REVISTA INVECOM
ISSN en línea: 2739-0063

Pedagogical implications and emerging challenges of generative AI in basic education: A systematic review

Implicaciones pedagógicas y desafíos emergentes de la IA generativa en la educación básica: una revisión sistemática

Received: 20/02/2026 - **Accepted:** 15/05/2026

Maria Lourdes Quispilay Joyos
https://orcid.org/0009-0001-9374-1080
mquispilay69@ucvvirtual.edu.pe
Universidad César Vallejo. Lima, Peru

Abstract

This study aimed to analyze the pedagogical implications and emerging challenges associated with the use of generative artificial intelligence in basic education through a systematic review of recent scientific literature. To this end, the PRISMA 2020 guidelines were adopted, complemented by the SPIDER framework, which allowed for a rigorous structuring of the search, selection, and analysis process. The search strategy was conducted in the Scopus database, using an advanced search equation based on Boolean operators and keywords related to generative artificial intelligence, basic education, and teaching and learning processes. After a filtering and screening process based on inclusion and exclusion criteria, 33 studies were selected for in-depth analysis. The results identified five thematic areas: impact on learning, use of generative artificial intelligence in the classroom, transformation of the teacher's role, student perception, and ethical implications and emerging challenges. Taken together, the findings demonstrated that these technologies have high potential for personalizing learning, improving feedback, and strengthening student participation. However, risks related to technological dependence, superficial learning, and the need to establish clear ethical frameworks were also identified. It is concluded that the integration of generative AI into basic education requires a balanced pedagogical approach that ensures its use as a support tool and promotes the development of critical thinking skills in students.

Keywords: basic education, generative artificial intelligence, pedagogical implications.

Resumen

El presente estudio tuvo como objetivo analizar las implicaciones pedagógicas y los desafíos emergentes asociados al uso de la inteligencia artificial generativa en la educación básica, mediante una revisión sistemática de la literatura científica reciente. Para ello, se adoptaron los lineamientos del modelo PRISMA 2020, complementados con el marco SPIDER, lo que permitió estructurar de manera rigurosa el proceso de búsqueda, selección y análisis de los estudios. La estrategia de búsqueda se realizó en la base de datos Scopus, empleando una ecuación avanzada basada en operadores booleanos y términos clave relacionados con inteligencia artificial generativa, educación básica y procesos de enseñanza-aprendizaje. Tras un proceso de filtrado y cribado por criterios de inclusión y exclusión, se seleccionaron 33 estudios para su análisis en profundidad. Los resultados permitieron identificar cinco ejes temáticos: impacto en el aprendizaje, uso de la inteligencia artificial generativa en el aula, transformación del rol docente, percepción del estudiante e implicaciones éticas y desafíos emergentes. En conjunto, los hallazgos evidenciaron que estas tecnologías tienen un alto potencial para personalizar el aprendizaje, mejorar la retroalimentación y fortalecer la participación estudiantil. No obstante, también se identificaron riesgos relacionados con la dependencia tecnológica, la superficialidad del aprendizaje y la necesidad de establecer marcos éticos claros. Se concluye que la integración de la IA generativa en la educación básica requiere un enfoque pedagógico equilibrado, que garantice su uso como herramienta de apoyo y promueva el desarrollo de competencias críticas en los estudiantes.

Palabras clave: educación básica, inteligencia artificial generativa, implicaciones pedagógicas.

SciELO Venezuela latindex LatinREV CC BY

Introduction

In recent years, the emergence of generative artificial intelligence (AI) has reshaped the educational landscape, characterized by automated content production and dynamic interaction between digital systems and users. This technology, grounded in models capable of generating texts, images, and other resources from learned patterns, has transcended its instrumental function to position itself as a transformative agent in teaching and learning processes (Ocak et al., 2026; Starr & Wickam, 2026). In this context, its integration into basic education presents both opportunities and threats that demand rigorous examination from a pedagogical standpoint.

