

Generative Artificial Intelligence: Ethical challenges and pedagogical implications in emerging educational contexts

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Abstract. Generative Artificial Intelligence (GAI) has rapidly transformed education by introducing new possibilities for personalized learning and pedagogical innovation. It has emerged as a powerful support system capable of information processing and decision-making tasks in higher education. Unlike traditional educational technologies, models such as ChatGPT enable dynamic interaction with learners. Students engage with knowledge, complete academic tasks, and regulate their performance. Building upon previous studies, this article incorporates an expanded theoretical framework, and a deeper ethical analysis of student perceptions and emotions, emphasizing its role as a support tool in their learning processes. The results suggest that while ChatGPT enhances efficiency, accessibility, and learner autonomy, it also introduces significant risks related to overreliance, academic integrity, and the loss of critical thinking skills. The study concludes that should be integrated as an academic mediator, emphasizing the need for ethical guidelines and pedagogical institutional redesign.

Keywords: Generative Artificial Intelligence, ChatGPT, Educational environment, Academic ethics, Learning processes.

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1 Introduction

The integration of Artificial Intelligence into educational environments has accelerated rapidly. Particularly following the widespread adoption of generative models based on large-scale optimization algorithms. Systems, such as ChatGPT, rely on probabilistic modeling, deep neural networks, and high-dimensional optimization processes to generate contextually coherent responses. From an informatics perspective, can be conceptualized as computational decision-support tools that assist users in information retrieval, synthesis, and reasoning tasks. Previous studies have explored GAI as an emerging educational tool, in higher education students increasingly employ it to optimize academic activities, reduce task completion time, and manage cognitive load. The rapid advancement has marked a turning point in education worldwide. Unlike previous educational technologies these systems, specifically large language models such as ChatGPT, can produce coherent, context-aware, and human-like responses that directly influence students' learning behaviors (Rudolph et al. 2023).

The technological shift has generated both enthusiasm and concern among educators and researchers. It has been examined primarily as an emerging support tool for academic tasks. According to García Peñalvo et al. (2024) requires a more comprehensive analysis that considers pedagogical implications, ethical issues, and cognitive consequences. In new educational contexts, where institutional resources and digital literacy vary significantly, its adoption represents additional challenges related to equity and responsible use. This study expands on previous research by Alfaro Rodríguez et al. (2025) analyzing new dimensions as: 1) Academic efficiency and task optimization; 2) Cognitive support and learning facilitation; 3) Ethical awareness and academic integrity; and 4) Perceived risks of dependency and overuse. Through an inferential analysis of the following questions:

- How do students perceive the pedagogical value of GAI tools in higher education?
- What cognitive, metacognitive, and ethical implications emerge from sustained use?

- How can institutions integrate them responsibly while preserving academic integrity and critical thinking?

Currently, it is advancing exponentially in terms of use and application in all areas of society. However, it brings different problems and challenges specifically in education. According to the Organization for Cooperation and Economic Development (OCDE), it has appeared to be one of the most disruptive technologies in the last decade. Affecting industrial and academic spheres. It is progressively integrated into global education systems, transforming the way students interact with knowledge and academic resources (OCDE, 2024). Nevertheless, some concerns emerge related to the impact of these technologies on students' ability to acquire fundamental skills such as critical thinking and problem solving.

There is a risk that students become passive actors in their learning process, if it depends on tools that generate automatic responses. This could inhibit their ability to analyze and question the information they receive (Correal Romero, 2025). GAI tools do not always provide accurate information, and their use could lead students to rely on incorrect data without adequate pedagogical oversight (González Rivas, 2025). Furthermore, in concordance with United Nations Educational, Scientific and Cultural Organization unequal global access to these technologies proposes another concern. Countries and regions with less technological resources are at risk of falling behind in the adoption of these advances (UNESCO, 2024).

2 Theoretical framework

According to Villena and Dunstan (2019), text analysis can take place automatically through computational simulation of linguistic properties. Computational techniques known as natural language processing are used to extract and analyze keywords from many documents. For that reason, chatbots have advanced successfully. They understand many questions that are asked in a variety of ways due to natural language and machine learning. Advanced strategies and natural language processes working together, interacting to improve research mechanisms and easier rules to process data. These systems have demonstrated their ability to understand, learn, and generate language in an increasingly sophisticated way. Automatic text analysis, through natural language processing, has transformed human machine interaction, highlighting the impact on technology and decision making (Boden, 2017).

As part of computer science appears GAI as a discipline, focusing on the development of a variety of systems that can simulate different aspects of human intelligence such as learning. It refers to the ability of artificial intelligence systems to generate new and original content from existing data, using advance machine learning algorithms (Kurzweil, 1992). In addition, others mention it as a subfield that focuses on models capable of producing text, images, and a variety of data by imitating learned patterns previously.

Many authors agree that it should not be seen as a replacement tool, rather a way to improve the human ability to do complex tasks. In the past the idea of automatization was seen as a replacement for human effort. Nowadays it is a support with a huge potential to expand the learning capabilities, provided it is used to amplify personal skills instead of displacing essential functions. Optimization driven nature positions it as a powerful tool for supporting decision-making processes. Nevertheless, the same optimization mechanisms that enhance efficiency may also prioritize speed over accuracy, requiring human oversight in educational applications.

