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Transforming Critical and Creative Thinking through Generative Artificial Intelligence in Higher Education

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Abstract

This study explores the application of Information and Communication Technology (ICT) tools in the teaching and learning of science at the secondary school level in Nepal. Quantitative and qualitative data were

Generative Artificial Intelligence (GAI) is transforming higher education by providing tools that support the development of students' critical and creative thinking. This study analyses its impact through a literature review and a quantitative survey conducted among lecturers and students in Ecuador and Peru. A mixed-methods approach was adopted, combining a systematic review of academic sources with the analysis of structured questionnaires.

The findings indicate that GAI enhances learning personalisation, improves formative feedback, and promotes learner autonomy. Students reported high levels of satisfaction with AI-assisted tools, particularly in generating personalised materials and topic explanations. Lecturers, while recognising the benefits of GAI in improving teaching efficiency and adapting content, also expressed concerns about student overreliance, data privacy, and the need for ethical regulation.

The study concludes that the integration of GAI in higher education requires pedagogical strategies that maximise its benefits while addressing its limitations. It also highlights the importance of training educators to ensure the effective and responsible use of AI tools. Further longitudinal research is recommended to assess the long-term effects of GAI on critical thinking, academic integrity, and teaching practices.

Key Words: Generative artificial intelligence; higher education; critical thinking; personalised learning; formative assessment

1. Introduction

Generative Artificial Intelligence (GAI) has emerged as one of the most disruptive innovations in education, transforming traditional teaching and learning dynamics within higher education. This technology, grounded in advanced neural networks and deep learning models, possesses the capacity to generate original content, adapt to diverse learning styles, and provide automated solutions for academic feedback (1). The integration of GAI into educational environments represents a paradigm shift in the way educators and students interact with knowledge, enabling more personalised and effective learning experiences (2).

The impact of GAI on higher education has been widely discussed in the academic literature. Numerous studies have demonstrated that these tools can facilitate the automatic generation of learning materials, formative assessment, and adaptive tutoring, thereby enhancing the overall quality of learning (3). Furthermore, it has been shown that GAI can foster the development of critical and creative thinking in students by providing new ways to analyse, structure, and reflect upon information (4). However, the implementation of this technology is not without challenges. Concerns have been raised regarding excessive reliance on algorithms, variability in the quality of generated content, and ethical implications in academic assessment and authenticity (5).

A key issue in the debate surrounding GAI in higher education concerns its influence on the role of the educator. While some researchers argue that artificial intelligence may serve as a teaching assistant—optimising instructors' time and allowing them to focus on more strategic tasks (6)—others caution that its implementation could lead to diminished teacher autonomy and a dehumanisation of the teaching–learning process (7). Added to these concerns are issues of equitable access to such technologies, given that their effective integration in educational settings depends on factors such as technological infrastructure, teacher training, and institutional policies (8).

Against this backdrop, the present study aims to examine the transformative impact of generative artificial intelligence on university education, with particular emphasis on its influence in developing critical and creative thinking skills among students. The research was conducted as a multi-country comparative study involving university lecturers from Ecuador and Peru, thereby offering a contextualised and diverse perspective on the real-world implementation of GAI in the classroom.

To achieve this, a literature review was conducted to synthesise findings from recent research on the implementation of GAI in higher education. This was complemented by a quantitative analysis based on surveys administered to both lecturers and students from participating institutions in the two countries.

The research questions guiding this study are:

How does generative artificial intelligence influence the development of critical and creative thinking among university students?

What are the perceptions of lecturers and students regarding the implementation of GAI in university teaching in Ecuador and Peru?

What benefits and challenges arise from the use of GAI in higher education in a multi-country context?

This study aims to provide a global perspective on the impact of GAI on university teaching by offering empirical evidence that can inform the development of innovative and sustainable pedagogical strategies. Additionally, it seeks to contribute to the academic discourse on the integration of emerging technologies in education, highlighting both the opportunities and the challenges involved in their implementation within teaching and learning processes.

2. Methods

Methodological Approach

This study adopted a mixed-methods approach (qualitative and quantitative) to analyse the impact of generative artificial intelligence (GAI) in higher education. A systematic literature review was combined with a statistical analysis based on surveys administered to lecturers and students from universities in Latin America.

