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Formative Assessment and Artificial Intelligence: Strategies for Human and Effective Learning

Evaluación Formativa e Inteligencia Artificial: Estrategias para un Aprendizaje Humano y Eficaz

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ABSTRACT

This study analyzes the impact of personalized feedback on formative assessment in higher education, considering the role of artificial intelligence in this process. A mixed-methods design with both qualitative and quantitative approaches was used, collecting data through surveys and response analysis on digital learning platforms. A total of 150 student responses from various institutions were analyzed to assess the effectiveness and perception of feedback. Results indicate that personalized feedback enhances meaningful learning and student motivation, although challenges remain for large-scale implementation. Pedagogical implications are discussed, and strategies are proposed to optimize its use in digital environments.

Palabras clave:
Evaluación formativa, inteligencia artificial, educación superior, retroalimentación personalizada, aprendizaje significativo

RESUMEN

Este estudio analiza el impacto de la retroalimentación personalizada en la evaluación formativa dentro de la educación superior, considerando el papel de la inteligencia artificial en este proceso. Se empleó un diseño mixto con un enfoque cualitativo y cuantitativo, recolectando datos mediante encuestas y análisis de respuestas en plataformas digitales de aprendizaje. Se analizaron 150 respuestas de estudiantes de distintas instituciones, evaluando la efectividad y percepción de la retroalimentación. Los resultados indican que la retroalimentación personalizada mejora el aprendizaje significativo y la motivación de los estudiantes, aunque existen desafíos en su implementación a gran escala. Se discuten implicaciones pedagógicas y se proponen estrategias para optimizar su uso en entornos digitales.

Introduction

Formative assessment seeks to foster responsible and reflective learning in students through the active guidance of teachers, who can systematically organize the learning process. Therefore, the need to reconsider formative assessment arises because it currently represents one of the most complex challenges in classroom teaching, given that it tends to be mostly quantitative and focused on academic performance. (Garcia et al., 2021)

In the current context of higher education, the integration of artificial intelligence (AI) in assessment offers opportunities to improve the accuracy, objectivity and efficiency of this process, however, it is crucial to maintain a human focus in formative assessment, ensuring that the emotional, social and ethical aspects of learning are not compromised in advanced technological environments (Van der Kleij et al., 2015).

In recent years, artificial intelligence (AI) has revolutionized the field of education, transforming the way in which teaching and learning take place. This technological advance has allowed for greater interaction between teachers and students, as well as a more efficient flow of information. According to Obaya (2003), information and communication technologies (ICT) facilitate social relations, cooperative learning and the development of new skills, promoting creativity, communication and reasoning.

The use of artificial intelligence represents an innovative tool that favors individualized learning, adapting to the learning styles and rhythms of each student. This type of software can be seen as a study partner with which various interactions can be established. Abarzúa and Cerda (2011), cited in Rojas, Gómez and García (2013), point out that the use of various digital tools contributes to the appreciation of diversity in the classroom by considering the individual differences of students, which makes them feel that their learning process is personalized and not comparative with that of their peers.

To investigate effective strategies to improve formative assessment in higher education in an environment where AI plays a relevant role, we seek to understand how these strategies can maintain a more humane monitoring of learning, considering the challenges and opportunities that arise from the integration of AI in educational assessment, in addition, we intend to provide practical recommendations for educators and designers of assessment systems to take full advantage of the capabilities of AI without losing sight of the importance of human interaction in the learning process.

The effective integration of artificial intelligence (AI) in formative assessment in higher education can significantly improve the accuracy, objectivity and efficiency of the assessment process, while maintaining a human approach that safeguards the emotional, social and ethical aspects of learning, by identifying and applying appropriate strategies for this integration and achieving a more effective and humane monitoring of learning, thus offering benefits for both students and educators.

Internationally, studies such as Tumoi (2018) have explored the impact of AI on formative assessment and proposed approaches to optimize its use in the educational process. They have demonstrated how AI can provide more accurate and detailed data analysis, enabling more personalized and effective feedback for students similarly they have analyzed how AI can personalize assessment to better serve individual student needs. This type of work highlights the importance of careful integration of AI in formative assessment to ensure meaningful student learning outcomes and highlights the need to address ethical and social issues in this integration.

