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Learning to Teach AI: Design and Validation of a Questionnaire on Artificial Intelligence Training for Teachers

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Abstract: This study aims to design, produce, and validate an information collection instrument to evaluate the opinions of teachers at non-university educational levels on the quality of training in artificial intelligence (AI) applied to education. The questionnaire was structured around five key dimensions: (a) knowledge and previous experience in AI, (b) perception of the benefits and applications of AI in education, (c) AI training, and (d) expectations of the courses and (e) impact on teaching practice. Validation was performed through expert judgment, which ensured the internal validity and reliability of the instrument. Statistical analyses, which included measures of central tendency, dispersion, and internal consistency, yielded a Cronbach's alpha of .953, indicating excellent reliability. The findings reveal a generally positive attitude towards AI in education, emphasizing its potential to personalize learning and improve academic outcomes. However, significant variability in teachers' training experiences underscores the need for more standardized training programs. The validated questionnaire emerges as a reliable tool for future research on teachers' perceptions of AI in educational contexts. From a practical perspective, the validated questionnaire provides a structured framework for assessing teacher training programs in AI, offering valuable insights for improving educational policies and program design. It enables a deeper exploration of educational AI, a field still in its early stages of research and implementation. This tool supports the development of targeted training initiatives, fostering more effective integration of AI into educational practices.

Keywords: *Artificial intelligence, continuous training, professional recycling, ICT, training courses.*

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Introduction

Artificial intelligence (AI) has become a crucial area of development in today's society, transforming industries and reshaping daily life. However, its integration into education remains largely unexplored, leaving a significant gap in how future generations are prepared for an AI-driven world. One of the main challenges is the lack of updated teacher training programs that address AI's potential in educational contexts. To bridge this gap, it is essential to develop validated instruments capable of evaluating the effectiveness of such training initiatives. This study seeks to design, produce, and validate a questionnaire aimed at assessing teachers' opinions on AI-related training programs, contributing to the advancement of research in AI education and fostering better implementation strategies in schools.

Literature Review

Educational Technologies

In an increasingly interconnected world, globalization has led to the need to carry out a transformation of educational structures at a global level (Guggemos, 2024; Kadhim & Hassan, 2020). This process of economic, cultural, and social integration has generated a growing demand for education to prepare students to be future citizens of the world, in addition to being able to compete in the labor market (Vijayakumar et al., 2019). In this context, information and communication technologies (ICT) are becoming increasingly important as fundamental tools to achieve these goals, allowing the creation of more dynamic, accessible, and personalized learning environments (Harati et al., 2021; Selwyn, 2017).

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The incorporation of ICT in education is not simply a matter of modernization but a response to the needs of an increasingly globalized world that requires new pedagogical and curricular approaches (Sharma et al., 2019). ICTs have transformed education on multiple levels. First, they have expanded access to education, especially in geographically isolated regions or in communities with limited resources (How & Hung, 2019). Through online learning platforms, mobile apps, and digital educational resources, students can access high-quality educational content from anywhere in the world (Means et al., 2014).

This democratization of access to education has reduced inequality gaps, allowing more people to acquire the skills and knowledge necessary to actively participate in the global economy (Jara & Ochoa, 2020). In this sense, ICTs have facilitated learning, providing the possibility of updating their skills and knowledge continuously, which is essential in a constantly changing world of work (Chang et al., 2022; Stöhr et al., 2024).

As for schools, the digitization of content and the incorporation of technological tools in the classroom have allowed teachers to adopt more interactive and student-centered teaching methods (Punie & Redecker, 2017; Rodríguez-García et al., 2020). For example, the use of digital whiteboards, interactive simulations, and multimedia resources has enriched the learning experience by making abstract concepts more understandable and engaging for learners (Lee & Yeo, 2022). In addition, ICT has made it possible to implement more personalized pedagogical approaches, where learning can be adapted to the needs, interests, and individual rhythms of students, which has proven to be effective in improving academic performance and student motivation (Luckin et al., 2016; Vieluf et al., 2012).

Another of the virtues that ICT has contributed to school management has been the reduction of the administrative burden that falls on teachers. In this way, teachers are freed up to be able to dedicate more time to teaching and interacting with students. Likewise, the ability to collect and analyze large volumes of data has opened up new possibilities for educational research, allowing learning patterns to be identified and more effective pedagogical interventions to be designed (Sanusi et al., 2024; Zawacki-Richter et al., 2019).

However, as ICTs become more deeply integrated into education systems, new challenges and opportunities arise. One of the most promising developments in this field is the increasing integration of AI in education. AI, with its ability to process and analyze large amounts of data in real-time, offers the potential to take learning personalization to a whole new level (Kubsch et al., 2022; Luckin et al., 2016). For example, smart tutoring systems can adapt content and teaching methodology based on each student's individual progress, offering additional support to those who need it and challenging more advanced students with more complex tasks (Gilson et al., 2023). In addition, AI can facilitate the creation of adaptive learning environments, where resources and activities are dynamically adjusted in response to student performance and preferences (Lampos et al., 2021).

While ICT has laid the foundation for a more technological and accessible educational environment, AI promises to take these innovations even further, offering personalized, data-driven solutions that have the potential to radically transform education (Marques et al., 2020). In this way, it not only improves the personalization and efficiency of learning, but also opens new possibilities for educational research and data-driven decision-making (Cruz-Jesus et al., 2020; Zawacki-Richter et al., 2019). By connecting these technological advances with education, it is possible to create a more equitable, inclusive, and effective education system, capable of responding to the needs of an ever-changing society (Jokhan et al., 2022; Stöhr et al., 2024).

In conclusion, globalization has driven the adoption of ICT in education, leading to a significant transformation of teaching and learning methods. These advances have improved access to education, facilitated the personalization of learning, and optimized educational management (Stadelmann et al., 2021). However, the future of education lies in the integration of even more advanced technologies, such as AI, which promises to take these achievements to new heights (Khan et al., 2021).