The accelerated growth of these digital tools has been particularly evident over the past decade, intensifying significantly in recent years. Generative AI not only expands access to information but also redefines how students engage with knowledge, fostering more personalized, adaptive, and interactive learning environments (Ginige et al., 2026; Kwon et al., 2026). Yet this technological evolution also introduces challenges related to content quality, technological dependency, and the need to cultivate critical competencies among users (Anderson & Bauml, 2026).

From a historical perspective, AI integration in education is not a recent phenomenon; early applications date back to the late twentieth century with computer assisted instructional programs. Nevertheless, the generative nature of current tools marks a turning point, as they not only facilitate content access but autonomously produce it, directly affecting knowledge construction and the pedagogical mediation traditionally exercised by teachers (Ocak et al., 2026; Starr & Wickam, 2026).

Within this framework, the adoption of generative AI in educational settings has sparked growing debate regarding its influence on cognitive skill development, student autonomy, and the transformation of the teacher's role. On one hand, its potential to foster motivation, facilitate comprehension of complex content, and optimize lesson planning through adaptive resources is widely recognized (Ginige et al., 2026; Kwon et al., 2026). On the other, concerns arise over inappropriate use, including shallow learning, erosion of analytical abilities, and possible violations of ethical principles concerning authorship and academic originality (Anderson & Bauml, 2026).

Furthermore, the implementation of these technologies in basic education does not occur under uniform conditions, revealing gaps in access and digital literacy among both teachers and students. This situation underscores the need for pedagogical strategies that enable responsible and equitable integration of generative AI, ensuring its role as a support resource rather than a substitute for educational processes (Starr & Wickam, 2026). In this regard, analyzing its pedagogical implications and emerging challenges is essential to understanding its true reach within the educational system. Hence, it becomes imperative to examine how these technologies are being incorporated into basic education and what implications they carry for formative processes.

Given the foregoing, the present study aims to analyze, through a systematic review of recent literature, the principal pedagogical implications and emerging challenges associated with generative AI use in basic education during the 2024–2026 period. Through this approach, the study seeks to identify trends, issues, and opportunities that can inform future research and educational practices in a context marked by rapid digital transformation.

Methodology

This study was developed as a systematic review of recent scientific literature, with the purpose of analyzing the pedagogical implications and emerging challenges related to the use of generative artificial intelligence in basic education. To ensure transparency, rigor, and reproducibility, the guidelines established in the PRISMA 2020 statement were adopted, widely recognized in academic research for the identification, selection, and synthesis of scientific evidence.

Additionally, to more precisely delimit the scope of the systematic review, the SPIDER framework was employed, which is pertinent for synthesis studies in the social sciences and education. This model enabled the organization of the core research components across five elements: sample, phenomenon of interest, design, evaluation, and research type.

Table 1

Application of the SPIDER framework in the systematic review

SPIDER element	Description applied in the study
S (Sample)	Scientific studies focused on basic education, including primary, secondary, and K-12 contexts, addressing the use of generative artificial intelligence in educational settings.

PI (Phenomenon of Interest)	Use of generative artificial intelligence in education, including tools such as ChatGPT, large language models (LLMs), and automated content generation systems applied to teaching-learning processes.
D (Design)	Empirical and theoretical studies were considered, including qualitative, quantitative, and mixed-methods research, experimental designs, case studies, and systematic reviews, provided they were linked to the basic education context.
E (Evaluation)	Pedagogical implications, impact on learning, teaching practices, student perception, competency development, as well as ethical risks, educational challenges, and effects derived from generative AI use.
R (Research Type)	Peer-reviewed journal articles published in English or Spanish, with open access, from the 2024–2026 period, primarily in the social sciences area.