In the current era, artificial intelligence (AI) has played a significant role in transforming education, redefining both teaching methods and learning processes. This

technological evolution has led to greater interaction between teachers and students, as well as an optimization in the transfer of knowledge. According to Obaya (2003), information and communication technologies (ICT) not only improve social relations in the educational environment, but also facilitate collaborative learning, stimulate the development of new skills and promote creativity, communication and reasoning.

The use of artificial intelligence has become an innovative tool that favors personalized learning, adapting to the different learning styles and rhythms of each student. This type of tool contributes to the recognition and appreciation of diversity in the classroom, while giving students the feeling that their learning process is unique and personalized, without comparisons with others. Abarzúa and Cerda (2011),

It is essential to highlight the importance of digital literacy and inclusive education in the context of artificial intelligence applied to education. These aspects allow students to work autonomously and strengthen their individualized learning.

In the field of higher education, formative assessment has been the subject of numerous studies that seek to understand its impact on the learning process of students. For example, Cabero-Almenara and Palacios-Rodriguez, (2021) conducted a comprehensive systematic review on the integration of assessment tools in digital education at the higher level, their work highlights the importance of these tools to provide personalized feedback and improve the learning experience of students.

However, it is important to take into account ethical considerations in the use of AI in educational assessment, as this is a subject of debate and study. A UNESCO research (2021) conducted a policy analysis on AI-driven education and assessment, highlighting the need to address aspects such as privacy, equity and transparency in these practices, as it is essential to understand students' perceptions of AI-based assessment tools.

These previous works provide a theoretical and empirical basis for the development of this study on the importance of improving formative assessment in higher education in the era of artificial intelligence. First, previous research has identified the existing limitations and challenges of traditional formative assessment methods, highlighting the need for more dynamic and adaptive approaches that align with the changing demands of today's educational environment.

In addition, these studies have demonstrated the potential of artificial intelligence to significantly improve the formative assessment process. By analyzing large volumes of data and using advanced algorithms, artificial intelligence can provide personalized *insights* and recommendations that enable educators and students to identify areas for improvement more accurately and efficiently.

The existing literature underlines the importance of taking advantage of the capabilities of artificial intelligence to improve formative assessment in higher education, without losing sight of the limitations, regulations and the human sense that education should have.

Method

The present study focuses on investigating innovative strategies to improve formative assessment in higher education, specifically in relation to the integration of artificial intelligence (AI) in educational assessment processes in higher education. The scope of this research encompasses both the exploration of the existing literature and the detailed analysis of a case study at the higher education level on formative assessment strategies using AI. The objective is to understand in depth how these strategies can contribute to a more humane monitoring of learning, considering the challenges and opportunities that

arise from this technological integration in education and what is the perception of students regarding their application in the teaching-learning process.

The methodological design of this study combines a qualitative and quantitative approach to comprehensively address the research objective. The literature review was carried out systematically, using recognized academic databases and consulting high-impact sources in the field of education and technology, and a detailed case analysis of the perception of higher education students on the use of artificial intelligence in their learning. This combination of approaches provides a holistic and in-depth view of the subject under study.

Sample and Method of Sampling.

The sample for the case analysis was selected intentionally and representatively, considering criteria such as the diversity of technological approaches used, the size and type of population in contact with the use of AI.

A questionnaire of 17 questions was carried out, including open and closed questions, as well as the follow-up of a schedule of activities, the questionnaire was applied to 85 students from different higher education careers in the state of Puebla, Mexico, whose age ranged between 18 and 23 years, having 49 women and 36 men in the study. For the application of the questionnaire, a previous review of the bibliography was made, as well as its validation, which was previously piloted with a group of students. For its implementation, a document on the ethical considerations of the study to preserve the confidentiality of the data collected from the participants, as well as a link to the questions, was sent by e-mail invitation.

Applied Statistical Analysis

Data analysis was carried out using both qualitative and quantitative techniques. For the qualitative analyses of the case studies, a content analysis approach was applied to identify significant patterns, themes, and relationships related to formative assessment and the use of AI, and descriptive and comparative statistical techniques were employed to examine the effectiveness and impact of formative assessment strategies with AI on students' performance and learning experience.