Artificial Intelligence in Education

AI is revolutionizing various sectors, and education is no exception. As indicated, as ICT has become increasingly integrated into the educational environment, AI has emerged as a powerful tool to personalize learning, optimize educational processes, and improve academic outcomes (Baek et al., 2024; Luckin & Cukurova, 2019). AI's ability to analyze large volumes of data allows it to identify patterns and tailor teaching to students' individual needs, which is changing the way we think about education (Fleischmann, 2024; Soysal et al., 2022).

The ability to offer personalized learning experiences is one of the highlights of AI in education. Through intelligent tutoring systems, AI can adapt to the pace, learning style, and level of knowledge of each student (Li et al., 2023; Su et al., 2022). These systems provide immediate, personalized feedback, adjusting content and learning activities based on student responses and progress (Joudieh et al., 2024; Zammit et al., 2022). In this way, an approach is created that not only improves knowledge comprehension and retention but also increases students' motivation by providing challenges appropriate to their level of proficiency (Kanglang & Afzaal, 2021).

In addition to the personalization of learning, AI is also transforming educational assessment, which has traditionally relied on standardized tests that offer a limited view of student progress and skills (Jara & Ochoa, 2020). For its part, AI

allows for the development of continuous and more holistic assessment systems that can capture a wider range of competencies and skills (Joudieh et al., 2024; Pikhart & Klímová, 2020). These systems can analyze student performance in real-time and provide formative feedback that helps them continuously improve (Jeong, 2020).

AI also has the potential to address one of the most persistent challenges in education: educational differentiation and inclusion. In classrooms where students have a wide range of skills and backgrounds, it is difficult for teachers to cater to each student's individual needs effectively (Stokel-Walker, 2022). This is where AI can play a critical role. AI-powered tools can help identify students who need additional support, as well as those who are ready to advance to a more advanced level, allowing teachers to implement more accurate and timely interventions (Vázquez-Cano et al., 2021).

Similarly, these individual data analyses can help within decision-making to improve operational efficiency and make informed decisions about education policies, thus optimizing administration (Pozdniakov et al., 2024; Sharma et al., 2019). These tools not only help improve the management of schools but also allow educators and administrators to make evidence-based decisions, which can lead to significant improvements in educational quality (Druzhinina et al., 2021).

However, the integration of AI in education also raises ethical considerations that need to be considered, such as data privacy, the digital divide in access to technology, and the potential for bias in AI algorithms (Stadelmann et al., 2021). The collection and analysis of education data by AI systems raises questions about who has access to this information and how it is used (Talan, 2021). In addition, there is a risk that AI systems will perpetuate existing biases if they are not properly designed and monitored (Garcia Corretjer, 2022).

In summary, AI has the potential to profoundly transform education by personalizing learning, improving assessment, supporting educational differentiation and inclusion, and optimizing educational management. However, to make the most of these opportunities, it is crucial to address ethical challenges and ensure that the implementation of AI in education is equitable and accountable (Chatterjee & Bhattacharjee, 2020). The future of AI education is promising, but it also requires careful reflection and strategic planning to ensure that all students benefit from these innovations (Singh & Hiran, 2022).

Need for Teacher Training

While it is true that the potential of AI and ICT to transform education is indisputable, the human factor is essential to be able to use these advances correctly. In this sense, it is necessary to have proper teacher training that gives them the necessary tools to know how to use all these technological advances, as well as those that arise in the future (Sanusi et al., 2024; Thompson et al., 2018; Winkler & Söllner, 2018).

Proper ICT training should not focus on learning how to use a particular program, as rapid advances in technology mean that new options periodically emerge that improve or replace those that were already being used (Palasundram et al., 2019; Stöhr et al., 2024). For this reason, teachers should focus on acquiring general knowledge about the use of technology that enables them to use any type of tool that arises (Kuleto et al., 2021; Pozdniakov et al., 2024).

In this sense, it is essential that teachers develop specific pedagogical competencies that allow them to effectively integrate ICT and AI in the classroom. This implies not only technical mastery of the tools but also a deep understanding of how these technologies can be used to improve teaching and learning processes (Talan, 2021; Vázquez-Cano et al., 2021). Teachers need to be able to design learning experiences that use technology to promote critical thinking, creativity, and peer collaboration (Baek et al., 2024; Stokel-Walker, 2022; Zawacki-Richter et al., 2019).

In this way, they must be prepared to face the challenges that may arise, such as classroom management in digital environments and learning assessment in a technological context (Druzhinina et al., 2021; Jokhan et al., 2022). Teacher training must integrate ethical aspects regarding the use of AI and ICT in educational contexts. With the increasing integration of these technologies into teaching, educators need to be fully aware of the associated ethical implications, such as the protection of personal data, equitable access to technologies, and the detection of bias in AI algorithms (Chatterjee & Bhattacharjee, 2020; Garcia Corretjer, 2022).

On the other hand, it is important to understand teacher training as a continuous process because while technologies evolve rapidly, the same must happen with the skills and knowledge of teachers. Educational institutions should offer regular professional development opportunities, including workshops, courses, and communities of practice that allow teachers to keep up with the latest technological innovations and their pedagogical applications (Kadhim & Hassan, 2020; Vijayakumar et al., 2019). This continuous learning approach ensures that teachers can adapt to new tools and methodologies that emerge while maintaining the relevance of their educational practice (Khan et al., 2021; Zammit et al., 2022).

Thus, teacher training in ICT and AI must be adapted to the specific needs and contexts of each educational environment (Baek et al., 2024; Khasawneh, 2024). Since access to technology varies significantly between schools and communities, training programs must address these disparities by offering relevant and effective strategies and resources in different

situations. This approach should consider elements such as existing technological infrastructure, students' level of digital literacy, and the educational priorities of each community (Harati et al., 2021; Sharma et al., 2019).