2.1 GAI and learning theories

From a pedagogical perspective, GAI aligns with constructivist and connectivist learning theories, where knowledge construction occurs through interaction, feedback, and networked information systems (Siemens, 2005). These tools can operate as cognitive scaffolds, supporting learners in organizing ideas, clarifying concepts, and accessing diverse perspectives. Though, unlike traditional educational technologies, they actively participate in meaning-making processes. This raises questions about authorship, agency, and the balance between support and substitution in learning. Recent research highlights both positive and negative cognitive effects of its use. On one hand, students report increased efficiency, reduced cognitive load, and enhanced self-regulated learning.

On the other hand, excessive reliance in outputs may lead to cognitive offloading, diminishing deep processing and critical reasoning skills. These technologies interact with human cognition by externalizing certain reasoning processes. Students often use the systems to decompose problems, generate alternatives, or validate preliminary solutions. While this interaction can enhance productivity, it also raises concerns where reliance on computational systems reduces internal cognitive effort (Loján et al. 2024). From a computational cognition perspective, they should be viewed as rationality enhancers, supporting but not replacing human reasoning processes. Metacognitively, GAI promotes reflection when used as a feedback tool; although, non-critical use may foster passive learning behaviors (Correal Romero, 2025).

UNESCO (2019) considers that GAI should be used to innovate in teaching and learning. Under a framework of inclusion, equity and sustainable development, based on ethical principles (Barrera Cámara et al. 2025). In this sense, the use of tools with intelligent features has grown considerably since 2022 and even more so today. Encouraged by a high processing capacity. Language models are trained to identify which words are most likely to appear together, basing large amounts of data. Although the answers they generate are coherent, they are not always correct, because they do not involve reasoning. Despite the advances, in the case of educational tools GAI can produce coherent answers in a linguistic sense but inaccurate or misleading. This is especially important in educational contexts (Gruetzemacher & Paradice, 2022).

In the perspective of García Peñalvo et al. (2024) the topic involves a lot of interest in educational community. The solution is not to ignore or prohibit its use of these kinds of technological tools, rather to train teachers and students about their correct and ethical use to get a higher performance. It proposes an approach that builds trusting environments for students, considering a human centered pedagogical design, where assessment is part of the learning process. Recent research indicates the need for an educational transformation to take advantage of the potential of it. Proposing ongoing training that includes digital literacy, critical thinking and ethics. This way, it is possible to encourage responsible use and prepare students by demonstrating its integration into education fields (Rudolph et al. 2023).

Excessive use can reduce students' ability to develop essential skills by encouraging a passive approach to learning (Loján et al. 2024). Indiscriminate use is alarming as it leaves students as learning receptors. Couple with a lack of critical skills that allow them to identify and evaluate genuine information with respect to artificially created information (Zawacki Richer et al. 2019). Students prefer to rely on the results offered by these tools than exercise their logical reasoning and applying in-depth analysis skills. This severely impacts the development of their professional competences (Real Zumba et al. 2024; Navarro, 2024). In this sense, widespread use has become an obstacle to the full development of cognitive skills (Bolaño García & Duarte Acosta, 2024).

2.2 Ethical challenges and academic integrity

Traditional academic integrity frameworks assume a clear distinction between human authorship and external assistance. GAI disrupts this distinction by producing original looking text through algorithmic recombination. This raises questions about authorship, attribution, and ethical responsibility (Romeu Fontanillas et al. 2025). Ethical concerns surrounding it include plagiarism, authorship ambiguity, algorithmic bias, and unequal access (UNESCO, 2024). According to Cossio Franco et al. (2025), unlike traditional plagiarism, assisted writing blurs the boundaries between original work and external support, requiring a reconceptualization of academic integrity policies. Regarding its impact on ethical and social aspects, it is important to consider that its utilization and implementation must always take care of its ethical and responsible use and be in favor of humanity (Díaz Arce, 2023).

In a positive perspective, it offers possibilities to personalize learning, create adaptive content, and promote students and teachers' interaction. This brings many challenges and risks with its use. On the one hand, it can produce quality content, but it is also possible, generate misinformation, which focuses on integrity of the educational process and academic development of students in risk (Zawacki Richer et al. 2019). This duality shows the importance of a balanced approach that not only maximizes its benefits but also implements effective supervision and verification strategies of the content to work with (Andreoli et al. 2024).

Algorithmic governance mechanisms, including transparency requirements, constraints and usage guidelines, are important for supporting responsible deployment within academic systems. Academic institutions should therefore move beyond

prohibition towards ethical integration, emphasising transparency, attribution and critical engagement with AI outputs. Uncontrolled use may foster technological dependence and weaken critical and reflective thinking, as well as creativity, which are fundamental abilities in students' learning processes (Cajamarca Correa et al. 2024). Educational environments should therefore promote students' critical reflection rather than incorporating AI solely as a didactic resource.