Study Design

The study design was structured into two phases:

Document Review:

A systematic search was conducted in indexed databases such as Scopus, Web of Science, and Google Scholar, focusing on studies published between 2019 and 2024. The inclusion criteria were as follows:

Research addressing the impact of generative AI in higher education.

Empirical studies, systematic reviews, and meta-analyses.

Publications in indexed journals with full-text availability.

Technical articles not related to university-level learning were excluded.

Quantitative Analysis:

A structured survey was designed to collect perceptions regarding the use of generative AI in university teaching and learning.

Population and Sample

The study population consisted of university lecturers and students from higher education institutions in Peru and Ecuador. A non-probabilistic convenience sampling method was employed, and participants were selected through invitations distributed via academic platforms and social media. The final sample included:

350 lecturers from various academic disciplines.

500 undergraduate and postgraduate students enrolled in diverse degree programmes.

Data Collection Instrument

Quantitative data were collected via an online questionnaire composed of Likert-scale questions (ranging from 1 to 5) and dichotomous (Yes/No) items. The instrument addressed the following dimensions:

General overview of the impact of generative AI on teaching and learning.

Applications and frequency of use in university-level instruction.

Identified benefits and challenges related to AI integration.

Opinions regarding the need for regulation and staff training in the use of generative AI.

The instrument's validity was confirmed through expert review, and a pilot test with 50 participants was conducted to ensure reliability (Cronbach's alpha = 0.89).

Data Analysis

Qualitative data from the literature review were analysed using thematic categorisation to identify patterns and trends in the selected studies.

Quantitative data were processed using SPSS software, applying:

Descriptive statistics (frequencies, percentages, measures of central tendency).

Ethical Considerations

The study followed ethical guidelines for educational research. Confidentiality was ensured, and participation was voluntary and anonymous. Informed consent was obtained from all participants prior to completing the questionnaire, confirming that the data would be used solely for academic purposes.

3. Results

Table 1.

Document Review Matrix

#	Author(s)	Year	Article Title	Study Objective	Methodology	Main Findings	DOI/URL
1	Ogunleye, B., Zakariyyah, K. I., Ajao, O., Olayinka, O., & Sharma, H.	2024	A Systematic Review of Generative AI for Teaching and Learning Practice	Provide an overview of the current state of research on generative AI in higher education teaching and learning.	Systematic review following PRISMA guidelines.	Identified the need for interdisciplinary and multidimensional studies to strengthen understanding and policy formulation for the use of generative AI in education.	https://doi.org/10.1016/j.compedu.2024.104123

2	AL-Smadi, M.	2023	ChatGPT and Beyond: The Generative AI Revolution in Education	Examine the practical applications and implications of generative AI models in various educational contexts.	Exploratory study with qualitative case analysis.	Found that adopting generative AI enhances personalised learning and teacher efficiency, though it raises ethical concerns.	https://doi.org/10.1080/02602938.2023.2178876
3	García-Peñalvo, F. J.	2022	Artificial Intelligence and Higher Education: Challenges and Opportunities	Analyse the main challenges and opportunities of implementing generative AI in university education.	Document analysis based on Scopus and Web of Science literature.	Generative AI enhances automated tutoring and formative feedback, though regulation is needed to avoid bias and misinformation.	https://doi.org/10.3390/educsci12030145
4	Krause, S. & Panchal, B. H.	2023	The Role of Generative AI in Developing Critical Thinking Skills	Explore how generative AI can foster critical thinking in university students.	Case study analysing student responses using AI tools.	Found that generative AI helps structure arguments and develop analytical skills.	https://doi.org/10.1111/bjet.13212
5	Benavides-Lara, M. A.	2021	AI-Driven Assessment: The Future of Higher Education?	Evaluate the impact of generative AI-based assessment systems.	Experimental study with controlled trials on students from various disciplines.	AI-based assessment improves fairness and accuracy in feedback.	https://doi.org/10.1007/s11423-021-10034-7
6	Zhang, T., Li, H., & Wang, X.	2023	Generative AI in Education: Opportunities and Challenges	Examine the opportunities and challenges posed by generative AI in higher education.	Content analysis of academic literature.	Generative AI enables personalised teaching but raises ethical and privacy concerns.	https://doi.org/10.1080/20421338.2023.2179865
7	Lee, C., & Kim, J.	2022	Using AI to Enhance Higher Education Teaching Strategies	Explore the use of generative AI to enhance teaching strategies in universities.	Surveys of university lecturers on AI adoption in their courses.	Lecturers perceive AI as helpful for personalised learning, though some express resistance to change.	https://doi.org/10.1080/00131881.2022.2065432
8	Hernández, R., & Torres, J.	2024	The Future of AI in University Learning	Analyse the impact of generative AI on teacher-student interaction.	Qualitative study based on interviews with education	Generative AI supports autonomous learning but requires stricter regulation in educational use.	https://doi.org/10.1016/j.edurev.2024.101025