In order for these elements to transform education, teachers need to be adequately equipped to integrate these technologies effectively and ethically into their pedagogical practices. This implies a flexible and well-adapted approach to teacher training, a commitment to continuous training, and careful attention to the variations in the needs and contexts of each educational environment (Lee & Yeo, 2022; Rodríguez-García et al., 2020).

Training Courses

Among the training options available to teachers, continuing education courses are the most chosen for the professional development of in-service teachers. These courses allow educators to update their knowledge, acquire new skills, and adapt to changes occurring in the educational field (Jokhan et al., 2022; Kadhim & Hassan, 2020). Within this context, Teacher Training Centres (CEPs) play a crucial role in offering a wide range of training programmes designed to address the specific needs of teachers at different stages of their professional careers (Khasawneh, 2024; Vázquez-Cano et al., 2021).

The courses offered by CEPs focus on providing teachers with the necessary tools to improve their pedagogical practice, foster innovation in the classroom, and respond to contemporary educational challenges (Rodríguez-García et al., 2020; Sharma et al., 2019). These training programs are designed to be flexible, allowing teachers to juggle their participation in courses with their job responsibilities (Palasundram et al., 2019). In addition, many of these courses are organized in varied formats, such as face-to-face workshops, online seminars, and self-study modules, making it easier for a greater number of teachers to participate, regardless of their geographical location or working hours (Lee & Yeo, 2022; Stokel-Walker, 2022).

The training offered by CEPs not only focuses on improving pedagogical practices, but also on the development of emotional and social competencies, which is crucial for a comprehensive educational approach (Khan et al., 2021; Zawacki-Richter et al., 2019). In recent years, there has been a notable increase in the popularity of courses related to educational technology, reflecting the growing importance of ICT and AI in the educational environment (Druzhinina et al., 2021; Harati et al., 2021; Khasawneh, 2024).

CEPs have responded to this demand by increasing the offer of courses that address everything from the basic use of digital tools to the advanced integration of technologies into the curriculum (Jara & Ochoa, 2020; Thompson et al., 2018). These courses are designed not only to teach teachers how to use new technological tools, but also to help them understand how these technologies can transform the teaching-learning process, improve student engagement, and facilitate continuous assessment (Talan, 2021; Vijayakumar et al., 2019).

Educational technology training also includes the development of critical skills such as digital literacy and cybersecurity, essential aspects in today's digital world (Fleischmann, 2024; Kuleto et al., 2021; Vázquez-Cano et al., 2021). The incorporation of technology-focused courses into the training offer of CEPs has been a response to the growing need for teachers to be prepared to effectively integrate ICT and AI into their pedagogical practices (Khasawneh, 2024; Stokel-Walker, 2022; Zawacki-Richter et al., 2019).

Not only have these courses gained popularity among teachers, but they have also proven essential in ensuring that educators can provide high-quality education in an increasingly digitized world (Lee & Yeo, 2022; Rodríguez-García et al., 2020). The growing offer of these training programs reflects a recognition by educational authorities that mastery of new technologies is essential for success in modern education (Guggemos, 2024; Kadhim & Hassan, 2020; Palasundram et al., 2019).

In addition, participation in these courses has led to greater confidence and competence in the use of digital tools among teachers, which in turn has had a positive impact on the quality of teaching students receive (Jokhan et al., 2022; Sharma et al., 2019).

In summary, the training courses offered by CEPs are a crucial avenue for in-service teachers to continue to develop professionally, especially in the context of the rapid evolution of educational technologies. The growing inclusion and popularity of courses focused on the use of ICT and AI not only reflects the importance of these tools in today's educational environment but also underscores the need for teachers to be continuously updated and trained to meet the challenges of education in the twenty-first century (Khan et al., 2021; Zammit et al., 2022).

Continuous training through these courses ensures that educators can stay at the forefront of educational innovations and that they can offer their students an education that is aligned with the demands of modern society (Druzhinina et al., 2021; Harati et al., 2021).

Need for Validation of a Questionnaire

All of the above demonstrates the need for continued research on the implementation and effects of AI in education, as it is an area that is still unexplored (Jara & Ochoa, 2020; Khasawneh, 2024; Talan, 2021). This highlights the urgency of

having validated questionnaires that can offer reliable and systematic empirical data (Rodríguez-García et al., 2020; Sharma et al., 2019).

A rigorously validated questionnaire allows researchers and educators to accurately measure the perceptions, experiences, and outcomes associated with the use of AI technologies in the classroom (Kadhim & Hassan, 2020; Khan et al., 2021). The validity of these instruments ensures that the findings are not only relevant, but also applicable to policymaking, curriculum design, and pedagogical strategies (Stokel-Walker, 2022; Zawacki-Richter et al., 2019). In addition, the accurate and reliable assessment facilitated by a validated questionnaire directly contributes to the identification of effective practices, barriers, and enablers in the integration of AI in education (Palasundram et al., 2019).

Questionnaire validation in this emerging field also drives the standardization of research, allowing meaningful comparisons between different studies and contexts and fostering a coherent accumulation of knowledge (Lee & Yeo, 2022; Thompson et al., 2018). This is very important within a field as dynamic and rapidly evolving as educational technology, where AI innovations and applications are constantly expanding (Jokhan et al., 2022; Kadhim & Hassan, 2020).

Validating questionnaires specifically designed to assess the use of AI in education is a critical step towards advancing academic understanding and informed practice in this vital area (Rodríguez-García et al., 2020; Sharma et al., 2019). This process supports the development of an educational framework that effectively integrates new technologies, offering students an education that is contemporary, relevant, and aligned with the demands of the digital world in which they live (Khan et al., 2021; Zawacki-Richter et al., 2019).

Objectives

Given this context, it becomes evident that a reliable questionnaire is needed to assess teachers' opinions on the quality of training in AI applied to education. Therefore, the general objective of this study is the design, production, and validation of an information collection instrument to evaluate the opinions of teachers at various non-university educational levels regarding the quality of training on AI applied to education. This effort aims to provide a robust tool that supports research in educational AI and informs future training programs.