2.3 Current overview in Mexico

Worldwide related to emerging educational systems, studies show that many countries are not prepared to use GAI in the academic context. Specifically in Latin America, its adoption depends on infrastructural limitations, digital divides, and uneven teachers' training (OCDE, 2024). While has the potential to democratize access to academic support, it may also increase inequalities if it and guidance are not equitably distributed (Suárez Estavillo, 2025). In Mexico, according to the National Autonomous University of Mexico, has begun to integrate these technologies into the educational system, primarily higher education (Sánchez Mendiola and Carbajal Degante, 2023). The Ministry of Public Education states that one of the main challenges in education is preparing students for the future workforce, where technological skills and GAI knowledge will be essential.

Its adoption in the classroom has been slow due to the lack of technological infrastructure and the poorly specialized training for teachers. A 2023 study by National Autonomous University of Mexico (2023), highlights that only 25% of educational institutions in the country have begun experimenting with these technologies in their educational programs. This amount is worrying when compared to the average in developed countries, where they are already implemented in different education areas according to Ministry of Public Education (2025). Following the reorganization of the National Council of Science and Technology in 2023, a significant gap has emerged between educational institutions with access to advanced technologies and others that still use traditional methods. This inequality reflects a structural problem in the Mexican education system, where economic and regional factors affect access to technological resources. Therefore, it becomes essential that the government and institutions collaborate to ensure that all students benefit from GAI in education (UNESCO, 2024).

Although there is government interest, few schools have integrated it into their educational programs. The most common challenges include a lack of financial resources, limited infrastructure, and poor teacher training. A study made by the Sinaloa State Council of Science and Technology (2023), concludes that most teachers at the region's universities do not feel prepared enough to use it for preparing classes or in their classrooms. This situation represents an important barrier to its widespread incorporation. Likewise, in accordance with Suárez Estavillo (2025), the Autonomous University of Sinaloa and national reports, its adoption in Sinaloa is still starting.

3 Methodology

This extended study adopts a quantitative, non-experimental, cross-sectional design (Fig. 1). Based on the methodological framework of the original research from Alfaro Rodríguez et al. (2025). Data was collected through a structured questionnaire of 34 questions applied to university students, measuring their perceptions of GAI use in academic contexts. The analysis incorporates additional interpretative dimensions, including ethical awareness, perceived cognitive impact, and self-regulation. Descriptive and inferential analyses were conducted to identify patterns across demographic variables. Ethical considerations included informed consent and anonymity. It assessed perceptions of GAI in function of four dimensions: 1) Academic efficiency and task optimization; 2) Cognitive support and learning facilitation; 3) Ethical awareness and academic integrity; and 4) Perceived risks of dependency and overuse.

Participation was voluntary, and ethical research standards were upheld. A probabilistic sampling of higher education students was carried out on the population of the academic unit of 745. Using the statistical formula for the calculation of a finite sample, obtaining 254 study elements from Faculty of Informatics Mazatlán of Autonomous University of Sinaloa. Participants are in the first, second, and third grade of bachelor's degree in computer science (CS) and Information Systems Engineering (ISE). They responded, from first grade 119 students, 96 from the second grade, and 39 from the third year. This represents 46.9%, 37.8%, and 15.3%, respectively.

Taking into consideration a confidence level of 95% and a maximum estimation error of 5% (Formula 1). Additionally, to

enrich the quantitative results obtained, open-ended questions were analyzed to gather the participants' complete opinions, with the aim of providing the research with a human perspective.

$$n = \frac{N * z_{\alpha}^2 * \rho * q}{e^2 * (N - 1) + Z_{\alpha}^2 * \rho * q} \quad (1)$$