The statistical analysis was mostly done through *Google forms and Excel*, being these tools instruments used for the analysis of the responses collected which were interpreted through graphs that show a detailed overview of the study.

Limitations of the study.

It is important to recognize that this study may face some limitations, such as the limited availability of detailed data on the implementation of formative assessment with IA in certain educational contexts, and the qualitative approach may not fully capture the complexity and diversity of participants' experiences and perceptions.

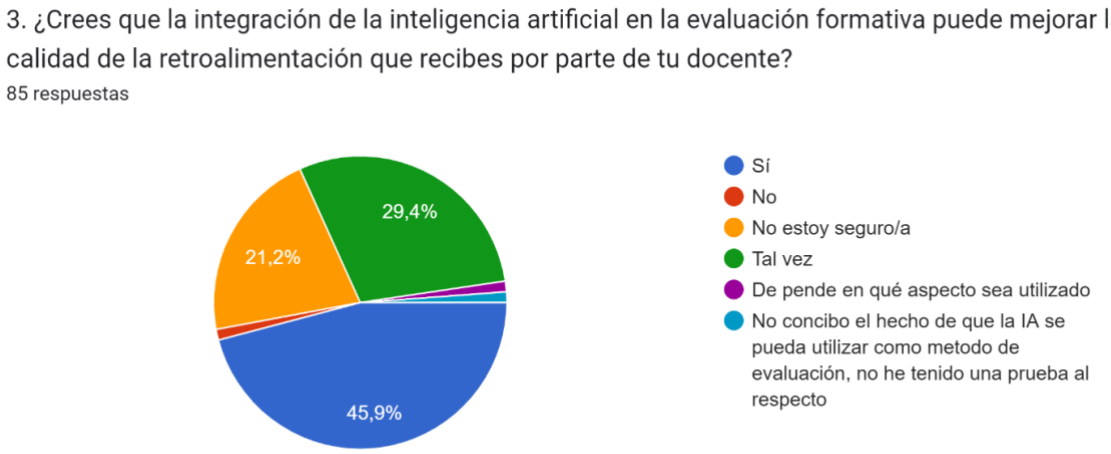
Likewise, the growing development and evolution of artificial intelligence, which is at an accelerated pace, implies that the results obtained may be very different in a few more months due to the change in new technologies, as well as in their use and insertion in the daily life of students.

Another limitation is the context in which the study was applied, since the results obtained may vary considerably in their application from one region to another, and even between public and private sector universities. However, formative assessment is something present in any institution, but its interaction in virtual environments or where there is the use of artificial intelligence may present variations.

Results

The study yielded several considerations which are worth analyzing and highlighting, since they mention important aspects of the students' perception of formative assessment in higher education. To begin with, more than 80% of the respondents show some degree of familiarity with the concept of formative evaluation, so that only a few are unfamiliar with the term.

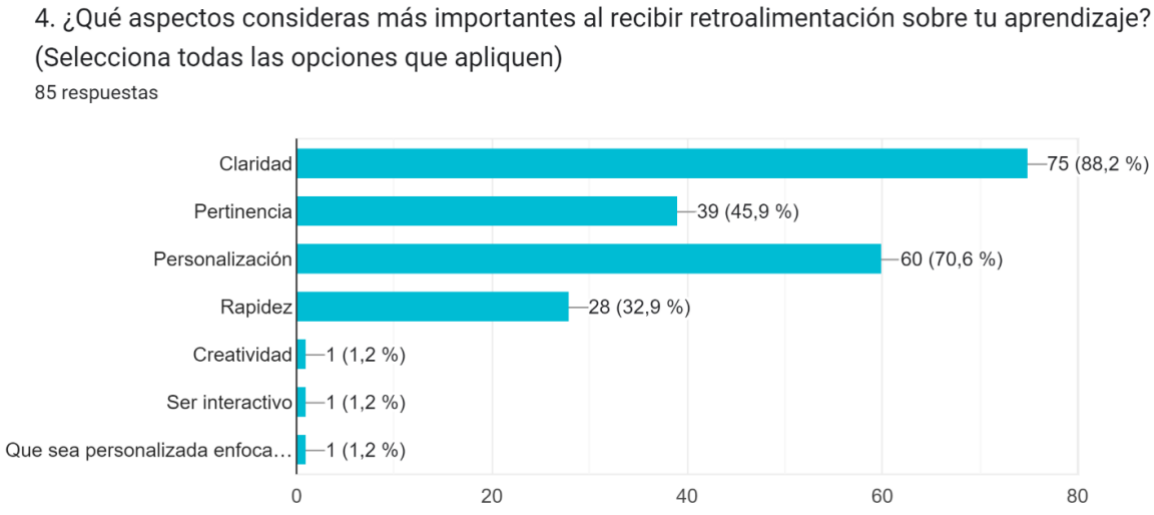
Graph 1.