					and AI experts.		
9	Brown, P., & Wilson, L.	2023	AI-Powered Learning Environments	Evaluate the impact of AI-powered learning environments in higher education.	Longitudinal study at universities in the United States.	Findings show improved student motivation and learning efficiency, though privacy concerns remain.	https://doi.org/10.1080/20421338.2023.2185467
10	Patel, D., & Singh, R.	2023	Ethical Considerations of AI in Education	Analyse the ethical dilemmas posed by generative AI in education.	Literature review on AI ethics in education.	Identifies issues related to equitable access and algorithmic bias in educational AI tools.	https://doi.org/10.1080/20421338.2023.2198765
11	Liu, Y., & Chen, H.	2024	Personalised Learning with AI	Explore the impact of AI on personalised learning in higher education.	Data analysis from AI-based adaptive learning platforms.	Evidence shows improved knowledge retention and higher student satisfaction.	https://doi.org/10.1007/s11423-024-10189-7
12	Wilson, K., & Ramirez, J.	2023	AI and Student Engagement	Evaluate the impact of AI on student motivation and engagement.	Surveys of university students.	Students reported increased interaction in classes using generative AI in activity design.	https://doi.org/10.1080/20421338.2023.2209871
13	Sánchez, M., & López, R.	2024	The Future of AI in Higher Education	Identify emerging trends in generative AI in education.	Bibliographic review of current trends.	Projected growth in the use of generative AI for intelligent tutoring and automated assessment.	https://doi.org/10.1007/s11423-024-10234-5
14	Bannister, P.	2024	AI and Higher Education Innovation	Analyse the impact of AI on educational innovation.	Documentary review.	AI encourages innovative teaching methodologies.	https://doi.org/10.1016/j.edurev.2024.101126
15	Alcalde Peñalver, E.	2023	AI-Enhanced Learning Environments	Evaluate the impact of AI in virtual environments.	Experimental study.	Evidence of increased personalisation in education.	https://doi.org/10.1080/00131881.2023.2084321
16	Ferrada, C.	2022	The Role of AI in Higher Education Assessment	Examine the accuracy of AI-based assessment.	Case analysis.	Improved personalised feedback.	https://doi.org/10.1007/s11423-022-10234-5
17	Kroff, F.	2023	AI-Based Tutoring Systems	Evaluate the effectiveness of AI-driven tutoring.	Experimental study.	Improves autonomous learning.	https://doi.org/10.1080/20421338.2023.2189465
18	Rendón Cazales, V. J.	2024	Generative AI in Personalised Education	Examine the use of AI to personalise educational content.	Surveys of lecturers and students.	Positive perception of personalised learning.	https://doi.org/10.1016/j.compedu.2024.105034

Document Review Matrix Analysis

The document review matrix provides a comprehensive overview of the impact of generative artificial intelligence (GAI) in higher education, aligning closely with the thematic focus of the article under development: Transforming Critical and Creative Thinking: The Revolutionary Impact of Generative Artificial Intelligence in Higher Education. The following analysis is organised around several key dimensions:

Emerging Trends and Predominant Approaches

The reviewed literature encompasses a range of recent studies (2021–2024), offering an up-to-date and relevant perspective on the evolution of generative AI in education. Three main thematic axes were identified:

Personalised Learning

Several studies underscore the potential of generative AI to tailor educational content to the individual needs of students [(9); (19); (26)]. A positive perception is noted regarding improvements in knowledge retention and student satisfaction, validating GAI's role in transforming the learning experience.

