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Factors impacting the integration of AI in Ecuadorian higher education: perspectives and implications

Fatores que afetam a integração da IA no ensino superior equatoriano: perspectivas e implicações

Factores que inciden en la integración de la IA en la educación superior ecuatoriana: perspectivas e implicaciones

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AI in Education
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This study discuss the critical role of technological and pedagogical strategies for effective AI integration in Ecuadorian higher education, addressing inequalities and fostering accessible innovation. It may be useful for educational administrators in the design of new AI-focused policies.
Originality/value:
Provides insights into AI's multifaceted influence on education, emphasizing challenges and opportunities in emerging nations, specifically within Latin America's socio-economic context.

ABSTRACT

Introduction: Artificial intelligence (AI) has become a significant aspect of contemporary society, impacting various sectors, particularly education. **Objective**: This study aims to explore the implications and viewpoints regarding integrating AI in higher education in Ecuador. **Methodology**: An interpretive paradigm guided the methodology, influenced by hermeneutics and phenomenology; the research was qualitative, exploratory, and descriptive. Data collection was conducted through surveys, utilizing confirmatory factor analysis for statistical evaluation. **Results**: Findings indicate that the technological approach exhibits the highest loading at 46.8, marking it as the most significant factor influencing AI integration in higher education, whereas the pedagogical approach shows the lowest loading at 24.9, reflecting a moderate current influence on the teaching-learning process. This suggests ongoing efforts are needed for genuine inclusion and optimal utilization of AI in higher education. The z-value of 4.90 and a p-value below .001 further affirm the validity and significance of the four approaches examined in this study. **Conclusion**: Socioeconomic inequality in the country limits the equitable and accessible adoption of AI, mirroring challenges faced throughout Latin America and globally in emergent nations.

Keywords: Higher Education, artificial intelligence AI, impact of technology, education policy, Ecuadorian reality.

RESUMO

Introdução: A inteligência artificial (IA) tornou-se um aspecto significativo da sociedade contemporânea, impactando diversos setores, particularmente o educacional. **Objetivo:** Este estudo tem como objetivo explorar as implicações e perspectivas relacionadas à integração da IA no ensino superior no Equador. **Metodologia:** A metodologia foi orientada por um paradigma interpretativo, influenciado pelas correntes filosóficas da hermenêutica e da fenomenologia; a pesquisa foi de natureza qualitativa, exploratória e descritiva. A coleta de dados foi realizada por meio de questionários, utilizando a análise fatorial confirmatória para avaliação estatística. **Resultados:** Os achados indicam que a abordagem tecnológica apresenta a maior carga fatorial, com um estimador de 46,8, posicionando-se como o fator mais influente na integração da IA no ensino superior, enquanto a abordagem pedagógica mostra a menor carga, com um estimador de 24,9, refletindo uma influência moderada no processo de ensino-aprendizagem. Isso sugere a necessidade de esforços contínuos para alcançar uma verdadeira inclusão e utilização otimizada da IA no ensino superior. Um valor z de 4,90 e um valor p inferior a .001 reafirmam a validade e a relevância das quatro abordagens examinadas neste estudo. **Conclusão:** As desigualdades socioeconômicas no país limitam a adoção equitativa e acessível da IA, espelhando desafios semelhantes na América Latina e em outras nações emergentes globalmente.

Palavras-chave: Ensino superior, inteligência artificial IA, impacto da tecnologia, políticas educacionais, realidade equatoriana.

RESUMEN

Introducción: La inteligencia artificial (IA) se ha convertido en un aspecto crucial de la sociedad contemporánea, impactando diversos sectores, particularmente el educativo. **Objetivo:** Este estudio busca explorar las implicaciones y perspectivas relacionadas con la integración de la IA en la educación superior en Ecuador. **Metodología:** La metodología estuvo guiada por un paradigma interpretativo, influenciado por las corrientes filosóficas de la hermenéutica y la fenomenología; la investigación fue de naturaleza cualitativa, exploratoria y descriptiva. La recopilación de datos se realizó mediante encuestas, empleando análisis factorial confirmatorio para la evaluación estadística. **Resultados:** Los hallazgos indican que el enfoque tecnológico presenta la mayor carga factorial, con un estimador de 46,8, posicionándose como el factor más influyente en la integración de la IA en la educación superior, mientras que el enfoque pedagógico muestra la carga más baja, con un estimador de 24,9, lo que refleja una influencia moderada en el proceso de enseñanza-aprendizaje. Esto sugiere la necesidad de esfuerzos continuos para lograr una verdadera inclusión y un uso óptimo de la IA en la educación superior. Un valor z de 4,90 y un valor p inferior a .001 reafirman la validez y relevancia de los cuatro enfoques examinados en este estudio. **Conclusión:** Las desigualdades socioeconómicas en el país limitan la adopción equitativa y accesible de la IA, reflejando desafíos similares en América Latina y otras naciones emergentes a nivel global.

Palabras clave: Educación superior, inteligencia artificial IA, impacto de la tecnología, políticas educativas, realidad ecuatoriana.