Source: author's elaboration.

With respect to the previous question we can visualize that more than 90% of the students consider that the use of artificial intelligence can translate into an improvement in the feedback they receive from their teachers, which leads us to highlight the importance that artificial intelligence is taking in the classroom, essentially in the way in which they receive feedback on their evaluations.

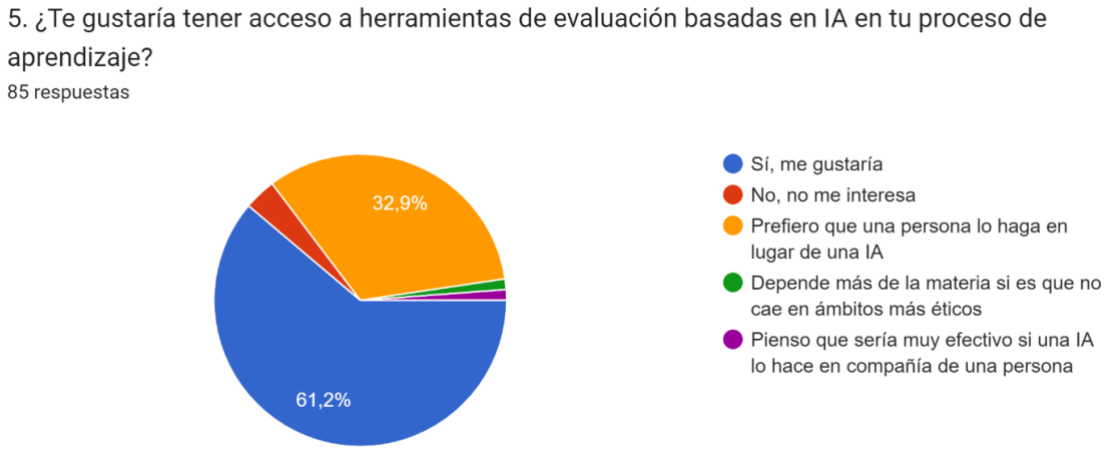
Graph 2



Source: author's own elaboration.

Regarding the aspects they consider most relevant when receiving feedback, there is an inclination towards personalization and clarity, over relevance, speed and creativity, aspects that are relevant, but according to the results are not predominant in the respondents. This leads us to the analysis of the following graph, where the students are divided into those who would opt for an AI to carry out part of their learning process and another part chooses the evaluation carried out by a human being, in this case their teacher of the subject in question.

Graph 3.



Source: Author's elaboration.

The results of question number 5 reveal a range of perspectives on whether artificial intelligence (AI) could outperform the teacher in identifying areas for improvement in learning. Some see AI as having greater potential because of its ability to offer a diversity of tools and approaches that a human teacher might not fully embrace, respondents argue that AI, with its accuracy and ability to identify specific errors, could provide more detailed feedback tailored to the individual needs of each student.

According to Aung et al. (2021) The impact of artificial intelligence on the evaluation and classification process is significant. AI not only influences teaching and learning, but also student assessment and grading. For example, AI examines assignments and research projects using tools such as Turnitin, which compares student work against a large database in a short time. This makes it easy to identify similarities and determine whether plagiarism has occurred. In addition, rubrics and online grading forms are used that specify criteria and scales for evaluating tasks, and final grades are automatically calculated without complications (Mahana et al., 2012). Artificial intelligence also offers interactive ways to provide constructive feedback to students, allowing easy and flexible access anytime, anywhere, ensuring greater privacy and autonomy. Also, instructors can provide written or recorded feedback to facilitate learning from mistakes.