Methodology

This study has used a mixed methodological approach for the design and validation of a questionnaire aimed at assessing teachers' perceptions and experiences in relation to the use of AI in the educational field. Mixed approaches combine qualitative and quantitative methods to provide a more comprehensive understanding of the phenomenon studied, integrating the strengths of both paradigms to improve the validity of the results.

This research has been structured in two main phases: the design and development of the questionnaire and its validation through expert judgment. The design and development process began with a thorough literature review, with the aim of identifying key concepts about the use of AI in education and essential requirements for training courses in this field. From this review, a preliminary set of items was generated, which were organized into four main categories or dimensions.

Subsequently, the questionnaire was subjected to a validation process by experts, specifically selected for their experience in educational technologies and AI, who evaluated the relevance, clarity, and adequacy of the items formulated. After the collection of the experts' responses, a statistical analysis was carried out to validate the questionnaire, thus ensuring the reliability and consistency of the proposed measurement tool.

Data Analysis

Selection of Experts

A panel of highly qualified experts composed of individuals with significant academic and practical experience in the field of educational technologies was selected for the validation of the questionnaire, which was essential to ensure a rigorous and relevant evaluation of the instrument.

Initially, 15 experts were contacted for the questionnaire validation based on the criterion that, during the past five years, they had been working on topics related to technology applied to education and possessed knowledge in AI. Ultimately, 9 experts expressed interest in participating in the study, which was considered a reasonable number for the questionnaire validation due to their high level of expertise, the diversity of their professional backgrounds, and the adequacy of this sample size for obtaining meaningful and reliable feedback. The experts belonged to renowned academic institutions in Spain, such as the University of Seville, Huelva, Burgos, the Pablo de Olavide University (Seville), and the University School of Osuna (Seville).

The selection of these experts ensures that the questionnaire validation process benefits from high theoretical knowledge combined with practical experience. The high consistency in the responses and the significant interest in educational

technologies by the experts will strengthen the relevance and credibility of the questionnaire evaluation. The diversity in its academic and practical backgrounds provides a solid basis for a thorough and critical evaluation of the instrument, ensuring that the questionnaire is robust, valid and suitable for future applications in education and technology-related research.

Characteristics of the Experts

The experts' profile included several critical dimensions related to teaching and research competence, as well as experience as education professionals. First, the number of theoretical analyses on educational technologies conducted by the experts showed an average of 5 on a Likert scale of 1 to 5, with an equally high median of 5, indicating that most experts are very active in theoretical research within this field.

In terms of practical experience, the experts presented a high level of experience as a teacher or researcher in educational technologies (4.33 points on average), reflecting a high degree of practical involvement within this area of knowledge. Similarly, the experience related to the publication of national and international works related to educational technology has also been very high, obtaining average scores of between 4 and 4.11 points respectively, this suggests that they have been experts who publish in both national and international publishers.

Knowledge of the current state of AI also presented a moderately high score, suggesting substantial familiarity with current trends and applications of AI in educational contexts. However, it is understandable that this area is inferior to the rest due to the novelty of AI and the lack of depth in research on this topic. In addition, knowledge about training courses related to educational technologies obtained an average of 4.11, indicating that experts are well informed about existing training opportunities and their contents.

A highlight was the interest in educational technologies, where the average was 5.00, the maximum possible value, highlighting a unanimous and enthusiastic commitment to the field. This not only reflects a passion for the area, but also an ongoing commitment to the evolution and application of new technologies in education. Considering the high score in the aspects analyzed, the selected experts are considered suitable for the validation of the questionnaire.

Expert Evaluation Procedure

The expert evaluation procedure followed a structured and systematic approach to ensure the quality and reliability of the validation process. Once they agreed to participate in the study, the experts were provided with a document through Microsoft Forms containing the full questionnaire. This document also included a Likert scale for the experts to evaluate how interesting each question was, indicating the relevance or interest of each item. Additionally, a comments section was provided where experts could leave observations and specific suggestions for each item. This feedback was crucial for the final design of the questionnaire, as it allowed for adjustments and improvements based on the experts' opinions and recommendations.

The experts evaluated the questionnaire items based on several key criteria: (1) *Relevance to Current Educational Trends*: Whether each item reflected contemporary issues and challenges in the fields of educational technology and AI. (2) *Clarity and Comprehensibility*: Whether the wording of the items was clear and easily understandable, ensuring that respondents could interpret the questions accurately. (3) *Applicability to Diverse Educational Contexts*: Whether the items could be applied to various educational settings, including different educational levels (e.g., primary, secondary, higher education) and geographical contexts. (4) *Content Validity*: Whether the items comprehensively covered key areas of educational technology and AI as identified in existing literature.

To ensure that all experts fully understood the purpose and objectives of the questionnaire, they were provided with a brief introduction and detailed instructions on how to evaluate the items. They were also encouraged to suggest modifications or improve the wording of the items, keeping in mind the broader context of educational technology and AI. The Microsoft Forms platform allowed experts to respond easily and efficiently, while also providing them with the option to leave additional comments in a structured manner.

Experts were given a two-week period to complete the evaluation. This timeframe was chosen to allow them to thoroughly analyze each question, reflect on their responses, and review any aspects related to the proposed items. During this period, experts received reminders halfway through the evaluation to ensure timely completion. After the two weeks had passed, all responses and comments were collected for analysis and subsequent incorporation into the final design of the questionnaire.

In cases where discrepancies arose between the experts' evaluations, a consensus-based resolution approach was employed. Initially, the comments were reviewed individually, and areas of divergence were identified. When differences persisted, experts were contacted for clarification, and if necessary, a brief discussion was organized to address the disagreements. During this process, experts were encouraged to provide detailed justifications for their assessments, referencing relevant literature or their professional experience. If consensus could not be fully achieved, the research team made the final decision based on most of the feedback, ensuring that the validation process remained objective and rigorous.