Note. The SPIDER framework allowed for systematic structuring of the search, selection, and analysis criteria, ensuring coherence between the research question, stated objectives, and methodological process

It should be noted that the advanced search strategy was conducted in the Scopus database, selected for its coverage of high impact indexed journals in education and technology. An advanced search equation was designed using Boolean operators and controlled terms in English, structured around four conceptual dimensions: generative artificial intelligence, educational context, teaching learning processes, and implications derived from its use:

TITLE-ABS-KEY(("generative artificial intelligence" OR "GenAI" OR "AI-generated content" OR "large language models" OR "LLMs" OR "ChatGPT" OR "generative AI tools") AND ("basic education" OR "primary education" OR "elementary education" OR "secondary education" OR "school education" OR "K-12 education") AND ("learning" OR "teaching" OR "pedagogy" OR "educational practices" OR "instruction" OR "classroom" OR "education") AND ("challenges" OR "implications" OR "impact" OR "effects" OR "ethical issues" OR "ethics" OR "opportunities" OR "risks")) AND PUBYEAR > 2022 AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English") OR LIMIT-TO (LANGUAGE, "Spanish"))

Regarding inclusion criteria, peer reviewed articles published between 2024 and 2026, in English or Spanish, belonging to the social sciences area and with open access were considered, ensuring full document availability for analysis.

Table 2
Inclusion and exclusion criteria for selected studies

Inclusion criteria	Exclusion criteria
Peer-reviewed articles published between 2024 and 2026	Studies published outside the established time frame
Research in English or Spanish	Studies in languages other than English or Spanish
Studies indexed in academic databases (Scopus)	Non-indexed documents or those with low academic rigor
Open-access articles	Studies with restricted access or no full-text availability
Research focused on basic education (primary, secondary, or K-12)	Studies focused exclusively on higher education or non-school contexts
Studies explicitly addressing generative artificial intelligence (ChatGPT, LLMs, etc.)	Research addressing artificial intelligence in general without a generative focus

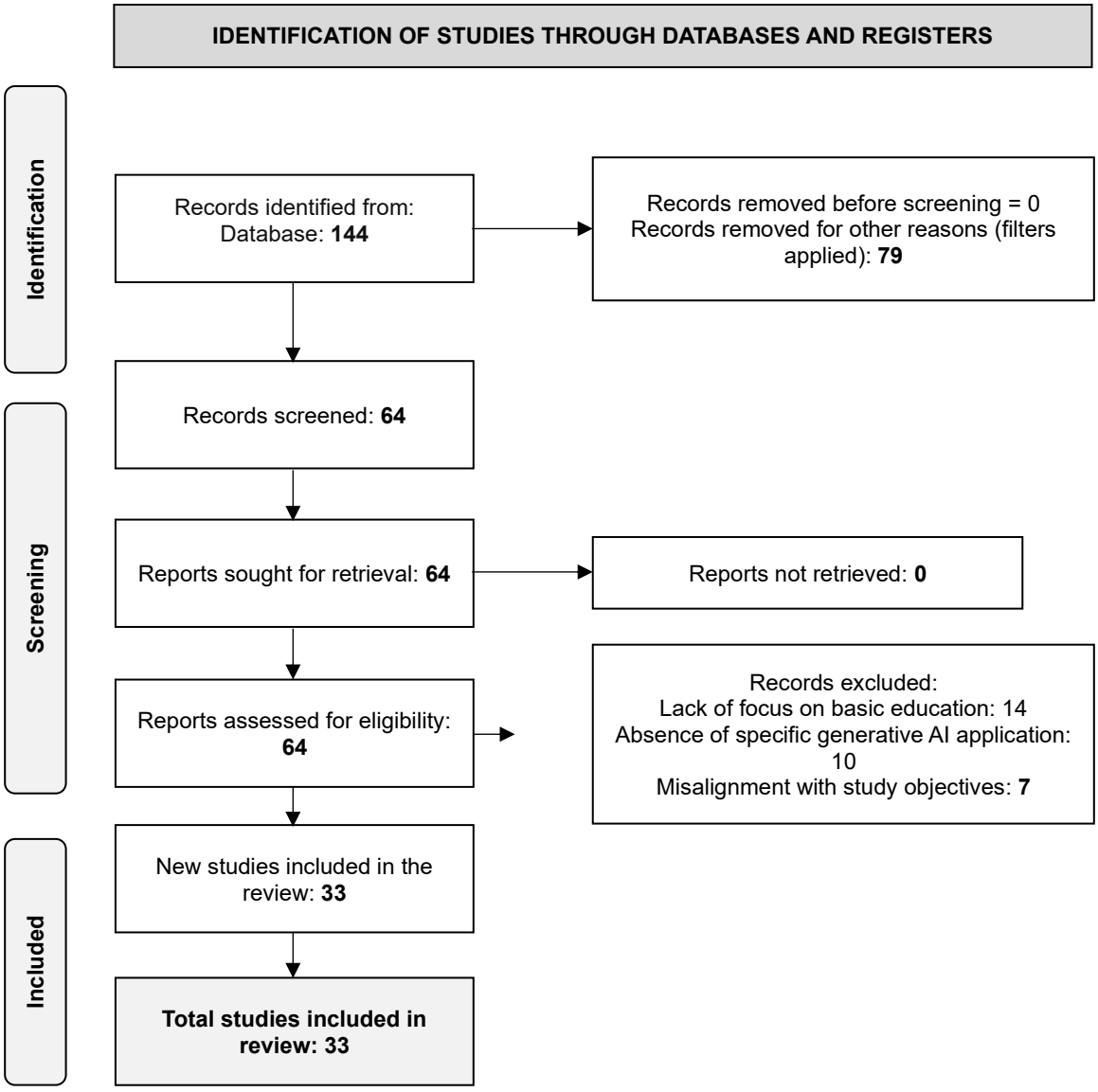
Research with an educational or pedagogical approach	Technical studies (engineering, health, programming) without educational application
Studies analyzing pedagogical implications, impact on learning, or ethical challenges	Research unrelated to teaching-learning processes or without implication analysis