On the other hand, there are those who defend the effectiveness of the human teacher, highlighting their ability to explain in a clearer and more personalized way (in a human way), taking into account aspects such as the personality and learning habits of each student, in addition, they value the emotional connection and experience that a teacher can offer, as well as the necessary balance between the use of technology and the integral development of learning.

According to Gómez Vahos, Muriel Muñoz and Londoño-Vásquez (2019), the role of the teacher is fundamental for the achievement of meaningful learning supported by ICTs highlighting the importance of integrating technological tools in educational training. These technologies are seen as a way to expand the capacity to create, share and master knowledge, being a crucial factor in today's global economy and in the rapid evolution of society (Piscitelli, 2002)

Among the neutral or mixed opinions, there is the idea that AI could be useful as a complement to identify areas for improvement, but that the presence and guidance of the teacher are still essential in the educational process. The possibility of using AI as an additional tool to adapt to individual learning needs and provide faster and more accurate feedback where the predominant factor is human is mentioned. (Ayuso and Gutierrez, 2021)

Continuing with the analysis of the results of question 10, the following assumptions are obtained 10. Do you think AI could improve equity in formative assessment by considering the individual needs of students? Why? The question generated a variety of interesting responses and perspectives. In these 85 responses, several key points are revealed that reflect both the potential and perceived limitations of AI in this context, which are described in the table below.

Table 1.

Key aspects of the use of AI to promote equity in formative assessment

Aspects	Description
Customization and Ease of Use	Many responded in the affirmative, highlighting the ability of AI to personalize the assessment without undue effort. This suggests that AI could be tailored to the specific needs of individual students more efficiently than traditional methods.
Support and Complement	Others see AI as a support tool or a complement to the teacher's work, indicating a vision of collaboration between technology and faculty for the benefit of students.
Adaptation to Individual Needs	The ability of AI to adapt to individual needs is repeatedly mentioned as a key factor in its potential to improve equity in assessment. Personalized feedback and elimination of bias are highlights in this regard.
Limitations and Ethical Concerns	However, ethical and practical concerns are also raised. Some express doubts about the ability of AI to fully understand the emotional and contextual needs of students, as well as to address all relevant assessment parameters.
Variety of Perspectives	Responses reflect a wide range of perspectives, from confidence in AI's ability to improve equity to caution about its limitations and the continuing role of the teacher in the educational process.
Fair and Accessible Evaluation	Many recognize the potential of AI to provide fairer and more accessible assessment, especially when it comes to personalizing feedback and adapting to unique learning styles.

Source: Author's elaboration with information from Hernández León, N. (2025). *Artificial intelligence applied to university educational assessment*. Universidad de Salamanca.

https://gredos.usal.es/bitstream/handle/10366/159077/Herna%CC%81ndez%20Leo%CC%81n%2C%20Nuria-rep.pdf?sequence=1

The responses show that while AI has the potential to improve equity in formative assessment by considering the individual needs of students, it also raises important challenges and questions that need to be addressed ethically and practically. Collaboration between technology and faculty, with a focus on personalization and elimination of bias, could be key to maximizing the potential of AI. (Ponce López, J.L. and Castañeda de León, L.M. 2023).

Continuing with the analysis in question 12. Do you think AI could help teachers identify the specific needs of individual students more efficiently? How can I help you? The responses were analyzed by dividing them into 8 points to be considered.