Structure of the Questionnaire

The information collection instrument is structured according to several categories, these were designed based on the information obtained after the theoretical study related to the topic and based on the research needs raised:

1) Previous AI knowledge and experience: Respondents' basic AI knowledge and personal experiences with AI applications in the educational context are assessed. Items 1 to 5.
2) Perception of the application and benefits of AI in education: Respondents' views on the impact of AI on academic performance, personalization of learning, and student engagement are explored. Items 6 to 17.
3) AI training: It asks about the completion of courses related to AI, the learning of practical and theoretical aspects, and the incorporation of ethical knowledge. Items 18 to 27.
4) Course expectations: The expectations of the contents that educators have encountered or expect to find in a training course are examined. Items 28 to 36.
5) Impact on teaching practice: Study how the content learned in courses can affect teaching. Items 37 to 43.

The questionnaire items were carefully designed to meet the research needs, considering that AI in education remains a relatively unexplored field. Drawing on insights gained from an extensive review of the relevant literature, the ítems were developed collaboratively by the authors, ensuring that they addressed key aspects of AI integration in educational contexts. Given the evolving nature of the field, the questionnaire was intentionally designed with flexibility in mind, anticipating constructive feedback from experts. Their critical evaluation was considered essential for refining the items, enabling adjustments that would enhance the instrument's validity and relevance to the study's objectives. The questionnaire used for validation was hosted at the web address https://forms.office.com/e/MTmw6Ly7BY, and was sent to the selected experts via email.

Analysis of the Questionnaire

Introduction to Statistical Measures

The analysis of the mean scores obtained in each of the items is useful for summarizing datasets with a single figure that represents the central point of the data, which is crucial when assessing attitudes or perceptions that are relatively evenly distributed among respondents.

A calculation of the median has allowed us to identify the midpoint of the responses, which is particularly relevant in biased data, as observed in some of the questionnaire responses. We agree with Fabián (2019) who argue that the median is less susceptible to extreme values compared to the mean, providing a more stable measure of the central tendency in asymmetric distributions.

The analysis of the mode or value that appears most frequently has been very useful to us in the analysis of categorical data or when it is important to identify the most common value. Barahona et al. (2018) emphasizes its usefulness in highlighting the predominant responses in studies where response modalities are critical to understanding common behaviors or preferences.

The standard deviation has also been analyzed, which has been used to measure the variability or dispersion of the responses around the mean. Bland and Altman (1996) point out that understanding the dispersion of the data is essential to contextualize the mean, allowing the homogeneity or heterogeneity of the responses to be assessed.

The calculation of kurtosis, which has been decisive in determining the acuity and shape of the tails of the distribution of the responses. DeCarlo (1997) indicates that high kurtosis reflects a concentration of data around the mean with heavier tails, which may be indicative of the presence of outliers or extreme responses that may influence the overall interpretation of the data.

Symmetry analysis, which has provided information on distribution asymmetry. Trochim and Donnelly (2006) justify the importance of calculating symmetry to verify the assumptions of normality required by many statistical tests. In this study, symmetry helped identify whether response distributions were leaning towards higher or lower values, which is crucial for correctly interpreting attitudes and opinions about AI in education.

Analysis of Central Tendency and Dispersion

To evaluate the validity of the information collection instrument, the answers provided by the respondents were analyzed, using the measures of central tendency referred to above (Figure 1). These measures made it possible to identify the consistency and variability of the responses, facilitating the analysis of the internal validity of the questionnaire.

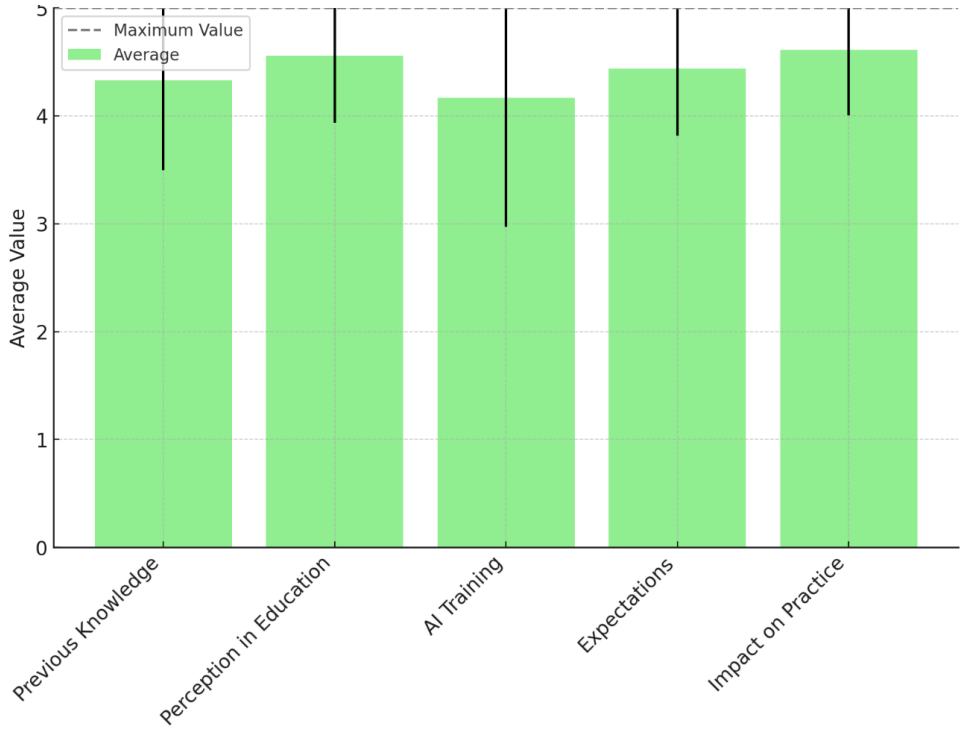

Figure 1. Average and standard deviation by dimension

Dimension 1. Previous knowledge and experience in AI. The items related to prior knowledge and experience in AI ("Prior knowledge about AI", "Experience using AI applications", "Ability to explain basic concepts of AI") showed means between 4.22 and 4.44. This data indicates that respondents have intermediate to high knowledge about AI. The standard deviation ranged from 0.667 to 1.000, suggesting that while there is some dispersion in responses, overall, opinions on this topic are consistent. The mode of 5 in most of these items reinforces this observation, showing that a sizable group of respondents' report having solid expertise in the field.