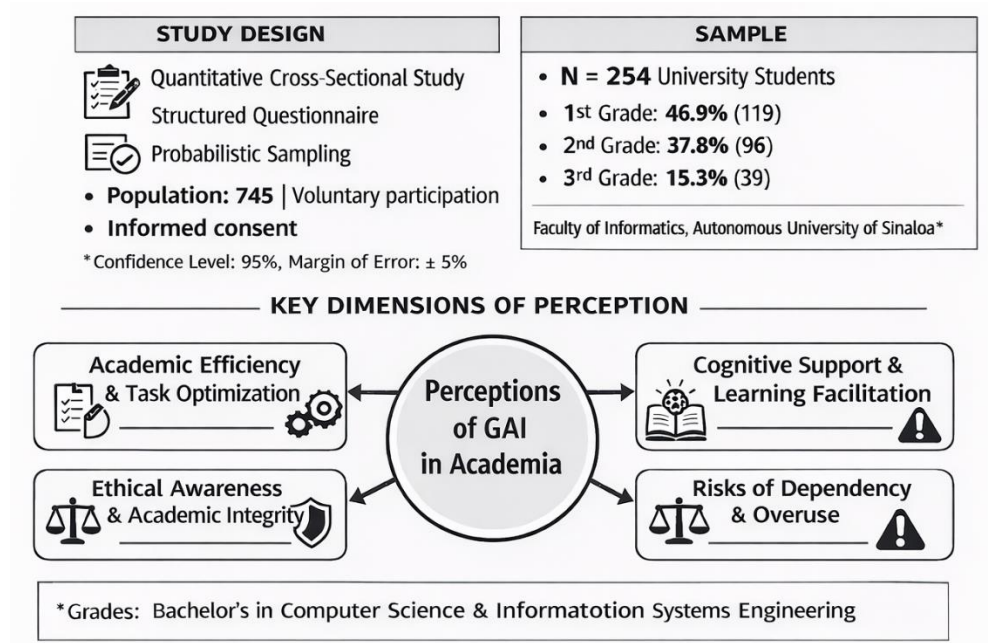


Fig. 1. Methodology

Participants were asked about GAI information, specifically about ChatGPT, given its popularity among young people. Their ages range mostly between 18 and 21, with 19 being the most common age. Wherein 18 are closed-ended single choice questions, 3 are multiple choice questions, 8 are Likert-type scale (strongly agree - agree - disagree - strongly disagree), and 5 are open questions. Validation was carried out by 4 professors teaching courses in both educational programs. The questionnaire was distributed to students online through Google forms, so that everyone could easily and reliably access it.

The sample size was 86.6% male, and 13.4% female. This shows a higher number of males (220) than females (34). Most students in both programs are males; a situation generally associated with the type of career they are studying. This happens every year, men prefer these careers more than women.

4 Results

Results indicated that most participants perceive GAI as an effective support system. Because it enhances efficiency and reduces cognitive effort. They reported frequent use for drafting, summarizing, and problem clarification. Also affirmed increased motivation and time efficiency. However, a substantial part expressed uncertainty regarding ethical boundaries and appropriate use. Notably, students with higher levels of digital literacy demonstrated more critical engagement with output. This suggests that computational awareness moderates' dependency risks. The stage affirms that guidance and training play a crucial role in responsible adoption.

Based on participants' gender and the educational program (Table 1), regarding the frequency of ChatGPT use, it is inferred that in both cases women use it more frequently, at 31.2% and 38.8%, respectively. While men use it occasionally, at 32.4% and 33.0%, respectively. Therefore, although the frequencies of use are similar, its use is predominant among women.

Table 1. How often do you use ChatGPT? Taken from Alfaro Rodríguez et al. (2025).

	Always	Very frequently	Frequently	Sometimes	Rarely (%)	Never
	(%)	(%)	(%)	(%)		(%)
CS						
Female	25.0	18.8	31.2	12.5	12.5	0.0
Male	10.4	21.0	24.8	32.4	6.7	4.7
ISE						
Female	5.5	22.2	38.8	33.3	0.0	0.0
Male	6.1	20.0	24.3	33.0	10.4	6.1

Considering Artificial Intelligence as a support tool in the learning process, students were asked about their interest in using it (Fig. 2). Because of this, 50.4% expressed that they agree and 33.9% totally agree. This represents 84.3% are interested, while 15.8% disagree or do not use it for that purpose. In addition, particularly related to the use of ChatGPT similar results were obtained where 37.4% totally agree and 49.6% agree. The majority 87%, in contrast to 13% who disagree or do not use it. It is shown that this application is popular and used by students for educational purposes.

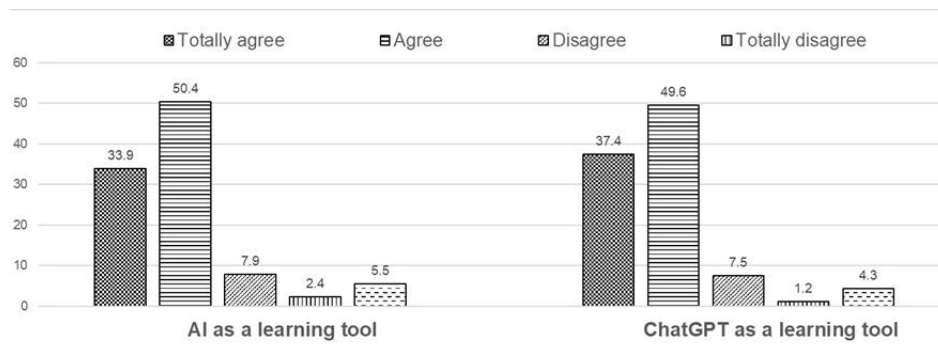


Fig. 2. Interest in using a learning tool. Taken from Alfaro Rodríguez et al. (2025).

Upon finding positive perceptions about the use of ChatGPT, it was inferred that the response is consistent across the study. It has greater acceptance in the three semesters studied (1, 3, and 5) with 62.1%, 55.2%, and 71.7% respectively. Fifth-semester students consider it the most effective for educational purposes (Table 2).

Table 2. Do you consider effective to use ChatGPT in your school activities? Taken from Alfaro Rodríguez et al. (2025).

Grade	Totally agree	Agree	Disagree	Totally disagree	I don't use it
	(%)	(%)	(%)	(%)	(%)
1st semester	21.0	62.1	8.4	3.3	5.0
3rd semester	31.2	55.2	7.2	0.0	6.2
5th semester	28.2	71.7	0.0	0.0	0.0

Participants affirmed to use it for many school activities, then the question arises how do they process the information they obtain? 67.7% say they read all the information, 65.4% analyze the data, and 57.9% summarize what they find most useful. On the other hand, regarding the sources they consult, 35.8% affirm that they review additional sources and compare results. Only 19.3% take responsibility by ensuring they directly copy the information without reading, analyzing, or consulting other external sources (Fig. 3). This contradictory situation is concerning due to the ethical issue of the use of GAI. It reaffirms the need to promote a responsible culture regarding the use of these technologies.