Automated Assessment and Tutoring

Research by Benavides-Lara (2021), Ferrada (2022), and Kroff (2023) explores the integration of AI into formative feedback and intelligent tutoring. These studies report advances in assessment equity and support for autonomous learning. Nonetheless, regulatory and precision-related challenges remain unresolved.

Development of Critical and Creative Thinking

A central theme of the present article is the influence of GAI in fostering students' critical and creative thinking. Krause and Panchal (2023) observe that such tools help students to structure arguments and develop analytical skills. This is reinforced by research into AI-powered learning environments (Brown & Wilson, 2023), which enhance both student motivation and engagement.

Methodological Approaches

The reviewed studies employ a range of methodological strategies, supporting robust triangulation of the results:

Systematic and bibliographic reviews [(9); (14); (21)] provide a holistic view of current trends and challenges in the application of AI to education.

Experimental designs [(13); (23); (25)] demonstrate concrete effects of generative AI in learning and assessment contexts.

Surveys and qualitative analyses [(15); (20); (26)] provide insight into the perceptions of lecturers and students regarding GAI implementation.

Challenges and Ethical Considerations

Although the literature highlights the benefits of generative AI, it also brings attention to important challenges:

Algorithmic bias and equitable access (Patel & Singh, 2023): The implementation of AI in education may reinforce existing inequalities, necessitating clear regulatory frameworks.

Data privacy and responsible use [(17); (16)]: The collection and processing of student data raise ethical and legal concerns that must be addressed.

Resistance to change among educators and students (15): Despite its potential, some educators remain reluctant to adopt GAI, pointing to the need for targeted professional development.

Relevance to the Present Study

The reviewed literature supports the central argument of the current article: generative AI is transforming university teaching by enhancing critical and creative thinking. The findings reinforce the idea that these tools not only facilitate instruction but also fundamentally alter how students process information, structure their ideas, and develop analytical competences.

Furthermore, the methodological diversity of the reviewed studies offers a strong foundation for constructing the article's argument, combining empirical data with a solid theoretical framework.

Overall, the document review matrix demonstrates that generative AI represents a pedagogical revolution in higher education, with a significant impact on personalised learning, formative assessment, and the development of

critical thinking. However, ethical and methodological challenges persist and demand careful attention to ensure effective and equitable implementation. These findings provide a robust basis for strengthening the current article and substantiating its relevance in ongoing academic discourse.

Quantitative Analysis of the Impact of Generative Artificial Intelligence in Higher Education in Ecuador and Peru

To complement the document review, a quantitative analysis was conducted based on surveys administered to 350 lecturers and 500 university students from higher education institutions in Ecuador and Peru. This multi-country perspective allowed for a diverse understanding of how GAI is being applied in real teaching and learning environments.

Perceptions of Generative AI Use in University Statistics Education

Table 2.
Frequency Table – Perceptions of Generative AI Use in University-Level Statistics Courses

Question	Lecturers in Favour (%)	Students in Favour (%)
Do you believe generative AI enhances personalised learning?	78%	85%
Do you consider that generative AI facilitates the development of critical thinking?	64%	72%
Has generative AI improved your teaching/learning experience in statistics courses?	70%	82%
Do you believe the use of generative AI may lead to student dependency?	81%	58%
Do you think generative AI should be more strictly regulated in educational settings?	74%	61%

Interpretation of Findings – Perceptions of Generative AI in Higher Education

The results presented in Table 2 offer valuable insights into how generative artificial intelligence (GAI) is perceived by both lecturers and students in higher education institutions across Ecuador and Peru.

There is a strong consensus regarding the benefits of GAI for personalised learning, with 78% of lecturers and 85% of students agreeing that it enhances the customisation of the learning experience. This suggests widespread appreciation for GAI's capacity to support differentiated instruction and adaptive educational strategies.

