3

Validation of the Attitude Scale on the Perceptions of Future Teachers about Artificial Intelligence and its Consequences on their Motivation, Critical Thinking and Improvement of their Learning

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Abstract
The aim of this study was to analyze the validated psychometric characteristics of the 'Scale of Attitudes towards the inclusion of Artificial Intelligence, called Pretest_Perception and Attitude towards Artificial Intelligence in the Educational Environment' (EIPAA-IAE)' using a short version for future teachers, in the integration of AI as a learning tool. The study describes future teachers' attitudes towards critical thinking, emotional competencies and creativity, determining the internal consistency and reliability of the designed tool. The design structure of the instrument consists of the following three latent factors, which were obtained through an exploratory factor analysis (EFA): AI/critical thinking, AI/emotional competencies, and AI/creativity. The questionnaire was applied to a sample of 205 participants. With confirmatory factor analyses (CFA), a prior hypothesis was established regarding the relationship of the factors and their number and nature, specifying the number of factors and the way in which the variables relate to each other. According to the analyses, 66.53% of the total variance was explained. Reliability, calculated with Cronbach's alpha, reached an overall value greater than 0.90 (α = 0.94). This valid and reliable questionnaire, which incorporates a dimension that measures the transfer of learning in hybrid and multimodal models of digital ecosystems in higher education with AI, can be applied in the evaluation of online education processes.

Keywords: educational environment, emotional competencies, creativity, Artificial Intelligence, motivation and critical thinking.

3.1. Introduction

Transformation of training institutions in this digital era is a crucial issue, especially when considering the growing role of Artificial Intelligence (AI). The integration of AI in educational environments not only optimizes teaching and learning processes, but also prepares students for a future where technology is ubiquitous. Recent discourse on ChatGPT (e.g., Bai et al., 2022; Kasneci et al., 2023; Rudolph et al., 2023) and a growing rate of research on artificial intelligence in education (AIED; see Zawacki -Richter et al., 2019) demonstrate a growing interest in the potential of AI to transform teaching and learning (Tuomi, 2018). However, the prohibitive costs of developing cutting-edge AI tools, combined with resource disparities among stakeholders, can result in AI applications that further encroach existing inequalities. In response, efforts to develop policies for ethical AI

have identified multi-stakeholder dialogue as a method to mitigate the risk of exacerbating social inequalities (e.g., IEEE, 2018; OECD, 2022; UNESCO, 2021).

Firstly, AI allows personalizing education, which, by implication, places us in the unstoppable advance of educational inclusion. AI-based systems can analyze the learning style and performance of each student, offering materials and resources adapted to their specific needs, surely advancing in equality and equity. By offering access to quality educational resources through online platforms and other technological tools, AI has the potential to reduce education gaps and provide opportunities to a broader audience. This personalization contributes to a more effective and motivating learning experience.

In addition, AI will help educational organizations to improve their quality. Since the last century, the scientific community has sought efficiency in educational administration. In the management of teaching-learning processes, it is essential in these years, where the Educational Administration is precipitating the bureaucratization of teachers. It can be a great support for the automation of administrative tasks, provide evidence to improve evaluation processes, and help in research with advanced data management. AI can free up time and resources, allowing educators to focus on the teaching and development of their students.

AI also fosters innovative teaching methods. For example, intelligent tutoring systems and virtual reality environments provide immersive learning experiences that were previously unimaginable. These tools not only enrich the educational process but also prepare students to work with advanced technologies in their future careers. Ultimately, AI will support a large part of the transformations that will occur in training institutions. This integration not only improves the quality of education but also equips students with the necessary skills to thrive in the future.