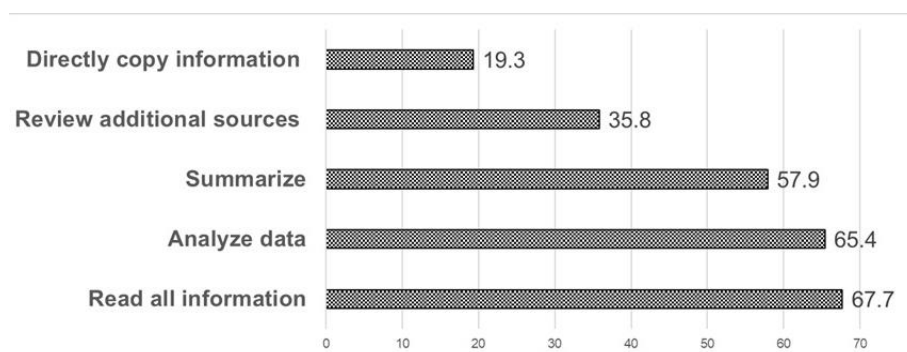


Fig. 3. Processing of information generated by ChatGPT. Taken from Alfaro Rodríguez et al. (2025).

Considering the outputs, important aspects in educational matters were emphasized, such as usefulness of the information, motivation and interest towards learning, and effectiveness for the development of schoolwork and activities. Most of them have shown a positive perception and suggest it is effective and supportive in their processes of acquiring significant knowledge. Then, the need arises to identify whether teachers use it in their academic context. According to Fig. 4, most said that only few teachers did it (36.2%), no teacher (34.3%). Reflecting that even though most students use them, teachers still do not integrate them as part of their formal teaching planning process.

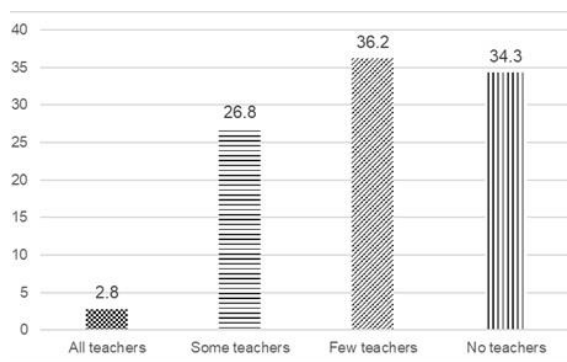


Fig. 4. Teachers use ChatGPT as a support tool in class.

Related to their emotions about the use of ChatGPT and the obtained information, more than 70% answered they did not feel dependent. This represents an attitude of control over the application. Additionally, their academic performance in concordance with them, more than 50% observed an improvement. Although not everyone sees significant changes in their grades, most say their school activities have changed with the use of GAI, becoming more efficient. Students' emotions were diverse (Fig. 5). The reflection of the level of confidence in ChatGPT as a support tool shows that 79.6% feel confident when using it, 48.4% satisfied, 35% interested in learning, and 33.9% motivated to learn. In contrast 53.1% feel concerned about making mistakes, 26.8% doubtfully, and only 14.6% guilty because of few efforts.

There are ambiguous answers, that means they use it and trust but at the same time they are worried about results. Currently there are no regulations or guidelines on the use of GAI in the context of the Autonomous University of Sinaloa. This emphasizes the importance that as an institution, establishes regulations containing ethical standards to govern the proper use of the application by students. This will ensure its safe use and prevent risks in their educational processes.

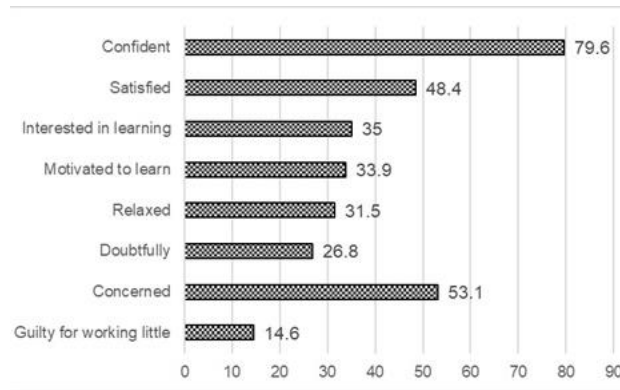


Fig. 5. Emotions about use of ChatGPT .

On the other hand, 68.9% ensured that information provided in response to their requests is accurate and useful. They did not provide data related to the previous critical analysis and reflection of the information obtained. They focused on the help it provides without considering the ethical issues related to it. Another important aspect was the real dependency on ChatGPT for schoolwork, most of them (68.9%) answered totally disagree with it. But there was no more information about their daily practices with GAI, Table 3.

Table 3. Experience and daily schoolwork use of ChatGPT.