Dimension 2. Perception of the application and benefits of AI in education. Items related to the perception of the impact of AI on education, such as "Transforming education with AI", "Impact of AI on learning" and "Personalization of learning with AI", have high averages, ranging from 4.33 to 4.67. This reflects a generally positive attitude towards the use of AI in education. The variance and standard deviation are low in these items (0.500 to 0.750), indicating that the responses are concentrated around the mean, suggesting a high degree of consensus among the participants. These results indicate that respondents perceive AI as a valuable tool to improve various aspects of teaching.

Dimension 3. AI training and preparation. Regarding training and preparation in AI, the items that evaluated participation in courses and the acquisition of theoretical and practical knowledge presented means between 3.78 and 4.56. Although the mean reflects a moderate level of training, the greater dispersion observed in the standard deviations (up to 1,394 in the item "AI training courses completed") suggests that the respondents have had very varied training experiences. This points to the need to design more homogeneous or specialized training programs to better meet the needs of teachers.

Dimension 4. Expectations about AI integration. The items related to expectations about the integration of AI in educational practice, such as "Improvement of academic performance", "Personalization of learning", "Increase of interest in the subject" and "Participation in class with AI", registered averages between 4.22 and 4.56. These figures reveal that respondents expect positive outcomes from integrating AI into education. Low variances and standard deviations, around 0.500 to 0.750, indicate a high level of agreement among participants, reinforcing the validity of these questions. In addition, the near-zero kurtoses suggest that the responses are evenly distributed, with no noticeable extremes.

Dimension 5: Impact on teaching practice. The items related to the perception of the impact of AI on teaching practice, such as "Improving teaching practice with AI", "Application of what has been learned in AI training" and "Tools provided by the courses", have high averages (between 4.33 and 4.89). The low dispersion of responses, with variances ranging from 0.278 to 0.528, and standard deviations ranging from 0.500 to 0.707, indicates that respondents unanimously perceive that AI can improve their educational practice. This suggests that the questionnaire can capture the positive view and expectations about the use of AI in the educational field.

Kurtosis and Symmetry Analysis

The global analysis of the scores obtained shows that the questions present a high consistency in the answers, with generally low standard deviations and controlled variances. The average of the items is mostly around 4, reflecting a generally positive perception by respondents about the use and benefits of AI in education.

The low dispersion of responses across most items suggests that the questionnaire is consistent and that respondents share a common view on AI. Likewise, negative kurtosis in several items indicates that the responses are relatively evenly distributed, without bias towards the extremes, which reinforces the internal validity of the questionnaire.

Some items such as "Improvement in academic performance with AI", "Transformation of education with AI" and "Application of what has been learned in AI training", the kurtosis is negative (-0.040, -1.714 and -0.286 respectively), this indicates that the answers are distributed in a more dispersed way, with flatter tails compared to a normal distribution. This means that respondents do not converge very tightly around a specific value (such as the mean), but that the responses are more dispersed. This could reflect the diversity in individual opinions or experiences about AI in those aspects, suggesting that some respondents may have more moderate or less defined expectations.

Other items such as "Ability to explain basic concepts of AI" or "Ethical aspects in AI training", have a low or close to zero kurtosis (-2,571 and 5,657 respectively), which implies that the answers are relatively evenly dispersed around the average, without strong concentration or extreme queues. The explanation is that the data do not show a trend towards extremes and the answers are distributed in a reasonably normal way. It's a sign that opinions are varied, but not extreme, supporting the idea that the questions don't polarize respondents and capture a wide range of perceptions.

Finally, some items show high positive kurtosis: "AI training" or "Quality of teaching resources in AI training" (9,000 and 4,000 points respectively), indicating that the responses are highly concentrated around the average, with very few extreme responses. In these cases, respondents converge very strongly around a common opinion, which may indicate a shared perception about certain aspects of AI use. For example, the high kurtosis in the "Quality of teaching resources" suggests that most respondents agreed in evaluating this issue in a similar way, indicating consensus on the quality of the training received.

In summary, the analysis of kurtosis reinforces the validity of the questionnaire in its ability to capture a diversity of opinions, as well as to identify areas where there is greater consensus among participants. In items with high positive kurtosis, a generalized agreement is confirmed, while in those with negative kurtosis, greater dispersion is observed, which may indicate topics that require further exploration or differentiation in future studies.

Validation of the Questionnaire

The analysis carried out suggests that the questionnaire is valid for measuring perceptions and expectations about AI in education, given the consensus observed in the responses. However, it is recommended to refine the questions related to AI training, since the high dispersion in these items reflects significant differences in the training experiences of the respondents. In addition, it might be useful to incorporate questions that further explore perceived challenges or limitations in the use of AI, given that the current questionnaire mostly reflects a positive view. In conclusion, the results indicate that the questionnaire is a reliable tool for assessing perceptions about AI in education, although improvements could be made to the questions on training and challenges to provide a more complete picture of teachers' opinions.

The analysis of the dispersion of the data, reflected in the variances and standard deviations, suggests that the questionnaire has good internal validity. The questions are clear and consistent with each other, and respondents tend to agree on key aspects related to AI in education. The items with the greatest dispersion, particularly those related to AI training, highlight the need for more homogeneity in training programs or greater differentiation in the experience levels of the respondents.