Artificial Intelligence and critical thinking

The field of AI in education (AIED) uses techniques from AI and cognitive science to better understand the nature of learning and teaching and to build systems that help students acquire new skills or understand new concepts. There are meta-reviews and

meta-analyses to advocate for blended learning, in which teachers can offload part of the work to AIED systems (Boulay, 2016). Videoconferencing, for example, has allowed synchronous communication in the classroom and created multisensory content to stimulate students. AI involves complex equations that are best when teaching processes are using constructive pedagogy, where students experiment with alternative ways of solving the same problem. Multiple-choice questions have high reliability and can easily reveal students' skill levels quickly. Managing software projects is a challenge for students with visual or attention-related disorders. Therefore, it is fundamental to know how to use graphs to visually observe variables and narrow down possible relationships before performing an in-depth analysis. One of the main purposes of education is employability. Therefore, if a greater context of real-world industry examples is introduced into the conferences, we will achieve the transfer we are looking for (Chaturvedi, Cambria & Welsch, 2023). Other research has focused on the effects of AI on administration, instruction, and learning. Teachers can perform different administrative functions, such as reviewing and grading student assignments, more efficiently and effectively, and therefore achieve higher quality in teaching tasks. This educational quality can be reflected in the adaptability, as the curriculum and content have been customized according to the needs of the students, which has encouraged acceptance and retention, thus improving the student experience and the overall quality of learning (Chen, Chen & Lin, 2020).

AI has impacted the transformation of teaching methods in the university environment, this also influences critical thinking, leaving the traditional classroom, removing limitations of teaching resources, enabling the transformation of educational times, and promoting the advancement of new hybrid spaces. Modern distance education uses advanced technology such as computer networks, multimedia, and artificial intelligence to build a network-based virtual teaching environment, eliminating the limitations of teachers, teaching materials, experimental equipment, and other resources that exist under the traditional teaching model. Using educational resources of the same scale can exponentially expand educational capabilities and, at the same time, overcome the unified progress of traditional teaching methods, one-size-fits-all teaching methods, and student dissatisfaction. The

deficiencies of differences and personalities that are not reflected favor the improvement of the quality of education. The original intention of education is to provide students with special study resources and stimulate their enthusiasm for learning. These new learning systems can also provide personalized and intelligent recommendations to female students based on their learning habits. The system should be developed on the basis of an intelligent multimedia method, possesses the characteristics of security and stability, and has helped develop the network teaching of educational institutions to a certain extent (Zhang, 2022). It is possible to make students understand the course content before starting the course by simulating the real class and choosing the style and form of the course according to the students' ability and interest in the learning process. In the era of vigorous development of artificial intelligence, the development of smart classrooms will not be underestimated, which will also play an important role in the development of life in the future (Qi, 2019).

Artificial Intelligence and emotional competencies

In the review of the scientific literature on trends in emotional intelligence research, verified from different disciplines such as neuroscience, psychology, and education, different authors have highlighted the importance of research in the evaluation and training of emotional intelligence in the field of education and how AI can play a role in this process. In the case of teachers, emotional intelligence is a protective factor against teacher burnout (Fernández-Berrocal et al., 2022). In this sense, motivation is intrinsically linked to the study of emotions. If we combine AI, the state of the art on this topic shows numerous findings on education and the process of sentiment analysis when these tools are used. In the research carried out, the Analyze Sentiment methodology (Google, 2022) has been used, with conclusions such as the following: the combination of artificial intelligence methods for natural language analysis, together with descriptive statistics and discourse analysis techniques, constitutes a viable approach for data and sentiment analysis to improve the transmission of messages used in the classroom (Meléndez-Gómez et al., 2022). However, it is also important to consider the possible psychological consequences of using AI.

Artificial Intelligence and creativity

AI has the potential to enhance creativity by providing diverse perspectives and resources. In this sense, research indicates that, as AI is used by students to increase their work, their production is greater. From an artistic point of view, the Institute of Human Artificial Intelligence's spring conference finds that the symbiosis between AI and art is beneficial. Now, that does not mean it can replace human skills like judgment, empathy, and contextual understanding. Significantly, it can generate a wealth of ideas based on existing data and patterns, which helps unlock creative thinking. On the other side of the scale, we find research on the impact that AI generates on the personal learning environments of university centennials through unethical practices in the classroom. Consequently, it is found that critical and creative thinking, and linguistic and logical-mathematical intelligence are affected (Castillejos-López, 2022). In this sense, we find the dilemma between AI and the ability that human beings develop from their experiences and their level of cognitive evaluation and assessment (Oviedo Guevara, 2023). Other research focuses on the use of AI-supported systems and the tension that occurs between the potential for problem solving and the risks related to the violation of human rights, access to education, and educational inclusion (Dellepiane & Guidi, 2023).

