns and adapting educational content accordingly.

Regarding the use of artificial intelligence to provide automated feedback, the results demonstrated that instructors valued this functionality positively as a tool capable of

improving formative assessment processes. Recent research has indicated that intelligent systems can offer immediate feedback to students, fostering continuous learning improvement. In this regard, Holmes et al. (2022) emphasized that artificial intelligence applied to education can help optimize assessment and learning monitoring processes, provided that its implementation adheres to ethical and pedagogical principles.

Finally, the results related to the use of artificial intelligence-based learning analytics showed that instructors recognized the value of educational data for improving pedagogical decision-making. This finding aligns with studies highlighting the role of learning analytics in educational innovation and in enhancing the quality of higher education. Recent research has indicated that the development of instructors' digital competencies constitutes a fundamental element for strengthening academic innovation and the digital transformation of educational institutions (Moreira et al., 2025; Garzón et al., 2025).

Conclusions

The results of the study allow concluding that the development of instructors' digital competencies constitutes a fundamental factor for the pedagogical integration of artificial intelligence tools in virtual university environments. The majority of participating instructors reported favorable levels of technological proficiency, reflecting a positive disposition toward the educational use of these tools. However, areas for improvement were also identified, particularly regarding specialized training in artificial intelligence applied to higher education.

Furthermore, it was concluded that pedagogical-technological knowledge plays a key role in the effective incorporation of artificial intelligence tools within virtual teaching processes. The results showed that instructors recognize the

importance of linking technology with teaching strategies that promote meaningful learning. In this sense, the pedagogical integration of these technologies requires not only technical skills but also pedagogical competencies that guide their use with clear educational purposes.

Another relevant conclusion of the study indicates that educational innovation is strengthened through the use of artificial intelligence tools in virtual university environments. Participating instructors identified that these technologies facilitate the creation of instructional resources, the design of interactive activities, and the optimization of teaching processes. However, for this innovation to be sustainable, it is necessary to promote institutional processes for continuous professional development and ongoing training of university faculty.

The results also evidenced that artificial intelligence provides significant opportunities for learning personalization and automated feedback in virtual education contexts. Instructors recognized that these tools allow for adapting educational content to students' individual needs and improving the monitoring of their academic progress. Nevertheless, their effective implementation requires strengthening instructors' competencies related to educational data analysis and learning analytics.

Finally, the study concluded that the development of instructors' competencies for the pedagogical use of artificial intelligence constitutes a strategic element for improving the quality of higher education in virtual environments. The evidence obtained confirms that teacher training, access to technological resources, and institutional support are determining factors for promoting the adoption of these tools in contemporary university educational processes.

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