Note. The established criteria enabled rigorous delimitation of the analysis corpus, ensuring thematic and methodological relevance of the selected studies

The study selection process unfolded in several stages. In the identification phase, 143 records were initially retrieved. Subsequently, after applying filters related to publication period, subject area, document type, language, and open access, the number of studies was reduced to 64 potentially relevant articles. In the screening phase, titles and abstracts were reviewed to verify thematic alignment with the research objectives. As a result, 30 articles were excluded for not meeting the established criteria, primarily due to lack of focus on basic education or absence of a specific generative AI emphasis.

Ultimately, 33 studies were selected for in depth analysis, forming the basis of this systematic review. Relevant information was organized using a data extraction matrix that included variables such as author, publication year, study objective, methodology employed, and principal findings. Subsequently, the studies were grouped into five thematic axes: impact on learning, use of generative AI in the classroom, teacher role, student perception, and ethical implications with emerging challenges. This categorization allowed for coherent structuring of the results synthesis and facilitated interpretation.

Figure 1
PRISMA flow diagram



Note. The flow diagram was developed following PRISMA 2020 guidelines (Page et al., 2021) to ensure transparency and traceability in the study selection process. Records retrieved from the Scopus database were included, applying inclusion and exclusion criteria related to publication period (2024–2026), focus on basic education, and relevance to generative artificial intelligence

Overall, the methodological procedure adopted enabled the development of a rigorous and structured systematic review, aimed at providing a comprehensive and up to date view of generative AI application in basic education, ensuring validity and consistency of the findings obtained.

Results and discussion

From the systematic analysis of the selected studies, five thematic axes emerged that structure understanding of generative AI use in basic education. These axes correspond to: impact on learning, use of generative AI in the classroom, transformation of the teacher's role, student perception and experience, and ethical

implications alongside emerging challenges. This categorization allowed coherent organization of empirical evidence, facilitating interpretation of findings from an integrative perspective. Likewise, these axes should not be understood as isolated dimensions but as interrelated components that collectively configure the current scenario of generative AI integration into educational processes.

1. Impact of generative artificial intelligence on learning

The analyzed studies show that incorporating generative AI into basic education has generated significant transformations in learning processes, particularly in cognitive and metacognitive skill development. Various investigations report improvements in reading comprehension, information retention, and self-regulated learning when students interact with systems based on advanced language models. In this regard, Kong et al. (2024), Fütterer et al. (2026), and Kreijkes et al. (2026) highlight that generative tools favor knowledge organization and study strategy optimization, especially in teacher guided contexts.