3.2. Methodology

The research design used is descriptive; this means that it is an approach in which the main objective was to describe and understand the attitudes of future teachers regarding the incorporation of AI in their teaching and learning processes. This type of design was used to collect information about the current situation, characteristics or behaviors of a group of future teachers, without manipulating variables or establishing causal relationships. This methodological section contains the objectives, the sample (participants, procedure) and the collection and analysis of the data.

Goals

The objective of this study was to validate the 'Attitude scale towards the inclusion of Artificial Intelligence, called 'Pretest_Perception and Attitude towards Artificial Intelligence in the Educational Environment' (EIPAA-IAE)'. The tool was designed by researchers from a Spanish university with the aim of diagnosing the new scenarios that have arisen after the arrival of artificial intelligence, such as the emergence of ChatGPT in November 2023. The study focused on describing the attitudes of future teachers towards critical thinking, emotional competencies, and creativity, as well as determining the internal consistency and reliability of the aforementioned tool. In this sense, the design structure of the instrument consists of three latent factors: AI/critical thinking, AI/emotional competencies, and AI/creativity. The innovation experience was carried out during the 2023/24 academic year.

The sample

The sample was randomly selected by simple random sampling, in which each member of the population has the same probability of being selected to be part of the sample. Therefore, it was done for the convenience of the students. The total number of participating students was 205 (Female = 88%; men = 13%). The students belonged to the Degree of Early Childhood Education (96) the Double Degree of Early Childhood and Primary Education (108) and the Degree of Pedagogy (1). Bartlett's sphericity test and Kaiser-Meyer- Olkin (KMO) test were also performed for sample adequacy.

The instrument

An instrument was developed that would allow evaluating the training experience carried out, aimed at future education professionals, as well as AI/critical thinking, AI/Emotional Competencies and AI/Creativity.

Starting from this objective, a first questionnaire of eight sociodemographic questions was designed that would allow us to know the characteristics of the population evaluated: they were

asked for their name and surname to prevent duplicate records, their e-mail, in case they wanted to receive additional information about the study, academic year in which they were enrolled (all participants belonged to the 2023-2024 academic year), gender (open question: female, male and other), age (multiple-choice question: 18-20 years, 21-24 years, and >25 years), academic year of the subject and degree (multiple-choice questions: pedagogy, primary education and early childhood education), and course (multiple-choice question: 1, 2, 3, and 4).

On the other hand, a block of 32 questions was developed, with the questions being responded in a 5-point Likert scale (1 = totally agree, 5 = totally disagree). These questions were based on 3 dimensions: AI/critical thinking, AI/Emotional Competencies and AI/Creativity.

Procedure

This work was carried out in three phases: (1) validation of the instrument by experts in the subject and in research methods; (2) determination of the validity of the construct after passing the version of the questionnaire developed in the previous phase; (3) calculation of instrument reliability; and (4) validation of the proposed model, specifying the number of factors and the way in which the variables were related. After these phases, the questionnaire was designed and validated for its final version.

After this first work, the group of experts was selected to validate the questionnaire, with the 30 professionals mentioned in the participants section. They were given the guide for validating the content of the instrument, which they completed, taking into account its relevance, clarity, and adequacy. Kendall's test was applied to evaluate agreement between evaluators.

Once this phase of the procedure was completed, the questionnaire was reviewed, designing a new version for its final validation. The instrument was analyzed, studying its structure through an exploratory factor analysis using the factor extraction method of the principal components and promax rotation, since there was a correlation between the dimensions, which is why the extraction of factors is detailed in later sections. To this end, the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy and

Bartlett's sphericity test were applied. The sample of this study was made up of a total of 205 students from a Spanish University (mentioned in the participants section). An online questionnaire was administered to this sample using the Microsoft Forms platform. This procedure provides simple, fast and economical access to a large number of participants, allowing them to complete the questionnaire in a flexible manner. In addition, this online tool has numerous advantages, such as the direct exploitation of responses in different formats for analysis.

The obtained factors and the complete scale were subjected to a reliability analysis procedure using Cronbach's alpha and McDonald's Omega to evaluate the internal consistency of the scale.