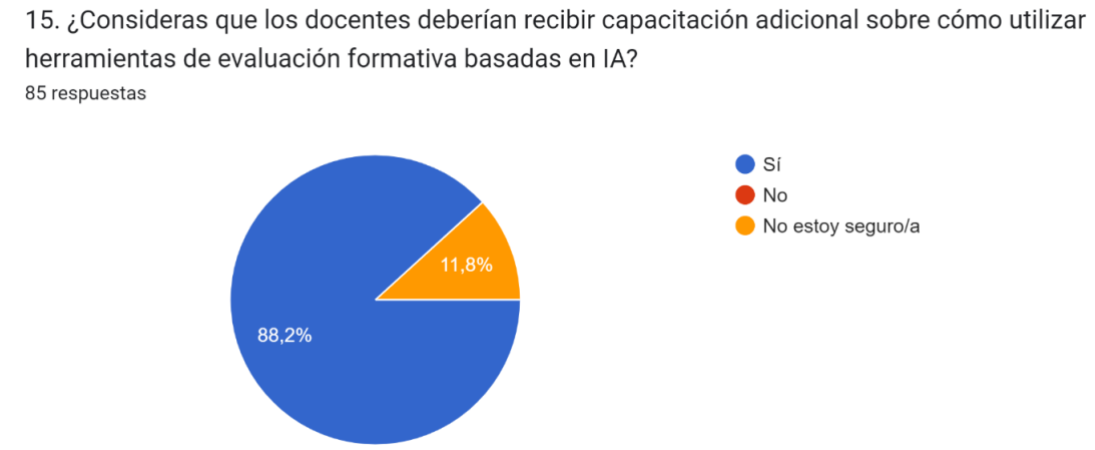
I. Data Analysis and Personalized Recommendations: A considerable number of responses highlight the ability of AI to analyze student performance data and provide personalized recommendations to address their individual needs. This suggests that AI can be useful in identifying patterns and trends that teachers might miss.
II. Support in the Personalization of Teaching: It is mentioned that AI can be a support tool to personalize teaching and adapt it to the learning styles of each student. This could improve the efficiency of teaching by specifically targeting the areas that require attention, which is going to be determinant depending on the area of study they are in
III. Registration and Progress Tracking: Some responses highlight the ability of AI to keep a detailed record of each student's progress, which would make it easier for teachers to have access to clear and actionable information about their students' needs, which represents a great challenge because there is still a lot of ignorance about AI within the teaching profession.
IV. Information Organization: It is mentioned that AI could help organize information about students' needs into tables or profiles, which would facilitate the identification of areas for improvement and the planning of teaching strategies.
V. Evaluations and Feedback: AI could conduct periodic evaluations and provide detailed feedback to teachers on each student's performance and areas of difficulty, which would contribute to more individualized attention, however, the human factor would still be predominant in this type of feedback.
VI. Potential for Improvement and Warnings: Some responses express the idea that, while AI has potential to assist in identifying needs, it should not be considered the only tool and care should be taken to avoid generalities that do not apply to all students and that feedback and guidance from a human teacher is not lost amidst the use of

The responses show an overall positive perception of the role of AI in identifying student needs by teachers, the ability of AI to analyze data, provide personalized recommendations and support individualized teaching, these elements are considered as key aspects that could improve the efficiency and effectiveness of education, however, it is also emphasized the importance of not relying exclusively on AI and to consider its use as a complementary tool in the educational process.

Related to this, it is important to point out that the use of generative artificial intelligence in higher education is beginning to be studied from an ethical and academic integrity perspective. According to Gallent-Torres, Zapata-González and Ortego-

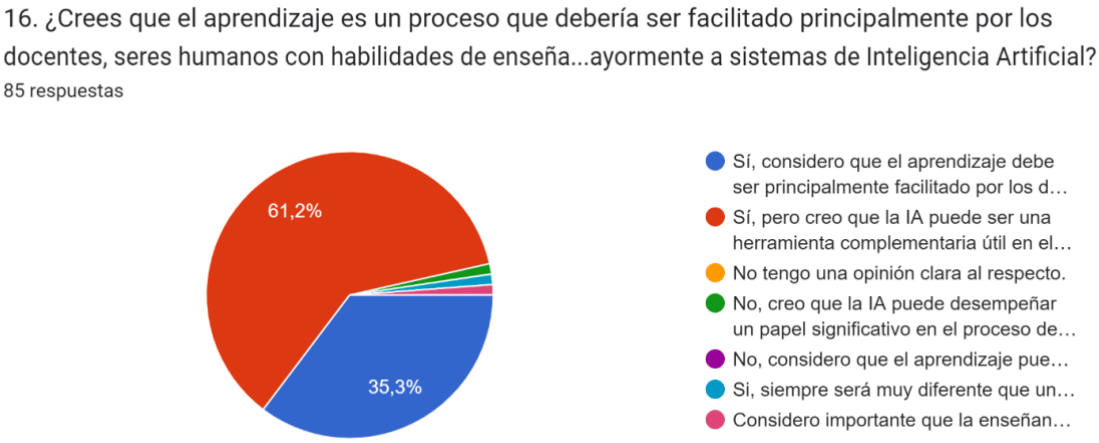
Hernando (2023), a mostly positive reception towards the role of AI in the identification of students' needs by teachers has been observed, however, the importance of considering it as a complementary tool in the educational process is stressed, thus maintaining a balance between technological use and attention to academic integrity from the human perspective. This leads us to the analysis of the following graphs.