INTRODUCTION

"*Rapid technological innovation has revolutionized all fields of today's society and education has been no exception.*" (Hidalgo Achig et al., 2021) Artificial intelligence has had an accelerated evolution influencing different areas including education. AI uses sophisticated algorithms and applies complex data analysis models that help it to perform activities that would normally only be possible with human intelligence. Especially in education, it emerges as a potential tool for quality improvement (Vera et al., 2023).

Globally, the use of artificial intelligence has generated multiple benefits especially in the identification of students at risk of dropping out of school, AI has proven to be an excellent analyzer of large amounts of information such as grades, behaviors, student attendance and determine those who are at risk of dropping out and act in time to increase school retention. Feedback and personalization of learning, as well as automation of administrative and assessment tasks, automatic and real-time correction of tests, generation of student progress reports and generation of timetables (Bolaño & Duarte, 2024). AI contributes significantly to knowledge worldwide are emerging tools that combine human skill with the power of analysis of algorithms and large amounts of data AI which generates invaluable accuracy and reliability, AI currently includes the analysis of movement and analysis of temporal actions ie deep learning, which in previous educational eras required complex and progressive observations in real time, AI generates new methodologies that use large amounts of data for educational purposes which is useful in all areas of knowledge (Peek & Ross, 2023).

The difficulty is highlighted when it is identified that artificial intelligence progresses by leaps and bounds, unlike the educational system, which progresses more slowly. In many countries worldwide, especially in developing countries, education faces barriers, given by their own economic and social conditions, including the lack of resources, which limits the availability and access to technology. In contrast, investment in AI generation is increasing, which generates surprising advances, in this context education cannot adapt at the same speed, although in many countries the greatest effort is made. (Peña, 2018). UNESCO highlights that AI has the potential to address several of the educational challenges that remain at the global level and can be used to generate innovative practices and put countries on track to further achieve Sustainable Development Goal 4 "*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*" (Norman, 2023).

In Latin America and worldwide, AI has become popular at an accelerated pace and is used in various areas as a scaffolding for new practices (Guerrero-Quiñonez et al., 2023), where efficiency, precision and task automation are paramount. Especially in medicine it has had great reception, the inconsistency is found when the training of professionals does not go hand in hand with the technological reality, Múnera, (2023) states that at the level of Latin America in this specific area they were just becoming familiar with robotics and medical devices and tools related to AI emerge this generates a proliferation of terms that can generate confusion especially when in training they do not receive information and practice on this new technology professionals will face professional challenges. In Latin American universities there is evidence of an increase in the use of AI-based tools and applications, aimed at facilitating the work of teachers and contributing to the significance of educational quality (Shrivastava, 2023, Chen et al., 2023 cited by Fajardo et al., 2022).

It is important to highlight the contribution of Frigerio & Rashidian (2023) stating that AI can be used to reduce gender disparity in training and education, i.e., it can be used to identify patterns and trends that lead to gender bias and overcome barriers and challenges that Latin American women have faced throughout history in the educational process. However, the authors agree with Bellini, Panizzi & Bignami (2024) who state that it is necessary to bear in mind that, despite the potential of AI in Latin American education, it cannot be relied upon resolutely because it may not consider and predict all the variables or elements in play, which may generate information biases that distort reality. It must be taken into account that AI has previous training, but just like humans, it learns and changes with experience. For this reason, active awareness and diligent and permanent supervision are necessary to ensure accuracy and relevance in the use of AI.

In Ecuador, as in Latin America and the world, AI is rapidly becoming popular in various areas, including education. The main contributions of AI are "*machine learning and deep learning algorithms*." (Voskens et al., 2022, p.9). However, there is special concern about ethics and data privacy as stated by Capelli & Verdi (2023) there is uncertainty about the current access to data collection from different sources, including regulated or official sources and other non-regulated sources, including anonymous ones, which generates biases derived from the use of non-representative data. This raises challenges in the educational system since it is necessary to evaluate to what extent AI, especially generative AI, contributes to the improvement of quality in Ecuadorian education and does not become a double-edged sword.

Therefore, the research aims to "identify the implications and prospects of AI integration in Ecuadorian higher education". In fact, in order to fulfill the general objective, the research revolves around the question "What are the challenges and opportunities generated by the integration of AI in the Ecuadorian higher education system?

Evolution of artificial intelligence

Artificial intelligence (AI) has a long history since its public appearance in 1956 in a summer course at Dartmouth College, United States, generated by researchers John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon. Since its origin, AI has been considered as simulation models of human intellectual processes generated from algorithms, based on data and integrated in a dynamic environment (García et al., 2020 cited by Tomalá et al., 2023).

The evolution of AI for Ganascia (2018) cited by García et al., (2020) consists of six major stages:

1. **The time of the prophets:** In the beginning there was not yet evidence and the current progress, this led researchers to generate excessive ideas of the scope of artificial intelligence, transcending to unrealistic forecasts.
2. **Dark Years**: In the 1960s, progress and advances in AI generation slowed down as the predictions and ambitions of researchers collided with reality, a definitive event was when a child beat a computer in a game of chess in 1965, which was the trigger for an unfortunate failure.
3. **Semantic AI:** After the events of the 1970s, a rethinking was necessary and researchers turned the orientation of AI towards the psychology of memory and human understanding, generating simulations based on the semantic representation of knowledge.
4. **Neo connectionism and machine learning:** The rapid evolution of programming language generated machine learning algorithms, which allowed computers to accumulate knowledge and reprogram themselves.
5. **From AI to human-machine interfaces:** In the late 1990s, AI began to be integrated with robotics, generating greater interaction between humans and machines, which developed emotional computing and gave way to machines that could generate emotions.
6. **Resurgence of AI:** It was not until 2010, with the processing of big data and deep learning, which is based on neural networks, that AI began to handle considerable volumes of data quickly and efficiently, surpassing previous processes, which led to the resurgence and popularity of AI.