Finally, the validity of the construct was analyzed using confirmatory factor analysis (CFA) to validate the instrument that aims to measure the attitudes of future teachers and which is defined in the set of attitudes and predispositions of future teachers towards teaching-learning processes mediated by AI.

Analysis of data

For these statistical analyses, the SPSS v.26 program was used.

3.3. Results

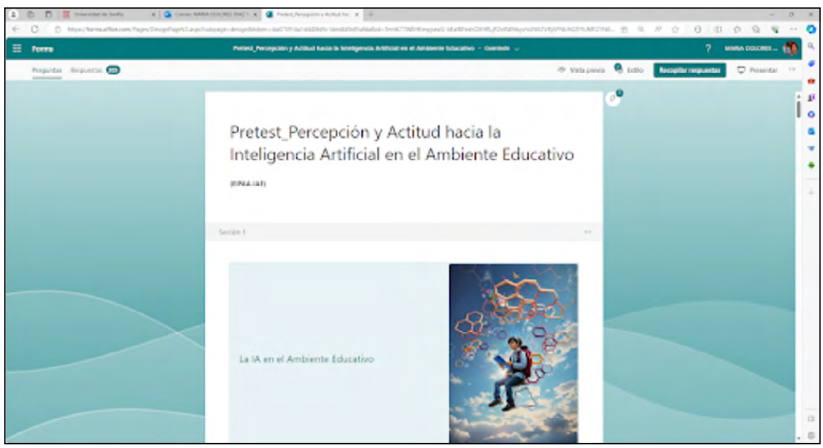

Figure 3.1. Título Pretest_Percepción y Actitud hacia la Inteligencia Artificial en el Ambiente Educativo

Table 3.1. Dimensions and items of the questionnaire.

DIMENSION	ITEMS
AI/CRITICAL THINKING (AI/PC)	AI/PCI. AI encourages critical thinking in students. AI/PC2. AI can stimulate discussion and critical analysis of complex topics. AI/PC3. AI has helped expand my critical thinking in the classroom. AI/PC4. I have found that AI offers tools that promote creativity in projects. AI/PC5. AI has enriched class discussions, promoting deeper critical analysis. IA/PC6. AI has helped me explore new ideas and approaches in my learning. AI/PC7. I find that AI supports the exploration and development of creative ideas in the classroom.
AI/EMOTIONAL COMPETENCES (AI/CE)	IA/CIS. I am excited by the possibilities that AI can offer to education. AI/CE2. I am willing to learn new tools related to AI. IA/CE3. I believe AI is a valuable tool for learning. IA/CE4. I feel intimidated by the use of AI in the classroom. IA/CE5. I think AI could reduce human interaction in the classroom. IA/CE6. AI increases my motivation to learn. IA/CE7. I am more motivated to participate in classes that integrate AI.
AI/CREATIVITY (AI/C)	AI/CI. AI can be a valuable tool to promote creativity in the classroom. AI/C2 AI can provide different perspectives and resources that foster creativity. AI/C3 AI can help students develop problem-solving skills. IA/C4. Personalization of learning through AI motivates me to achieve my academic goals. AI/C5 AI can provide additional learning resources that increase my creativity. IA/C6. I find that AI supports the exploration and development of creative ideas in the classroom. IA/C7. AI has helped expand my critical thinking in the classroom.

Source: developed by author.

In the latent factor "AI/Critical Thinking", 100% of the respondents responded to all items. In relation to the AI/PC1 item, 41.27% agreed and 58.73% totally agreed. Regarding item IA/PC2, 53.97% agreed and 46.03% totally agreed. Regarding item IA/PC3, 6.35% somewhat disagreed, 55. 56% agreed and 38.1% totally agreed. In item IA/PC4, 3.17% disagreed, 6.35% somewhat disagreed, 52.38% agreed, and 38.1% totally agreed. Regarding item IA/PC5, 1.59% somewhat disagreed, 55.56% agreed, and 42.86% totally agreed. Regarding item IA/PC6, 12.7% somewhat disagreed, 47.62% agreed, and 39.68% totally agreed. Finally, in item IAPC7, 3.17% somewhat disagreed, 50.79% agreed, and 46.03% totally agreed.