Figure 4.



Source: Author's elaboration.

Graph 5.



Source: Author's own elaboration.

The information gathered through the answers to the two questions reveals an interesting picture about the perception of the respondents regarding the use of Artificial Intelligence (AI) in education and the role of teachers in this context.

First, with regard to the training of teachers in the use of AI-based formative assessment tools, there is a marked division. On the one hand, a small percentage (11.8%) advocate the need for teachers to receive additional training in this area, suggesting an interest in improving educational technology skills; on the other hand, the vast majority (88.2%) believe that teachers already have the necessary skills to use these tools without requiring additional training, reflecting confidence in their current abilities.1

Regarding the role of AI in the educational process, the majority of respondents (61.2%) emphasize the importance of learning being facilitated primarily by teachers, highlighting the human skills of teaching and emotional understanding as fundamental. This position suggests a deep appreciation of the role of the teacher as a guide and facilitator of learning.

On the other hand, a significant percentage (35.3%) consider that AI can play a useful complementary role in the learning process. This indicates a recognition of the potential of AI to enhance and enrich the educational experience, though without replacing the central, human role of the teacher. The responses reflect a majority position that values the essential role of teachers in education, emphasizing their human skills and their ability to guide and emotionally understand students, aspects that after the pandemic caused by COVID 19 are taken into account even more in education.

Finally, the study concludes with question 17. What recommendations or suggestions would you have to improve the implementation of formative assessment in higher education in times of artificial intelligence? Based on the students' responses we can make the following analysis: By carefully studying the answers provided in this question on how to improve the implementation of formative assessment in higher education in the era of artificial intelligence, valuable insights emerge that illuminate the way towards a more effective education, and adapted to technological advances, to better present the information collected the following table was prepared.

Table2.

Recommendations for improving formative evaluation in times of IA

Appearance	Recommendation
Consider artificial intelligence as a complementary tool.	Recognize the unique value of human interaction in learning and use artificial intelligence to enhance and complement traditional teaching, rather than replace it entirely.
Personalization in the evaluations.	Use artificial intelligence capabilities to provide assessments tailored to the individual needs of each learner, adjusting the pace of learning and providing specific feedback.
Careful and moderate use of artificial intelligence	Warn about the importance of not relying exclusively on artificial intelligence, maintaining a balance with human skills in education to take full advantage of both capabilities.

[1] The counter position of opinions opens an approach that could be analyzed in future studies regarding the teacher's perspective on their interaction with AI.

Appearance	Recommendation
Student participation	Encourage self-assessment, personalized goal setting and student participation in their own educational process to improve their academic engagement and success.
Integrating vision	Promote a vision that combines the advantages of technology with the valuing and strengthening of human skills in education, seeking a balance that benefits both students and educators.

Source: Author's elaboration with information from: Aung, T., Khaing, A. K., Lwin, Z. H., Abdullah, N. A., Soe, K. K., and Htwe, M. Z. M. (2021). The impact of artificial intelligence on learning and teaching in higher education: A systematic literature review. *International Journal of Advanced Computer Science and Applications, 12(3), 353-361.* https://doi.org/10.14569/IJACSA.2021.0120345

Recommendations for improving the implementation of formative assessment in higher education in times of artificial intelligence advocate an integrative vision that takes advantage of the benefits of technology while valuing and enhancing human skills in the educational process.