Strengths of the Questionnaire

The questionnaire presents several important strengths that make it a suitable instrument for assessing perceptions and experiences about AI in education. First, it stands out for its *consistency and clarity* in the questions, which are directly aligned with the objectives of the study. This ensures that the experts interpreted the items uniformly, reflecting a clear level of understanding and high consistency in the responses. The observed internal consistency suggests that the questions are reliably measuring key constructs related to the use of AI, which reinforces the reliability of the questionnaire.

In addition, it covers a wide range of relevant aspects, making it a *comprehensive* tool for assessing respondents' interaction with AI. Topics ranging from prior knowledge and experience with AI to its application in learning personalization, automatic assessment, and academic performance improvement are explored. This *comprehensive coverage* ensures that both theoretical and practical aspects of AI in education are captured, allowing for a detailed and holistic assessment of respondents' perceptions. The inclusion of questions addressing the perceived benefits of AI

reflects a *good uptake* of the technology, underscoring respondents' optimism about its potential to transform educational practices.

Areas for Improvement

However, despite these strengths, the questionnaire also presents areas for improvement that could optimize its ability to capture the full respondents' experience. One of the most obvious challenges is the variability in responses related to AI training. The responses show a significant dispersion in the items related to training, which suggests that the respondents have heterogeneous training experiences. To improve this situation, it would be advisable to include questions that more precisely detail the type of training, the content addressed and the level of in-depth learning in AI. This would allow for a better understanding of the differences in levels of knowledge and preparation between participants, providing richer information for analysis.

Another aspect to consider is the possible positive bias in the answers, since most of the items present very favorable evaluations of AI. While this is indicative of an optimistic perception about integrating AI into education, it could mask perceived challenges or barriers in its implementation. To counter this bias, it would be useful to incorporate questions that explore the limitations or difficulties that teachers may face when using AI in their educational settings. This would help to obtain a more balanced and realistic view on the benefits and barriers of the use of AI, providing a more complete assessment of its impact.

Suggestions for Enhancing the Questionnaire

Overall, the questionnaire is presented as a robust and suitable tool for measuring perceptions about AI in education, but with **potential for improvement** in key areas such as differentiation in training and exploration of challenges. Adjustments to these points would allow us to obtain even more precise and useful results to understand how AI is being integrated and perceived in the educational field.

Internal Consistency and Cronbach's Alpha

To determine the internal consistency of the questionnaire, Cronbach's Alpha was calculated, which was 0.953 points (Table 1). This value indicates that the questionnaire has a good internal consistency based on the generally coherent and concentrated answers in most of the items. Nunnally and Bernstein (1994) suggest that a Cronbach's alpha value of 0.7 or higher is acceptable for studies of this type. Therefore, the high figure for this variable shows the low dispersion of the responses and the clear relationship between the items that measure similar perceptions and knowledge. In this way, the conclusion is drawn that the questionnaire is very reliable.

Table 1. Reliability Index (extracted from SPSS)

Cronbach's Alpha	Number of Items
.953	56

Discussion

The findings of this study confirm a strong acceptance and positive perception of AI integration in education among the experts consulted. The results highlight a clear enthusiasm for adopting AI-based tools in educational contexts, reflecting current trends reported in recent literature (Baek et al., 2024; Guggemos, 2024; Stöhr et al., 2024). The mean score of 5.00 in the "Interest in educational technologies" dimension underscores a unanimous commitment among experts, suggesting a favorable predisposition toward the adoption of AI in teaching and learning environments.

Perception of AI Benefits in Education: The experts' positive perception of AI's potential to enhance educational processes aligns with studies that emphasize its role in personalizing learning and improving academic performance (Joudieh et al., 2024). Items related to "Personalization of learning" and "Improvement of academic performance" received consistently high scores, indicating consensus on the transformative potential of AI technologies. This finding supports prior research demonstrating that AI can optimize learning outcomes by tailoring educational experiences to individual student needs.

However, some studies present a more cautious perspective. Research by Sanusi et al. (2024) highlights potential ethical concerns and technical limitations, such as bias in algorithms and data privacy issues, which were not fully explored in the current study. Future iterations of the questionnaire could benefit from including items assessing these potential drawbacks.

Training and Preparation in AI: The variability observed in the "Training and preparation in AI" dimension indicates a notable disparity in respondents' training experiences. This finding aligns with Pozdniakov et al. (2024), who argue that heterogeneous training backgrounds can hinder the effective implementation of AI in education. The standard deviation of responses points to differing levels of preparedness among educators, suggesting a need for more specialized and

uniform training programs. Addressing this gap through structured training could promote a more equitable adoption of AI tools in diverse educational contexts.

Diversity of Opinions and Response Distribution: The kurtosis analysis revealed both concentration and dispersion in responses, suggesting areas of strong consensus and divergent opinions. Items such as "Quality of teaching resources in AI training" (kurtosis = 4.000) showed a high degree of agreement, indicating satisfaction with the training materials provided. Conversely, "Transforming education with AI" (kurtosis = -1.714) reflected greater variability, possibly due to differences in individual expectations or personal experiences with AI implementation. These contrasting results underscore the complexity of AI's perceived impact, emphasizing the need for further investigation.

Comparison with Similar Validation Studies: The study's findings align with those reported by Fleischmann (2024), who identified high reliability in similar validation efforts using AI-focused questionnaires. The calculated Cronbach's Alpha of 0.953 corroborates the internal consistency of the questionnaire, supporting its use as a robust instrument for evaluating educational technologies. However, in contrast to DeCarlo (1997), who reported lower reliability scores due to diverse respondent backgrounds, this study's participant group, composed of AI-savvy educators, may have contributed to the higher reliability observed.

Recommendations for Future Research: To enhance the external validity of the questionnaire, future studies should aim to include a broader and more diverse sample of participants. Expanding the respondent pool could uncover new insights and further validate the instrument's applicability across various educational contexts. Additionally, incorporating items that explore challenges such as data privacy, resistance to technological change, and algorithmic biases would provide a more balanced view of AI's potential and limitations in education.