Artificial intelligence and education

Artificial Intelligence are computer systems that have the ability to perform tasks that require human intelligence. It is the ability generated in a computer system to appropriately decipher existing data and information and generate analysis and results under previously established objectives (Delgado et al., 2024).

For Tamalvanan (2022) there are four important domains that interact in AI these are: firstly machine learning which is based on an intelligence model based on existing data to make predictions and decisions, the second element is deep learning being fascinating as AI mimics the human neural network, thirdly computer vision is that factor that allows a visual interpretation of the information generated by the computer system and thus generates a recommendation or analysis and finally natural language processing is the fact that the computer understands and processes human language. Artificial intelligence in the field of education has the potential to be able to perform basic teaching tasks, including problem solving and decision making, help or assistance in translation, writing and interpretation, as well as providing immediate feedback. (Navarrete & Manzanilla, 2023).

Nowadays, the use of AI is becoming more and more common and the applications mediated by this tool are more frequent, especially AI generating text, images, presentations or videos are common in the daily life of students. (Salmerón et al., 2023). AI has revolutionized pedagogical practice, bringing the educational process in line with the current political, cultural, economic and technological context. However, it is important to keep in mind that the integration of AI in the educational system faces significant challenges and challenges such as accuracy, representation, relevance and quality of the data used, the resistance to change of some teachers, students and authorities based on the fear that the machine replaces the human, lack of resources, lack of training and understanding of algorithms, ethics and data privacy are latent concerns that limit the proper use in the classroom. (Bolaño & Duarte, 2023).

Even with the benefits that, according to studies, AI generates in education, including the personalization of learning, immediate and effective feedback, the integration of AI in educational practice has generated, generates and will generate concern and contradiction between the preservation of trust and authenticity in the creation of work and research and the potential it has to reinforce and assist human activities. (Llorens, Vidal & García, 2023).

At this point it is necessary to emphasize that AI can be used as a tool for early identification of students who are at risk of dropping out of school and dropout through the analysis of behavioral patterns generates the space for institutions to intervene effectively, however the monitoring and intervention must be carried out by teachers and authorities here the relevance of using AI as a complementary tool that assists the work and teacher management (Liu et al., 2023). In this sense, Sanabria et al. (2023) agrees by stating that AI can be widely used in performance prediction, identification of the risk of

failure to generate trajectories or personalized learning paths. But we should not overlook the excessive use of generative AI such as chatbots, which increases plagiarism and limits the development of new knowledge, competencies and skills such as critical thinking, reflection, self-determination, creativity and imagination.

Artificial Intelligence in higher education

Higher education, as in all educational levels, is a complex and dynamic process where teachers and students interact, influenced by elements such as student diversity, different learning styles and needs, etc. In this sense, AI emerges as an optimal tool to help improve these challenges by contributing to the personalization of content, monitoring and evaluation of group and individual progress of students, generating effective feedback and optimizing the educational process compared to the traditional teaching model (Ronquillo et al., 2023 cited by Rodriguez et al., 2023).

The purpose of integrating AI in higher education is to contrast this technology with the knowledge and pedagogical experience of teachers to generate learning spaces based on predictive analysis of patterns and trends that are more dynamic, flexible, adapted and personalized to meet the needs of students. (Valencia & Figueroa 2023). Figure 1 shows the benefits of AI in education according of Urquilla (2022):

Figure 1. Benefits of AI in education

Note. Authors' development based on Urquilla (2022)

In the perspective of Gonzalez (2023) AI in education is considered from two perspectives, the first is deep learning and the second is from the generative domain as detailed below:

Table 1. Perspectives of AI in education

Type	Deep Learning AI	Generative AI
What is it?	A model that uses neural network algorithms similar to those of the human brain to process and analyze large amounts of data and generate patterns and trends.	It is the model that, from the analysis of data and defined objectives, generates new content including images, music, text, etc. It is the most popular and is revolutionizing the way of understanding and interacting.
How it is used in learning	It is used to generate voice and text recognition systems, it allows the creation of chatbots that help students to solve doubts, as well as writing programs that automatically correct spelling and grammar, programs for transcription of lectures, master classes, etc. In addition, it is used to identify learning patterns to generate personalized study plans and paths.	It is widely used to generate exercises, exams, videos, pictures, etc. that can be customized. They also allow the generation of educational chatbots that can be trained to give answers, help and assistance to students, as well as to write essays and other texts, improving grammar, spelling and writing style, and can also be used to create ideas for assignments.

Note. Authors' development based on Gonzalez (2023)

Generative AI is the most widely used among students clear examples of this type of AI is ChatGPT, or Chat Generative Pre-trained Transformer, these tools use natural language understanding and 175 billion parameter, training-based learning algorithms with large amounts of data, which increases the accuracy of responses in complex requests

(Carrasco et al., 2023).