Grade	Totally agree	Agree	Disagree	Totally disagree	I don't use it
	(%)	(%)	(%)	(%)	(%)
Feel confident using it	79.6	0.0	15.7	0.0	4.7
Concern about making mistakes	0.0	53.1	42.2	0.0	4.7
Information provided is accurate and useful	16.9	68.9	9.1	0.4	4.7
Dependency for schoolwork	0.0	26.4	0.0	68.9	4.7

As final reflections, participants were asked: what do you think of ChatGPT? The responses were diverse, but generally positive about it and showed a conscious and critical thinking of its real use:

“A very easy-to-use tool with great power”.

“It's a good study tool”.

“Future”.

“I think it's a tool that's here to stay, and we use it in our daily lives to learn faster”.

“It's a very useful tool for various types of activities, such as education and daily activities”.

“I think it's an excellent way to study”.

“A useful tool, but only if you know how to use it”.

“It's a good application if it's used properly”.

“It's a useful tool, but its use should be moderated to avoid negative experiences”.

After a deep analysis of the 254 answers of the general opinion of ChatGPT, it was identified that opinions were varied. Most students (65%) made positive comments about the tool and its educational use. But only 23.6% were assured they are concerned and worried about the ethical and proper utilization. Higher education students require to learn from experts about the topic, the negative effects and how to solve them in a correct way. As well as all the ethical issues that arise with the irrational use.

In addition, the question: how do you think GAI can change the way we learn?

“On the positive side”.

“Easy access to information”.

“It can be a support”.

“More accurate information”.

“Giving us examples of use to simply analyze them”

“It could be an easier way to learn complex topics”.

“I don't think it will replace teachers”.

“It could be used as a study method”.

“In terms of obtaining information quickly and efficiently”.

“It can be an interactive teacher that we can use when we have any questions”.

“It can be used like a private tutor who teaches you the way you want, when you want, and without getting tired”.

“Being able to answer questions at any time so that with training the answers will be more personalized”.

Similarly, most perceptions tend toward a positive stance. The responses reveal characteristics that strengthen its use in school settings. This marks a step toward a gradual adoption governed by ethical principles and usage standards and supervised by trained teachers. This ensures that it always supports teaching and learning processes in educational contexts, being used just as a support tool.

5 Discussion

The results align with international findings indicating widespread student acceptance of GAI, coupled with ethical ambiguity (Rudolph et al. 2023; García Peñalvo et al. 2024). However, the emphasis on efficiency over critical and ethical thinking appears more accentuated in emerging contexts. Consistent with recent literature, the findings highlight the risk of reduced autonomy and superficial learning when these technologies are used without pedagogical framing (Loján et al. 2024). Excessive reliance on generated solutions may lead to over-optimization, where efficiency is prioritized at the expense of deep learning and problem-solving skills (Navarro Guaimares, 2024).

It is undoubtedly an increasingly powerful technology that is becoming part of the lives of everyone involved in academic and research. It is shaping how humans, especially students, learn, leading to an academic culture different from the one we are used to. Their use introduces new elements and significant challenges. In this sense, finding a balance between encouraging their use and deliberately prohibiting them to avoid potential academic risks is complex. From an informatics standpoint, it requires curricular adjustments that emphasize algorithmic literacy, critical evaluation of computational outputs, and ethical reasoning. Students must be trained not only to use tools, but to understand their limitations and underlying optimization logic.

It is necessary to redesign assessment strategies, shifting from product-oriented evaluation to process-oriented and reflective assessment (UNESCO, 2024). When integrated intentionally, it can function as a tutor, feedback generator, and metacognitive prompt rather than a shortcut to academic outputs. Consequently, framed as a heuristic tool can augment learning processes without displacing human judgment. In that sense, educators must therefore cultivate literacy that emphasizes questioning, verification, and ethical judgment to preserve academic integrity. Coupled with better professional skills development.

6 Conclusions

GAI represents a transformative force in higher education. While it offers unprecedented opportunities for personalization and support, its educational value depends on intentional, ethical, and pedagogically grounded use. This extended study demonstrates that should be understood not as a replacement for human cognition, but as a mediating tool that enhances learning when guided by critical and ethical frameworks. Represents a significant advancement in computational support systems for higher education. When conceptualized through an informatics and optimization lens, it offers substantial benefits in efficiency and cognitive assistance. Although, without ethical constraints and pedagogical oversight, these systems risk commit academic integrity and cognitive autonomy.

It contributes to the growing body of informatics research by framing as a decision-support system embedded within educational contexts. It demonstrates that students generally perceive these tools as valuable pedagogical support rather than as complete substitutes for learning. From the students' perspective, it enhances academic efficiency, facilitates understanding of complex concepts, and supports task organization and problem clarification. Most students view these tools as on-demand cognitive assistants that help optimize time and reduce initial cognitive barriers, particularly during drafting, summarization, and exploratory phases of academic work. However, this perceived value is closely linked to ease of use and immediacy, which can overshadow deeper pedagogical goals if not properly guided.

Sustained use generates significant cognitive, metacognitive, and ethical implications. Cognitively, can reduce extraneous cognitive load and support reasoning when used as a scaffold. But excessive reliance may lead to cognitive offloading, superficial learning, and diminished problem-solving depth. Metacognitively, GAI can promote self-regulation and reflection when students critically evaluate and refine generated outputs. Conversely, uncritical use may foster passive learning behaviors and weaken learners' awareness of their own learning processes. Ethically, constant use raises concerns regarding authorship, academic integrity, and dependency, as well as uncertainty about acceptable boundaries between legitimate assistance and misconduct.