In the latent factor "AI/Emotional Competencies", 100% of the participants responded to all items. Regarding item IA/CE1, 33.33% agreed and 66.67% totally agreed. In item IA/CE2,

39.68% agreed and 60.32% totally agreed. Regarding item IA/CE3, 22.22% somewhat disagreed, 39.68% agreed, and 38.10% totally agreed. In item IA/CE4, 41.27% agreed and 58.73% totally agreed. Regarding item IA/CE5, 22.22% somewhat disagreed, 42.86% agreed, and 34.92% totally agreed. Regarding item IA/CE6, 3.17% totally disagreed, 20.63% somewhat disagreed, 39.68% agreed, and 36.51% totally agreed. Finally, item IA/CE7 shows that 9.52% somewhat disagreed, 44.44% agreed, and 46.03% totally agreed.

In the latent factor "AI/Creativity", 100% of the participants responded to all items. Regarding item IA/C1, 7.94% somewhat disagreed, 61.90% agreed and 30.16% totally agreed. Regarding item IA/C2, 6.35% somewhat disagreed, 46.03% agreed and 47.62% totally agreed. In relation to item IA/C3, 4.76% somewhat disagreed, 50.79% agreed and 44.44% totally agreed. In item IA/C4, 6.35% somewhat disagreed, 49.21% agreed and 44.44% totally agreed. Regarding item IA/C5, 1.59% totally disagreed, 20.63% somewhat disagreed, 47.62% agreed and 30.16% totally agreed. Regarding item IA/C6, 7.94% somewhat disagreed, 53.97% agreed and 38.10% totally agreed. Finally, regarding item IA/C7, 1.59% totally disagreed, 20.63% somewhat disagreed, 47.62% agreed and 30.16% totally agreed.

3.4. Conclusions and Implications

The results of the study led to the following conclusions. We can indicate that our instrument 'Pretest_Perception and Attitude towards Artificial Intelligence in the Educational Environment' (EIPAA-IAE)' has brought us closer to the field of Artificial Intelligence in Education (AIED). We identified the implications of the use of educational techniques with AI and agree with authors who have reported similar results (Chaturvedi, Cambria & Welsch, 2023), including the idea that metacognition processes are essential in the deep learning. Another implication found is the impact on education quality, which can be reflected in creativity and the use of emotional intelligence in the adaptability of study plans (Chen, Chen & Lin, 2020).

We agree that critical thinking is essential, moving beyond the traditional classroom and eliminating didactic resource limi-

tations. This approach transforms educational time and advances new hybrid spaces that favor the development of autonomy among university students. As we have confirmed through their responses, AI facilitates this type of environment (Zhang, 2022). In the era of vigorous artificial intelligence development, the importance of smart classroom development in shaping the future should not be underestimated (Qi, 2019).

Artificial Intelligence undoubtedly provides us with many benefits in managing teaching and learning processes in Higher Education. However, as recommended by guidelines on ethics in its use and the humanistic approach that the concept of education itself should have, we must not forget the human aspect. Therefore, continuing to investigate emotional intelligence and neuroscience is of vital importance. In the responses obtained from the surveyed students, we have identified similarities with the results obtained by Fernández-Berrocal et al. (2022). AI has the potential to enhance creativity by providing diverse perspectives and resources. Creativity, emotional competencies, and personal learning environments are fundamental principles for advancing ethical experiences. As confirmed in other studies, the development of ethical practices is closely linked to the assessment processes in higher education and the types of learning that students can achieve. In this regard, metacognition and deep learning are essential for obtaining significant cognitive evaluation (Castillejos-López, 2022; Oviedo-Guevara, 2023). On the other hand, research findings on AI and its contributions to educational processes reveal a tension between two perspectives: 1) the idea that AI enhances and enriches these formative processes by addressing numerous learning problems; and 2) the concern that this tool could become a privilege accessible only to a few students. This would imply a lack of equality and inclusion in educational processes (Delphine & Guidi, 2023). This issue is one of the central points in the report by the International Commission on the Future of Education, which aims to reimagine our future together.

In conclusion, the proposed instrument we present is useful for identifying teaching and learning processes in higher education with AI. It is a valid and reliable questionnaire, with a Cronbach's alpha of 0.94 and a variance of 66.53%. Therefore, this tool can help measure whether learning transfer occurs when using hybrid and multimodal ecosystems in higher education.

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