It is crucial to consider that the latent concern for the ethical use of AI in higher education especially in the production of academic and scientific texts is imminent, in this context Gallent, Zapata & Ortego (2023) propose a list of guidelines that should be taken into account to achieve an efficient and relevant integration of AI in higher education:

I) It is important to establish appropriateness and inappropriateness in the use of AI, especially generative AI; II) Generate real-time activities such as debates and discussions as well as teacher-generated quizzes that are difficult to solve by AI requiring answers with different verbal expression in different environments and contexts; III) In the same way, generate tasks that require complex critical thinking that demand very specific contexts and situations or use fragments of videos that the AI currently cannot interpret automatically.

METHODOLOGY

The research is based on the interpretative paradigm that according to Martínez & Ríos (2006) cited by Miranda & Ortíz (2020) enables the development of methodologies to understand and signify the singularity of reality, from different types of data and perspectives. Understanding knowledge as a constantly evolving construction that transforms and opens the way for future research. This paradigm is based on two philosophical currents: hermeneutics, which maintains that there is no objective, transparent and definitive knowledge, but that it depends on the dimensions that influence and the perspectives, this philosophy allows to obtain the knowledge, the meaning and the experience that each individual has of life or of a particular subject. The second current is phenomenology where the individual, through his intuitions, senses, experiences and knowledge, interprets reality from different perspectives.

In this case, the interpretative paradigm was used to obtain information from the perspective of teachers and students of higher education in Ecuador, highlighting experiences, perceptions, trends and patterns of their daily lives and the integration of AI in the teaching-learning process, through the technological, pedagogical, ethical and socioeconomic dimensions. It has a qualitative approach mediated by the inductive method that, according to Cadena et al., (2021) seeks to identify the nature and deep particularities of the reality, the relationships and allow to explain in a comprehensive way the level of integration of AI in higher education in Ecuador.

It is exploratory and descriptive because it measures or evaluates various aspects, dimensions or components of the phenomena to be investigated, of a new topic in constant evolution. And it focuses on describing the situations, events and particularities of study from the perspective of the participants, from their experiences, attitudes, beliefs, etc. (Schuster et al., 2021). The exploratory element is included because the issue of AI integration is an evolving phenomenon, with this research an approach is made to establish the level of AI integration in higher education in Ecuador from the experience, opinion and perspective of teachers and students; meanwhile the descriptive element allows as its name indicates to describe and highlight trends and relevant patterns generating discussion and conclusions of the study.

A structured survey was used as an instrument, with questions that respond to the technological, pedagogical, ethical and socioeconomic approaches to the integration of AI in Ecuadorian higher education, thus achieving an integrated perspective that identifies the elements that directly influence its integration. The statistical technique used was confirmatory factor analysis, which according to Martínez (2021) is a second generation multivariate model in the analysis of covariance structures, it supports the validity, reliability and relevance of the elements or factors used in the research and their relationship, it serves to identify the correlation between the dimensions or focus of study and between the items used to measure it, and the flexibility of this technique makes it ideal because it can be used in any type of confirmatory, explanatory, exploratory, descriptive and predictive research.

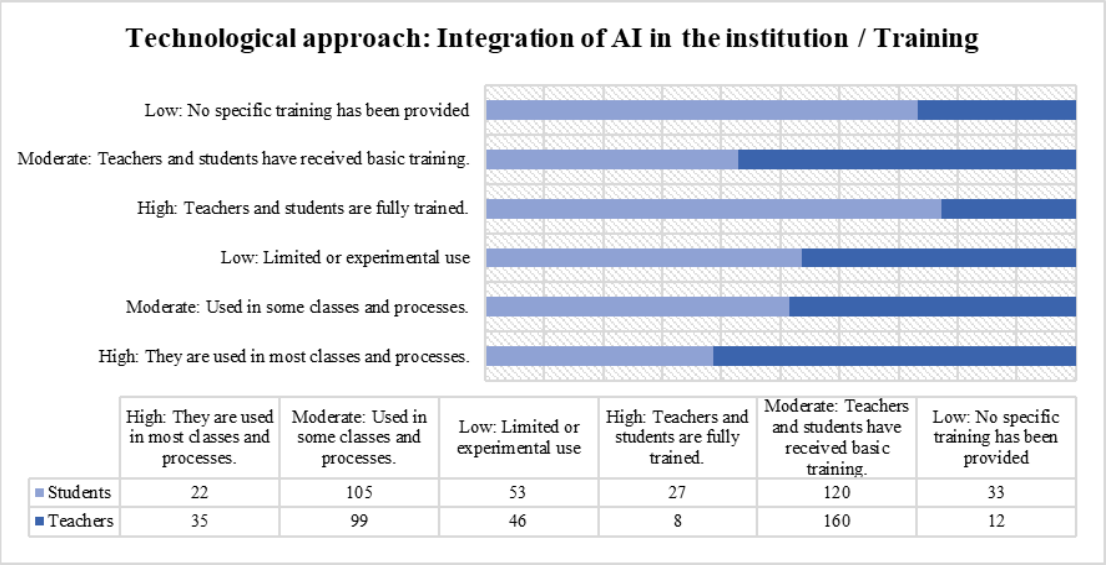
The confirmatory factor analysis was applied between the technological, pedagogical, ethical and socioeconomic approaches to determine to what extent they are related, that is, if they are relevant to measure the object of study, which in this case is the integration of AI in Ecuadorian higher education, and which of the approaches maintains a greater or lesser factor load, which reveals which factor has a greater or lesser influence on the interaction, that is, it provides a scale of statistical significance between the factors.