Similarly, studies by Meyer (2024) and Deng (2025) indicate that automated feedback generated by AI systems contributes to increased student motivation and engagement, facilitating revision and continuous improvement processes. However, this improvement does not occur uniformly, as authors such as Wu and Zhang (2025) and Huamani Anco (2025) caution that positive impact depends largely on the level of pedagogical support and the type of activity proposed. Along the same lines, Choi (2025) and Tai (2024) emphasize that unregulated use of these tools can generate technological dependency, undermining cognitive autonomy if not properly integrated into the educational process.

2. Use of generative artificial intelligence in the classroom and educational practices

The analysis of studies reveals a growing incorporation of generative AI tools into classroom dynamics, particularly through ChatGPT and other content generation systems. Research by Pardede (2026) and Gupta (2025) shows that these technologies are being used to support writing activities, problem solving, and idea generation, diversifying didactic strategies and enriching the learning experience.

Likewise, Callado (2025) and García Castro et al. (2024) highlight that AI use in the classroom fosters active student participation by offering immediate and tailored responses to individual needs. However, Ugras (2024) and Santos (2025) caution that integration of these tools remains in an exploratory phase, characterized by a lack of clear pedagogical guidelines. In this context, Alghasab (2025) notes that the potential of generative AI in the classroom depends not only on availability but also on adequate pedagogical mediation.

3. Teacher role and transformation of pedagogical practices

The implementation of generative AI has entailed a reconfiguration of the teacher's role, shifting from information transmitter to facilitator of technology mediated learning. Studies such as those by Cheah (2025) and Filiz (2025) show that educators face challenges related to effectively integrating these tools into their pedagogical practice, particularly concerning lesson planning and meaningful activity design.

Kim (2025) and Zammit (2025) point out that generative AI adoption requires the development of specific digital competencies and a critical understanding of its scope and limitations. Along these lines, Kamaghe (2026) and Tang (2026) emphasize that teachers who successfully integrate these technologies tend to promote more personalized and adaptive learning environments. Nevertheless, gaps in teacher training persist, limiting systematic implementation in educational contexts.

4. Student perception, experience, and behavior

The reviewed studies indicate that students' perceptions of generative AI use are predominantly positive, especially in terms of ease of use, perceived usefulness, and support in academic tasks. Research by Sorhaug (2026) and Brynildsen (2026) shows that students value these tools' capacity to offer immediate and personalized assistance, increasing motivation and confidence in learning.

Also, Du and Lv (2024) and Consoli (2025) highlight that acceptance of generative AI is influenced by factors such as technological familiarity, perceived utility, and educational context. However, problematic behaviors are also identified, such as excessive reliance on these tools for automatic task completion, which could undermine critical skill development if proper regulatory mechanisms are not established.

5. Ethical implications, risks, and emerging challenges

One of the most relevant aspects identified in the review concerns the ethical implications and challenges associated with generative AI use in basic education. Studies by Bower (2025) and Ofosu Asare (2025) underscore

CC BY

the need to establish regulatory frameworks governing these technologies, particularly regarding authorship, originality, and responsible information use.

Similarly, Al Eidan and Almisad (2025) and Chiu (2024) warn about risks associated with misinformation, algorithmic bias, and potential loss of cognitive skills among students. Meanwhile, Dimeli and Kostas (2025), Marzano et al. (2026), and Fock and Siller (2025) concur that generative AI integration in education requires a balanced approach, combining technological innovation with sound pedagogical principles and clear ethical considerations.

Overall, the results show that generative AI positions itself as a resource with high transformative potential in basic education, although its effective implementation depends on multiple pedagogical, technological, and ethical factors. While significant benefits are identified in terms of learning personalization, student motivation, and teacher support, challenges also emerge related to responsible use, technological dependency, and the need to strengthen critical competencies among both teachers and students. In this sense, integrating these tools demands a balanced approach that combines innovation with solid pedagogical criteria, ensuring that use contributes to comprehensive learning development rather than simplification. These findings not only enable understanding of the current state of the field but also guide future research and educational practices in a context marked by accelerated digital transformation.