To integrate GAI responsibly while preserving academic integrity and critical thinking, institutions must adopt a proactive and pedagogically grounded approach. This includes establishing clear, transparent policies on acceptable GAI-assisted practices. Redesigning assessments to emphasize reasoning processes, reflection, and decision-making rather than final products. And embedding it and algorithmic literacy within curricula. Teachers' development and student training are essential to ensure that it is understood as a decision-support and learning augmentation tool, not as an autonomous authority. When framed within ethical guidelines and critical pedagogical strategies, it can enhance learning without harming intellectual autonomy or academic standards.

Therefore, in education its use is not intended to be a substitute but rather an aid where each student focuses their learning process depending on their specific needs. They use their judgment and criteria to verify the information obtained, as well as to improve it. This is also relevant to the human-technology dynamic. Students should discover, through its use, their own potential for learning and critical thinking as individuals. Using these technologies to help them become better professionals, applying strategies such as:

- Develop institutional guidelines for ethical use.
- Incorporate literacy into curricula.
- Redesign assessments to emphasize critical thinking and reflection (reasoning processes over final outputs).
- Train teachers in its pedagogical integration in higher education.
- Incorporate algorithmic literacy into academic programs.
- Establish transparent policies on GAI-assisted work.
- Promote it as a support system rather than a decision-maker.

7 Limitations

The study is limited by its cross-sectional design and contextual scope. Future research could explore longitudinal effects, experimental designs, and cross-cultural comparisons to better understand the long-term cognitive and its pedagogical impact.

Acknowledgments

The ethical and responsible use of ChatGPT as a support tool in the writing process is hereby declared. It is intended for conceptual clarification, to improve textual coherence and the graphical scheme of methodology, respecting the principles of academic integrity and intellectual authorship. No substantive part of this work, such as the scientific content, research design, methodology, data collection and interpretation, or conclusions, was generated by the application. All information and academic decisions are the result of the authors' own authorship and expert judgment.

References

- Alfaro Rodríguez, A. P., Ibarra Martínez, R. L., López López, H. L., & Olivarría González, M. del C. (2025). Generative artificial intelligence as an emerging tool in education. *International Congress on Smart Machines and Data Engineering Proceedings (SMADE 2025)*, 68–75.
- Andreoli, S., Aubert, E., Cherbavaz, M. C., & Perillo, L. (2024). Entre humanos y algoritmos: Percepciones docentes sobre la exploración con IAG en la enseñanza del nivel superior. *Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología*, (37), 63–77. <https://doi.org/10.24215/18509959.37.e6>
- Barrera-Cámara, R. A., Fuentes-Penna, A., Sánchez-Martínez, F. E., Canepa-Sáenz, A., & Torres González, M. Á. (2025). Application of artificial intelligence in education: Models and tools to predict and improve academic performance towards an SDG perspective. *International Journal of Combinatorial Optimization Problems and Informatics*, 16(3), 64–72. <https://doi.org/10.61467/2007.1558.2025.v16i3.1131>
- Boden, M. A. (2017). *Inteligencia artificial* (I. Pérez Parra, Trans.). Turner.
- Bolaño-García, M., & Duarte-Acosta, N. (2024). Una revisión sistemática del uso de la inteligencia artificial en la educación. *Revista Colombiana de Cirugía*, 39(1), 51–63. <https://doi.org/10.30944/20117582.2365>
- Cajamarca-Correa, M. A., Cangas-Cadena, A. L., Sánchez-Simbaña, S. E., & Pérez-Guillermo, A. G. (2024). Nuevas tendencias en el uso de recursos y herramientas de la tecnología educativa para la educación universitaria. *Journal of Economic and Social Science Research*, 4(3), 127–150. <https://doi.org/10.55813/gaea/jessr/v4/n3/124>
- Correal Romero, T. F. (2025). La influencia de la inteligencia artificial en el pensamiento crítico en los estudiantes de secundaria. *Dialéctica*, 1(25), 150–177. <https://doi.org/10.56219/dialectica.v1i25.3882>
- Cossio Franco, E. G., Arreola Marín, M. E., Sossa Azuela, J. H., Chávez Marcial, M., Alcántar Alcántar, J. I., & Moya Sánchez, E. U. (2025). Artificial intelligence & society 5.0. *International Journal of Combinatorial Optimization Problems and Informatics*, 16(2), 55–59. <https://doi.org/10.61467/2007.1558.2025.v16i2.1073>
- Díaz-Arce, D. (2023). Plagio a la inteligencia artificial en estudiantes de bachillerato: Un problema real. *Revista Innova Educación*, 5(2), 108–116. <https://doi.org/10.35622/j.rie.2023.02.007>
- García-Peñalvo, F. J., Llorens-Largo, F., & Vidal, J. (2024). The new reality of education in the face of advances in generative artificial intelligence. *RIED-Revista Iberoamericana de Educación a Distancia*, 27(1), 9–39. <https://doi.org/10.5944/ried.27.1.37716>
- González Rivas, E. N. (2025). El uso de la inteligencia artificial generativa (IAGen) en el proceso de enseñanza-aprendizaje en la Licenciatura en Administración. *Punto CUNORTE*, 11(20), e20224. <https://doi.org/10.32870/punto.v1i20.224>
- Gruetzemacher, R., & Paradice, D. (2022). Deep transfer learning & beyond: Transformer language models in information systems research. *ACM Computing Surveys*, 54(10s), Article 204, 1–35. <https://doi.org/10.1145/3505245>
- Herrera Rivera, P., & Arancibia Carvajal, S. (2022). Modelo exploratorio de factores que inciden en el rendimiento académico percibido. *Revista de Estudios y Experiencias en Educación*, 21(45), 333–351. <https://doi.org/10.21703/0718-5162.v21.n45.2022.017>
- Kurzweil, R. (1992). *The age of intelligent machines*. MIT Press.