Discussion.

Initially, the limitations identified during the research are highlighted, although a significant amount of data was collected, it is important to note that the study sample may not fully represent the diversity of opinions and perspectives regarding the use of artificial intelligence in formative assessment.

On the other hand, the strengths of this study include the variety of responses and perspectives gathered, which provides a broad and diverse view of the higher education community's perception of the impact of artificial intelligence on formative assessment, and the implementation of artificial intelligence as a complementary tool in the formative assessment process is considered a promising opportunity to improve equity and personalization in educational feedback.

Regarding the opportunities identified, it is suggested the need to develop training strategies and training for teachers and students in the effective use of artificial intelligence in evaluation, this could contribute to optimize the use of technological tools and improve the quality of feedback provided to students, adapting more accurately to their individual learning needs.

It is important to mention that there is enormous ambivalence regarding AI. On the one hand, great hopes and expectations are raised, close to a technological "solutionism" according to which all our problems (economic, social, environmental) will be solved with the development and use of AI and other converging technologies. On the other hand, there is a huge social ignorance (among citizens, companies, institutions and organizations) about AI, its possibilities, potential benefits and risks (Ausín, 2021).

The important value chain provided by using, sharing and reusing data through AI algorithms to generate public policies focused on anticipatory education, services, economic activity and social denunciation actions, both at macro (institutions and administrations), meso (organizations and companies) and micro (associations and individuals) levels, is not socially perceived. Lack of knowledge translates into a distorted perception of this technology, where its performance, implications and limitations can only be evaluated in the medium and long term. (Ausín, 2021).

Discussion and Conclusions

The research and analysis of the responses provided by the participants yield important insights into the implementation of formative assessment in higher education in the age of artificial intelligence. One of the key points to emerge is the need to provide additional training to teachers in the effective use of AI-based tools. This aspect is based on the idea of providing them not only with technical knowledge, but also with practical guides, continuous advice and specialized courses that enable them to integrate AI efficiently into their pedagogical practices.

A relevant finding is the perception shared by many participants that AI should be seen as a complementary tool and not as a total replacement for human learning. It highlights the importance of maintaining a balance between the capabilities of AI to provide personalized assessments, adapt the pace of learning and provide specific feedback, and the unique human skills such as personal interaction, empathy and emotional understanding provided by teachers.

In this sense, teacher training acquires a fundamental role, as it allows them to take full advantage of AI capabilities while maintaining a holistic perspective of education, where socioemotional aspects of education can greatly complement the use and application of AI in education. This implies not only mastering technological tools, but also developing pedagogical strategies that effectively integrate AI into the educational process, thus ensuring an enriching, equitable and humanistic learning experience for all students.

Another relevant finding is the need to actively involve students in their own educational process through the use of AI, as it can play a crucial role in allowing them to self-assess, set personalized goals, participate in activities tailored to their learning styles, and receive timely and specific feedback. This collaboration between technology and student participation contributes to a more dynamic, inclusive and student-centered educational environment, which must be combined with the human guidance of the teacher.

To conclude, effective implementation of formative assessment in higher education in times of AI requires a comprehensive approach that combines teacher training, a balance between human and technological capabilities, and student participation. These reflections are based on the valuable input and recommendations provided by the participants, highlighting the importance of a collaborative and balanced vision in education. Likewise, include experiences and learning that are meaningful for students, which can include guidance and feedback from a socioemotional perspective that only the human side can provide, this does not work separately from technological advances, on the contrary, it complements and strengthens education.

Notes.

In the context of this analysis and reflection on the implementation of formative assessment in higher education in the era of artificial intelligence, no specific financial support is applied. In the process of developing this analysis on the implementation of formative assessment in higher education in the era of artificial intelligence, *ChatGPT* was used as a tool to improve the initial writing. Each paragraph was modified and reviewed

by the author to ensure consistency and accuracy of the content presented. In this sense, the use of *ChatGPT* enriched the writing and clarity of the text, although the content and conclusions are the sole responsibility of the author based on the responses collected and analyzed from the participants. If more information on the methodology or the questionnaire applied is required, please contact the author of the article for further details.

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