The study sample consisted of 360 individuals divided into two groups: 180 students and 180 teachers from higher education institutions in Ecuador. Data collection was carried out in collaboration with the authors using tools such as Google forms, which facilitated data collection without limitations of time, space and economic resources. In this way, the opinions of students and teachers from different cities and provinces of Ecuador were obtained. All ethical aspects of confidentiality and integrity of participants were respected.

RESULTS AND DISCUSSION

The survey applied to teachers and students revealed important trends in the technological approach, the integration of AI in higher education in Ecuador is present but not on a regular basis. 105 students and 99 teachers report using AI moderately, only 22 students and 35 teachers say they use it continuously. 53 students and 46 teachers say they have limited access or use it on an experimental basis. Regarding training on the use of AI 120 students and 160 teachers (160) report having received training and basic information on its use, this is a crucial aspect since teachers and students should be provided with the necessary knowledge for the effective use and exploitation of AI in higher education in Ecuador. These findings are presented in Figure 2.

Figure 2. Technological approach

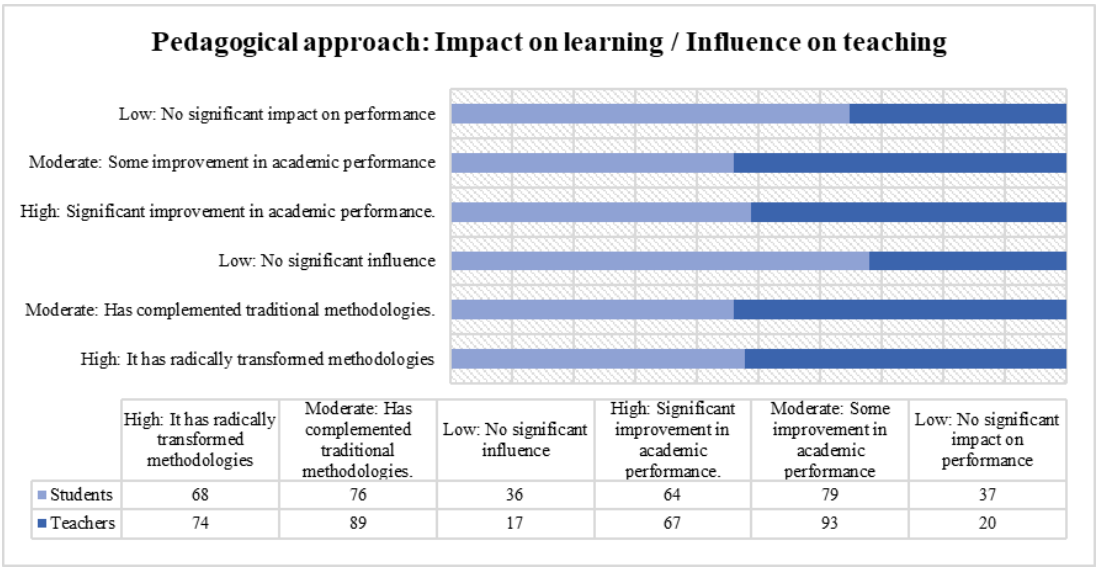


	High: They are used in most classes and processes.	Moderate: Used in some classes and processes.	Low: Limited or experimental use	High: Teachers and students are fully trained.	Moderate: Teachers and students have received basic training.	Low: No specific training has been provided
Students	22	105	53	27	120	33
Teachers	35	99	46	8	160	12

Note. Authors' development based on the survey results

The pedagogical approach shows that AI is considered as an innovation tool that transforms higher education (68) students and (74) teachers. While (76) students and (89) teachers perceive it more as a complement that does not necessarily change or innovate traditional teaching methods but rather complements and reinforces them. There are also students and teachers who do not perceive relevant changes brought about by the use of AI in teaching. Regarding learning (64) students and (67) teachers perceive that the use of AI increases learning which is reflected in academic performance, (79) students and (93) teachers have perceived moderately significant changes while (37) students and 20 teachers claim not to have observed changes in learning. These findings are presented in Figure 3.