- Loján, M. del C., Romero, J. A., Sancho Aguilera, D., & Romero, A. Y. (2024). Consecuencias de la dependencia de la inteligencia artificial en habilidades críticas y aprendizaje autónomo en los estudiantes. *Ciencia Latina Revista Científica Multidisciplinar*, 8(2), 2368–2382. https://doi.org/10.37811/cl_rcm.v8i2.10678
- Secretaría de Educación Pública. (2025, January 24). *Boletín 26. SEP se apoyará en IA para el fortalecimiento del Sistema Educativo Nacional: Mario Delgado*. Gobierno de México. <https://www.gob.mx/sep/prensa/boletin-26-sep-se-apoyara-en-ia-para-el-fortalecimiento-del-sistema-educativo-nacional-mario-delgado>
- Navarro Guaimares, J. M. (2024). Pensamiento crítico vs. inteligencia artificial, un desafío para la educación. *Revista Arbitrada Orinoco Pensamiento y Praxis*, 14(1), 17–34.
- Organisation for Economic Co-operation and Development. (2024). *Job creation and local economic development 2024: The geography of generative AI*. OECD Publishing. <https://doi.org/10.1787/83325127-en>
- Real Zumba, G., Daza Suarez, S. K., López Leon, A. C., & Guilindro Moreno, V. del C. (2024). Inteligencia artificial y escaso razonamiento crítico en estudiantes universitarios de la carrera de educación básica. *Journal of Science and Research*, 9(CININGEC-). <https://revistas.utb.edu.ec/index.php/sr/article/view/3457>
- Romeu Fontanillas, T., Romero Carbonell, M., Guitert Catasús, M., & Baztán Quemada, P. (2025). Challenges of generative artificial intelligence in higher education: Promoting its critical use among students. *RIED-Revista Iberoamericana de Educación a Distancia*, 28(2), 209–231. <https://doi.org/10.5944/ried.28.2.43535>
- Rudolph, J., Tan, S., & Aspland, T. (2023). Editorial 6(2): Personal digital assistant or job killer? Generative AI and the teaching profession in higher education. *Journal of Applied Learning & Teaching*, 6(2), 7–16. <https://doi.org/10.37074/jalt.2023.6.2.1>
- Rudolph, J., Tan, S., & Tan, S. (2023). War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its impact on higher education. *Journal of Applied Learning & Teaching*, 6(1), 364–389. <https://doi.org/10.37074/jalt.2023.6.1.23>
- Sánchez Mendiola, M., & Carbajal Degante, E. (2023). La inteligencia artificial generativa y la educación universitaria ¿Salió el genio de la lámpara? *Perfiles Educativos*, 45(Especial), 70–86. <https://doi.org/10.22201/iisue.24486167e.2023.Especial.61692>
- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1). http://www.itdl.org/Journal/Jan_05/article01.htm
- Suárez Estavillo, U. (2025). La inteligencia artificial en la educación: ¿Transformación o inofuscación? Un análisis crítico de la nueva frontera educativa. *Sintaxis*, (14), 69–88. <https://doi.org/10.36105/stx.2025n14.05>
- Miao, F., & Holmes, W. (2024). *Guía para el uso de IA generativa en educación e investigación*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000389227>
- UNESCO. (2019). *Beijing consensus on artificial intelligence and education*. <https://unesdoc.unesco.org/ark:/48223/pf0000368303>
- Grupo de trabajo de Inteligencia Artificial Generativa de la UNAM. (2023). *Recomendaciones para el uso de la inteligencia artificial generativa en la docencia*. Universidad Nacional Autónoma de México. <https://cuaed.unam.mx/descargas/recomendaciones-uso-ia-gen-docencia-unam-2023.pdf>
- Villena, F., & Dunstan, J. (2019). Obtención automática de palabras clave en textos clínicos: Una aplicación de procesamiento del lenguaje natural a datos masivos de sospecha diagnóstica en Chile. *Revista Médica de Chile*, 147, 1229–1238. <https://doi.org/10.4067/S0034-98872019001001229>
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education—Where are the educators? *International Journal of Educational Technology in Higher Education*, 16, Article 39. <https://doi.org/10.1186/s41239-019-0171-0>