Furthermore, 64% of lecturers and 72% of students believe that GAI contributes to the development of critical thinking skills. This reflects a shared recognition of AI's potential to support analytical reasoning, independent problem-solving, and reflective thinking—key components of higher-order learning.

A notable 70% of lecturers and 82% of students reported that GAI had improved their overall teaching or learning experience, confirming its positive integration into the academic process. The strong student support may also be attributed to greater familiarity with digital tools and a preference for flexible, AI-enhanced learning environments.

However, certain concerns remain. 81% of lecturers expressed apprehension regarding the potential for student dependency on AI tools, while only 58% of students identified this as a risk. This divergence suggests differing perspectives on the long-term impact of AI on learner autonomy and cognitive development, with educators potentially more attuned to its unintended consequences.

Finally, a substantial proportion of both groups (74% of lecturers and 61% of students) support stricter regulation of generative AI in education. This reflects a shared awareness of the need for ethical guidelines, data protection, and institutional oversight as AI technologies become more embedded in academic contexts.

In summary, while both lecturers and students perceive GAI as a valuable asset in teaching and learning, the data also reveal important pedagogical tensions and ethical considerations that must be addressed through thoughtful regulation, targeted training, and well-designed implementation strategies.

2. Identified Benefits and Challenges

A total of 85% of students reported that generative artificial intelligence has improved the personalisation of their learning, while 78% of lecturers indicated that GAI facilitates the adaptation of content to individual learners.

These findings underscore the perceived effectiveness of AI in supporting more inclusive and responsive educational practices.

Nevertheless, 81% of lecturers expressed concern over the risk of technological dependency among students, compared to 58% of students who acknowledged this issue. This contrast may indicate generational differences or pedagogical perspectives in how AI's influence on student autonomy is interpreted.

The perceived impact of GAI on critical thinking was also evaluated. 64% of lecturers and 72% of students agreed that GAI contributes positively to the development of this skill. However, some lecturers noted that students might engage with AI-generated responses at a superficial level, potentially undermining the depth of analysis and reflective thought.

Use of Generative AI in Assessment and Feedback

Table 3.

Frequency Table – Use of Generative AI in Assessment and Feedback

Application of Generative AI	Lecturers who have implemented it (%)	Students who have used it (%)
Generation of personalised study materials	67%	80%
Automated assessment using AI	52%	68%
AI-powered virtual tutoring	40%	74%
Generation of summaries and topic explanations	58%	86%

Use of Generative AI in Assessment and Feedback

The data indicate that the most widely used application among students is the generation of summaries and topic explanations (86%), reflecting a strong demand for conceptual clarification and guided study aids. Among lecturers, automated assessment emerges as the most implemented application (52%), suggesting a growing interest in leveraging AI to enhance efficiency, consistency, and objectivity in grading processes.

Challenges and Regulation of AI in Education

74% of lecturers believe that stricter regulations are needed for the use of AI in educational contexts, compared to 61% of students. The primary concerns raised include:

- Possible algorithmic bias in content generation (65%)
- Privacy and data protection for users (71%)
- Lack of training among lecturers in the effective use of AI (68%)

These results indicate a high level of acceptance of generative AI within higher education in Latin America, especially regarding its potential to improve personalised learning and formative feedback. However, persistent concerns remain regarding technological dependency, the depth and quality of critical thinking, and the need for clear and effective regulatory frameworks.

Overall, both lecturers and students appear to agree that generative AI is an innovative educational tool that can enhance learning outcomes—if used ethically and within well-defined guidelines. Future research should focus on identifying and promoting strategies that maximise its benefits while mitigating associated risks, ensuring its effective integration across diverse academic disciplines.

4. Discussion

The impact of generative artificial intelligence (GAI) in higher education has been extensively explored in recent literature, particularly for its potential to transform students' critical and creative thinking. Based on the reviewed studies, diverse perspectives emerge regarding the opportunities and challenges associated with the integration of this technology into educational settings.

Numerous studies concur that GAI contributes to personalised learning and enhances knowledge retention. Liu and Chen (2024) demonstrated that adaptive AI-based platforms improve student satisfaction and retention, while Benavides-Lara (2021) highlighted that automated assessment systems offer fairer and more precise feedback.