Figure 3. Pedagogical approach



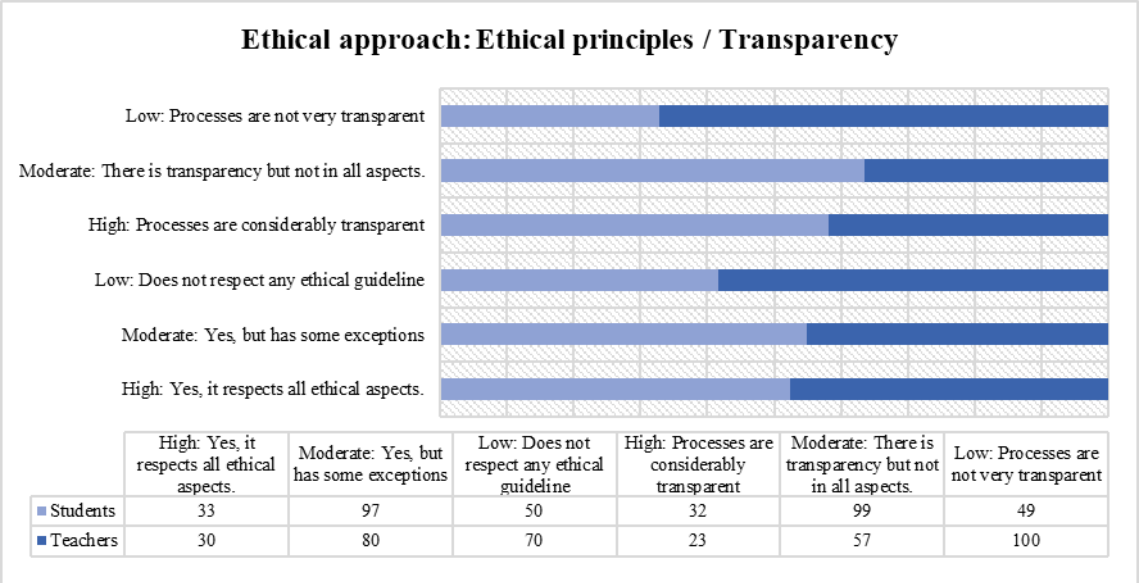
	High: It has radically transformed methodologies	Moderate: Has complemented traditional methodologies.	Low: No significant influence	High: Significant improvement in academic performance.	Moderate: Some improvement in academic performance	Low: No significant impact on performance
Students	68	76	36	64	79	37
Teachers	74	89	17	67	93	20

Note. Authors' development based on the survey results

The ethical approach that is a relevant factor in the use of AI in academia (97) students and (80) teachers consider that the measured use of AI respects the ethical principles of education, but they do not disregard the existence of exceptions especially when students use generative AI in the production of academic texts and research. Relative to the transparency of the teaching and learning process (99) students and (57) teachers consider that AI affects the transparency of papers in line with the above (49) students and (100) teachers consider little transparency in the use of AI for the generation of tests, papers, etc.

The results (presented in Figure 4) reflect that despite the undeniable benefits of the use of AI, the concern for ethical aspects is a limiting factor in the full use of AI in Ecuadorian higher education.

Figure 4. Ethical approach

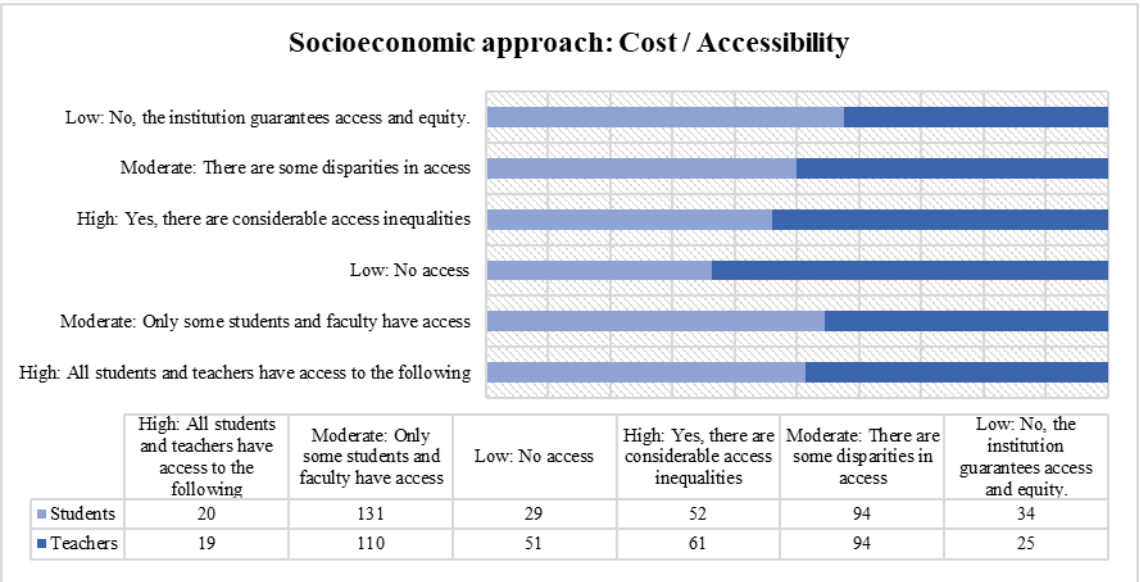


	High: Yes, it respects all ethical aspects.	Moderate: Yes, but has some exceptions	Low: Does not respect any ethical guideline	High: Processes are considerably transparent	Moderate: There is transparency but not in all aspects.	Low: Processes are not very transparent
Students	33	97	50	32	99	49
Teachers	30	80	70	23	57	100

Note. Authors' development based on the survey results

The socioeconomic approach aimed at determining aspects of accessibility revealed that only (20) students and (19) teachers have adequate access to AI, while the majority (131) students and (110) teachers report limited access and (52) students and (61) teachers report significant discrepancies in access to AI, related to tool costs, limited access to connectivity and technological devices.