Overall, this study reaffirms the high acceptance and positive expectations surrounding AI in education while identifying key areas for improvement, particularly in training and addressing potential challenges. By refining the questionnaire to incorporate both the benefits and barriers of AI adoption, future research can offer a more comprehensive understanding of how emerging technologies influence educational practices. The study underscores the importance of continued validation efforts, ensuring that AI-related tools are evaluated through a balanced and inclusive lens, consistent with the recommendations of Sanusi et al. (2024).

Conclusions

The present study has validated a quantitative questionnaire designed to assess the quality of educational technology training courses with a focus on AI. The validation was carried out through a judgment of experts, who demonstrated a high level of competence and experience in the field of educational technologies, which supports the relevance and reliability of the evaluations carried out.

The analysis of the collected data showed that the different dimensions of the questionnaire present high levels of internal consistency, with means generally greater than 4 on a Likert scale of 1 to 5. The dimension of "Previous knowledge and experience in AI" reflected a strong understanding and experience of the respondents in the use of AI in educational contexts, while the "Perception of the application and benefits of AI in education" evidenced a predominantly positive attitude towards the integration of AI in the educational field.

In addition, the reliability analysis, measured by Cronbach's alpha, yielded a value of .953, indicating excellent internal consistency of the questionnaire (Nunnally & Bernstein, 1994). This high reliability index suggests that the questionnaire items are highly correlated with each other, which reinforces the reliability of the instrument for future research.

In a world where AI gains prominence every day, it is imperative for teachers to receive appropriate training to equip students with essential skills for the future. Having validated tools like this questionnaire not only supports research but also drives continuous improvement in AI-focused educational programs, ensuring that schools remain at the forefront of technological and pedagogical innovation.

Recommendations

To improve the quality and consistency of educational technology training courses with a focus on AI, it is recommended to standardize AI training programs to address variability in participants' experiences, ensuring a homogeneous level of teacher preparation. Additionally, incorporating modular content tailored to different levels of AI proficiency would allow educators to build on their existing knowledge more effectively. Emphasis should be placed on demonstrating practical applications and benefits of AI in educational settings to foster positive perceptions and enhance relevance. Furthermore, continuous evaluation and iterative updates to training content are essential to align with advancements in AI and participant feedback. Finally, promoting peer collaboration and knowledge sharing could bridge knowledge gaps and support a community of practice, enriching educators' understanding and application of AI in education.

Limitations

However, areas for improvement were identified, particularly in the dimension of "AI training and preparation", where the high standard deviation suggests significant variability in respondents' training experiences. This finding points to the need to standardize and deepen AI training programs to ensure homogeneous teacher preparation.

Ethics Statements

The studies involving human participants were reviewed and approved by University of Seville. The participants provided their written informed consent to participate in this study.

Authorship Contribution Statement

Each author has contributed jointly during the development of the manuscript.

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Appendix

The following link provides access to the questionnaire for copying, translation if needed and subsequent use: http://surl.li/ofrvyi

Questionary:

Part A: Expectations about AI and Its Impact on Education

1. I believe that AI can transform education.
2. I believe that intelligent tutors are one of the most promising AI applications for education.
3. I believe that learning data analysis is one of the most promising AI applications for education.
4. I believe that automated assessment is one of the most promising AI applications for education.
5. I believe that AI can bring benefits to my teaching practice.
6. I believe that AI can effectively personalize learning.
7. I believe that training in AI will make me a more competent educator.
8. I believe that AI will have a major impact on education in the next five years.
9. I expect to see improvements in students' academic performance with the integration of AI.
10. I expect to see personalized learning for students with the integration of AI.
11. I expect to see an increase in students' interest in the subject with the integration of AI.
12. I expect to see greater student participation in class with the integration of AI.

Part B: Expectations about AI Training Courses

13. I have attended AI-related training courses.
14. In AI training courses, I have learned or expect to learn about practical applications of AI.
15. In AI training courses, I have learned or expect to learn about theoretical foundations of AI.
16. In AI training courses, I have learned or expect to learn about ethical aspects of AI.
17. In AI training courses, I have learned or expect to learn about AI project development.
18. In AI training courses, I would have liked or would like to find more theoretical content.
19. In AI training courses, I would have liked or would like to find more practical content.
20. In AI training courses, I would have liked or would like to find real-case examples.
21. In AI training courses, I would have liked or would like to find the development of a final project.
22. What applications have you used or would you like to learn about in such course(s)?

Part C: Evaluation of AI Training Courses

23. The AI training courses I have attended or would like to attend offer or should offer a balanced view between theory and practice.
24. The AI training courses I have attended or would like to attend address or should address ethical aspects of AI in education.
25. The AI training courses I have attended or would like to attend are or should be up-to-date with the latest technologies and methodologies.
26. The quality of the educational resources provided in the AI courses I have attended or would like to attend is or should be high.
27. The AI training courses I have attended or would like to attend promote or should promote collaboration and teamwork on AI projects.
28. The AI training courses I have attended or would like to attend include or should include real-case examples of AI in educational environments.
29. The AI training courses I have attended or would like to attend offer or should offer opportunities to develop personal AI projects.

30. The instructors of the AI training courses I have attended or would like to attend are well-informed and knowledgeable about AI.
31. The content of the AI training courses I have attended or would like to attend adequately prepares educators to use AI in their practice.

Part D: Impact and Application of Learning

32. I feel that taking AI courses would improve my teaching practice.
33. I plan to apply what I have learned or will learn from AI courses in my teaching practice.
34. The AI course has provided or will provide me with new tools or methodologies for my work.
35. I believe that the AI course has contributed or can contribute to my professional development.
36. I would recommend AI courses in education to other colleagues.
37. The AI course has influenced or could influence how I design and plan my learning activities in class.

After taking AI courses, my pedagogical approach to AI applied to teaching has changed or could change.