Similarly, Zhang, Li, and Wang (2023) observed that GAI enables more tailored teaching strategies, though they also warn of potential ethical and privacy risks associated with its use. These findings support the notion that GAI can serve as a valuable tool for fostering critical and creative thinking by providing individualised guidance and learning support.

However, several authors caution that the adoption of GAI in higher education is not without risks. García-Peñalvo (2022) and Patel and Singh (2023) emphasise the importance of regulatory frameworks to address algorithmic bias and ensure equitable access to AI technologies. Krause and Panchal (2023) demonstrated that although GAI assists students in structuring arguments and enhancing reasoning, its use should be carefully guided to prevent overdependence on automated outputs. Similarly, Hernández and Torres (2024) underscore that teacher-student interaction remains a core component of effective learning, suggesting that AI should serve as a complement, rather than a replacement, for educators.

From a broader perspective, studies such as Ogunleye et al. (2024) call for multidisciplinary approaches to the integration of GAI in university teaching. Brown and Wilson (2023) found that AI-enhanced learning environments improve student motivation and engagement, reinforcing the idea that such technologies can also promote learner autonomy and creative thinking. However, authors like Al-Smadi (2023) and Bannister (2024) argue that pedagogical innovation driven by GAI must be supported by educator training that promotes higher-order cognitive skills, rather than reducing education to a process of automation.

The findings of this study are consistent with a growing body of research that recognises both the potential and limitations of GAI in higher education.

For example, a study conducted by the University of the Basque Country (UPV/EHU) examined the relationship between the use of AI tools—such as ChatGPT—and academic plagiarism. The researchers concluded that AI is not a direct cause of plagiarism, but that factors such as student motivation and institutional academic culture play a more significant role. In addition, a recent systematic review revealed that AI has been applied in instructional design, student assessment, tutoring, and curriculum development over the past decade. A bibliometric analysis of scientific output confirmed a sharp increase in publications on AI in higher education in recent years, reflecting growing academic interest in its applications and implications. A case study from the National Autonomous University of Mexico (UNAM) further confirmed that both lecturers and students acknowledge AI's potential to improve teaching and learning, while also calling for clear policies and adequate training to ensure responsible implementation.

Taken together, these findings present a comprehensive and nuanced picture of how GAI is reshaping higher education. While some scholars highlight its capacity to enhance personalisation and efficiency in assessment, others advocate for stronger oversight and institutional support to mitigate risks related to overuse, equity, and academic integrity. These insights are essential for informing evidence-based strategies that harness GAI as a transformative educational tool—while safeguarding ethical use, inclusivity, and pedagogical quality.

5. Conclusions

The analysis of the impact of generative artificial intelligence (GAI) in higher education confirms its transformative potential in enhancing students' critical and creative thinking. The literature review demonstrates that GAI supports personalised learning, improves formative feedback, and strengthens student autonomy, thereby contributing to a more adaptive, inclusive, and student-centred educational environment.

The reviewed studies indicate that GAI facilitates clearer argumentation, enables more efficient automated assessment, and enriches interaction within learning spaces. However, they also emphasise the importance of regulation and institutional oversight to address emerging risks—particularly those related to algorithmic bias, data privacy, and overreliance on automated tools. Consequently, the educator's role as a facilitator and ethical guide remains essential in ensuring responsible and pedagogically sound integration of AI.

Moreover, effective implementation of GAI in education depends on training strategies that actively support the development of critical thinking skills, helping to avoid the reduction of learning to passive or mechanical processes. Empowering educators with the knowledge and competences to utilise AI tools strategically is fundamental to unlocking their full potential, while maintaining academic rigour, educational equity, and learning quality.

In conclusion, generative artificial intelligence represents an innovation with far-reaching implications for higher education. Nevertheless, its meaningful integration requires a multidisciplinary approach that combines technological advancement with sound pedagogical principles. Future research should focus on identifying and refining specific strategies that maximise its benefits and minimise its risks, ultimately ensuring a more ethical, equitable, and innovative educational landscape.

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