Figure 5. Socioeconomic approach



	High: All students and teachers have access to the following	Moderate: Only some students and faculty have access	Low: No access	High: Yes, there are considerable access inequalities	Moderate: There are some disparities in access	Low: No, the institution guarantees access and equity.
Students	20	131	29	52	94	34
Teachers	19	110	51	61	94	25

Note. Authors' development based on the survey results

Confirmatory factor analysis

The confirmatory factor analysis study between the technological, pedagogical, ethical and socioeconomic factors identified relevant trends. The technological approach is the one that obtained the highest factor loadings with an estimator of 46.8, placing it as the factor with the highest statistical significance in the integration of AI in Ecuadorian higher education. In second place, according to the factor loadings with an estimator of 36.7 is the socioeconomic approach, highlighting that equity, accessibility and availability are determining elements that underlie the effectiveness in the integration of artificial intelligence in higher education.

The ethical approach was ranked third in importance with an estimator of 27.4, reflecting that the latent concern for data integrity and appropriate use in the teaching process without neglecting meaningful and lasting learning is an element that has a determining influence on the use of AI, which is in line with the global situation and at the regional level in Latin America. And, in fourth place, the pedagogical approach with a load of 24.9 determining a moderate influence on the teaching-learning process, which highlights that there is still a need to implement resources, standards, and efforts to achieve a true inclusion and full use of AI in higher education in Ecuador. The z-value of 4.90 and the p-value of less than .001 support the validity, pertinence and relevance of the four approaches, these values support the relevance of the study conducted.

Table 2. Confirmatory factor anális

Factor loadings					
Factor	**Indicator**	**Estimator**	**EE**	**Z**	**P**
Factor 1	Technological approach	46.8	9.55	4.90	< .001
Factor 2	Pedagogical approach	24.9	5.08	4.90	< .001
Factor 3	Ethical approach	27.4	5.59	4.90	< .001
Factor 4	Socioeconomic approach	36.7	7.49	4.90	< .001

Note. Authors' development based on the survey results

Regarding the relativity and correlation between approaches, a significant positive relationship is identified between the technological and pedagogical approaches, suggesting that as technology is integrated into education, it generates a positive impact on pedagogical practices. A moderate relationship with a covariance of 0.4821 is visualized between the technological and ethical approaches, it is evident that the use of AI is related to the ethical implications of its use, by generating a positive trend it is affirmed that as the use and advancement of AI in Ecuadorian higher education increases, ethical concerns increase to a similar extent.

A positive and significant relationship is also identified between the technological approach and the socioeconomic approach. The covariance of 0.7800 indicates a close relationship, which shows that the adoption of AI in Ecuadorian higher education depends to a large extent on the availability of resources, i.e. the socioeconomic circumstances in which higher education institutions, students and teachers operate. As with the technological approach, the pedagogical approach is significantly related to the socioeconomic approach. The covariance of 0.5995 suggests that the adoption of AI in pedagogical practice depends on accessibility and socioeconomic equity leaving a gap especially in the vulnerable and poorest sectors.

Dissenting information identifies the most statistically significant relationships between technological approach and socioeconomics (0.7800), highlighting that AI adoption is highly dependent on economic factors and accessibility. There is also a significant relationship between pedagogy and socioeconomics (0.5995), warning that access to AI influences pedagogical practices. And the lowest relationship is observed between pedagogical and ethical approach shows that ethical concerns do not directly influence pedagogical perceptions.

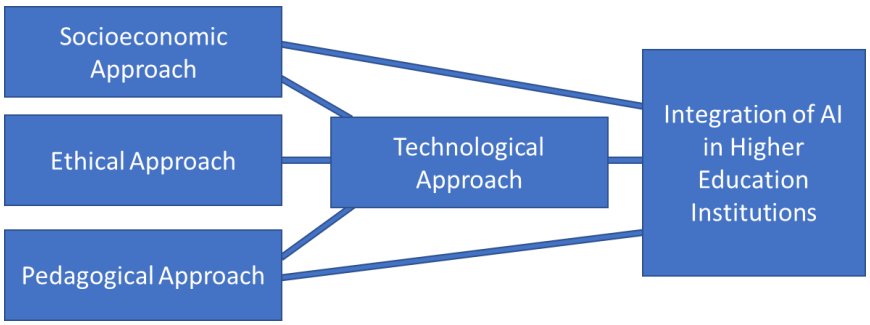
Table 3 *Covariance of factors*

Covariances of the Factors					
		Estimator	**EE**	**Z**	**p**
Factor 1	Factor 1	1.0000 [a]			
	Factor 2	0.6050	0.183	3.305	< .001
	Factor 3	0.4821	0.222	2.176	0.030
	Factor 4	0.7800	0.113	6.900	< .001
Factor 2	Factor 2	1.0000 [a]			
	Factor 3	-0.0893	0.286	-0.312	0.755
	Factor 4	0.5995	0.185	3.242	0.001
Factor 3	Factor 3	1.0000 [a]			
	Factor 4	0.5354	0.206	2.600	0.009
Factor 4	Factor 4	1.0000 [a]			
[a] fixed parameter					

Note. Authors' development based on the survey results

Reflected in a diagram it is represented as follows:

Figure 6. Diagram of the study approaches



Note. Authors' development based on the research design

Discussion

The results obtained in the study show marked patterns towards the adoption of technology, especially AI in the higher education process in Ecuador, where teachers say that they have evidenced that there is an improvement in student learning and performance, greater management, control, evaluation and feedback. This is aligned with recent research that asserts the usefulness of AI in education worldwide as stated by Bolaño & Duarte (2024) who argue that AI is revolutionizing education around the world, generating efficient analysis of large amounts of data such as grades, attendance behaviors, etc. Even managing to identify those patterns that alert about school risk allowing teachers and authorities to act in time to increase student retention.

In contrast, the challenges faced by teachers and students in integrating AI in the teaching and learning process became evident, the study revealed that there is resistance to change, lack of training and resources, especially the socioeconomic aspect is a determinant in the proper integration of AI in Ecuadorian higher education, This is framed with the situation of the Latin American region with the research of Múnera (2023) who states that at the Latin American level AI has become popular influencing in various professional areas including education, but the problems stand out when it is determined that education does not go hand in hand with the technological reality especially when in the training they do not receive information and practice on this new technology professionals will face professional challenges.

Therefore, it is imperative that authorities and organizations work together so that educational institutions have the necessary support to overcome these barriers and guide efforts towards an appropriate transition that guides the use of advanced technologies in the classroom such as AI, both generative and deep learning. There are advances such as the inclusion of the use of AI in education in important issues such as the global agenda and the objectives of good living, which is why UNESCO has included this topic in the agenda of the world summits and in the objective of good living number 4, which corresponds to achieving equitable quality education and inclusion that is framed with the reality and the current context. In addition, the research highlights that one of the great benefits of AI in education is the potential to uplift higher education by managing to personalize learning paths especially with the handling of large volumes of data and the mastery of machine learning and learning algorithms as stated by Capelli & Verdi (2023) there is special concern for ethics and data privacy.

The findings of this study also align with and complement existing research on the adoption and integration of AI in higher education. Chatterjee and Bhattacharjee (2020) emphasized the transformative potential of AI in reshaping the governance and functionality of higher education institutions. Similarly, our results reflect the significant role of technological approaches in driving AI adoption, evidenced by their highest factor loading, which aligns with the critical role of perceived usefulness and ease of integration identified by Chatterjee and Bhattacharjee. Moreover, Choi et al. (2022) noted that pedagogical beliefs and perceived trust are central to educators' acceptance of Educational AI Tools (EAITs). This finding echoes with the lower factor loading of the pedagogical approach in this study, suggesting that current trust and integration barriers in Ecuadorian higher education might mirror broader global trends. Furthermore, the insights from Al-Sharafi et al. (2022) regarding knowledge application and perceived usefulness as key determinants for sustainable AI usage parallel the findings here, as the technological approach's prominence reflects its utility in operationalizing AI integration. On the other hand, Almufarreh (2024) emphasized emotional well-being and content quality as essential factors in students' satisfaction with AI tools, while Pillai et al. (2024) identified personalization and interactivity as essential for the adoption of AI teacher-bots. These findings further contextualize the moderate influence of the pedagogical approach in this study, suggesting a need to increase personalized learning experiences and emotional engagement to optimize AI's pedagogical impact in Ecuadorian higher education.

Therefore, it is necessary to reflect on the ethical and privacy challenges as stated by Gómez (2022), Capelli & Verdi (2023) ensuring privacy and data security is essential to maintain confidence in the use of these technologies and avoid possible abuses and unethical actions. For this reason, this research is a first link for future lines of research to identify to what extent the use of AI contributes to improve Ecuadorian higher education without compromising meaningful learning, ethics and educational transparency.

FINAL REMARKS

The study was conducted as an exploratory analysis due to the limited existing information on the use of AI in higher education in Ecuador. It is a link that opens space for future significant research on the use of AI, highlighting that there is currently a considerable level of teachers and students using AI in education, especially generative AI such as chats and content generators. However, as the use of this type of technology increases, so do ethical considerations, authenticity and transparency in the production of AI-mediated academic and research work.

In addition, a context influenced by the socioeconomic inequality existing in the country can be seen as limiting factors that hinder the adoption of this technology in an accessible and equitable manner, a situation that is similar to that existing in Latin America and the world. For this reason it is important that authorities, governments and international organizations work together to overcome the existing limitations around the world, especially in the most vulnerable sectors, and that efforts are made to achieve true inclusion and use of AI in higher education.

Limitations and future research

The primary limitation of this study lies in its focus on a single country, Ecuador, which may limit the generalizability of the findings to other regions with differing socio-economic and educational contexts. Future research should expand the geographical scope to include comparative studies across multiple countries and explore longitudinal approaches to evaluate the developing integration of AI in higher education. Further, examining the interplay between technological, pedagogical, and socio-economic factors through mixed-methods research could provide deeper insights into addressing barriers to AI adoption.

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B. data research and statistical analysis:	20%	20%	20%	20%	20%
C. elaboration of figures and tables:	20%	20%	20%	20%	20%
D. drafting, reviewing and writing of the text:	20%	20%	20%	20%	20%
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