Conclusions

This study systematically analyzed the pedagogical implications and emerging challenges associated with generative AI use in basic education, showing that its incorporation is progressively transforming teaching and learning processes. Based on the review of recent literature, it was confirmed that these tools hold substantial potential for personalizing learning, optimizing feedback, and strengthening active student participation, provided their use is mediated by appropriate pedagogical strategies.

Regarding the findings, the impact of generative AI on learning was found to be non uniform, depending on factors such as the level of teacher support, activity design, and the educational context in which it is implemented. Likewise, its integration into the classroom has promoted new forms of interaction with knowledge, though it remains in a phase of progressive adoption characterized by exploration and a lack of consolidated pedagogical guidelines.

Another relevant aspect concerns the transformation of the teacher's role, which demands the development of digital competencies and a critical understanding of these technologies' use. In this regard, teachers position themselves as key agents in pedagogical mediation, responsible for guiding generative AI use toward formative rather than merely instrumental ends. Similarly, students showed favorable attitudes toward these tools, valuing their usefulness and accessibility, though risks associated with overuse and potential decline in analytical skills were also identified.

From an ethical perspective, the results underscore the need to establish regulatory frameworks and clear guidelines governing generative AI use in educational contexts. Issues such as authorship, academic originality, information veracity, and critical thinking development emerge as central challenges that must be comprehensively addressed by educational institutions.

In terms of contribution, this systematic review offers an updated and structured view of the state of knowledge on generative AI in basic education, contributing to understanding its main applications, benefits, and limitations. It also provides a theoretical and empirical basis that can inform pedagogical decision making and educational policy design in contexts of digital transformation.

Finally, the need for continued research in this emerging field is recognized, particularly through empirical studies evaluating the long-term impact of generative AI on learning, as well as investigations delving into its curricular integration and the development of sustainable pedagogical models. In this way, progress can be made toward a more critical, ethical, and effective incorporation of these technologies into basic education.

References

Al-Eidan, A., & Almisad, B. (2025). Risks of generative AI in education. Eurasia Journal of Mathematics, *Science and Technology Education, 21*(12), em2742. https://doi.org/10.29333/ejmste/17435

Alghasab, M. (2025). AI tools in EFL secondary education writing skills. *Cogent Education, 12*(1), 2505304. https://doi.org/10.1080/2331186X.2025.2505304

Anderson, S., & Bauml, M. (2026). "Just be careful": Exploring middle school students' views about generative AI. *RMLE Online, 49*(1), 1–19. https://doi.org/10.1080/19404476.2025.2596551

Bower, M., Henderson, M., Slade, C., Gulson, K., & Lodge, J. (2025). Generative AI challenges identified by policymakers. *Australian Educational Researcher, 52*(3). https://doi.org/10.1007/s13384-025-00801-z
Brynildsen, S. (2026). Exploring upper secondary students' chatbot-mediated writing practices. *Frontiers in Education*, *11*, 1767132. https://doi.org/10.3389/feduc.2026.1767132
Callado, A., Saude, I., & Araujo, J. (2025). Secondary school students' perceptions of ChatGPT. *Contemporary Educational Technology, 17*(4), ep610. https://doi.org/10.30935/cedtech/17516
Cheah, Y. H., Lu, J., & Kim, J. (2025). Integrating generative artificial intelligence in K-12 education. *Computers and Education: Artificial Intelligence, 8*, 100363. https://doi.org/10.1016/j.caeai.2025.100363
Chiu, T. K. F. (2024). Impact of generative AI on education. *Interactive Learning Environments, 32*(10). https://doi.org/10.1016/j.caeo.2024.100171
Choi, Y. (2025). Scientific validity of ChatGPT responses in elementary science. *Sustainability, 17*(7), 2962. https://doi.org/10.3390/su17072962
Consoli, T., & Petko, D. (2025). Which educational approaches predict students' generative AI confidence and responsibility? *Computers and Education: Artificial Intelligence, 9*, 100431. https://doi.org/10.1016/j.caeai.2025.100431
Deng, R., Jiang, M., Yu, X., Lu, Y., & Liu, S. (2025). Does ChatGPT enhance learning? *Computers & Education, 227*, 105224. https://doi.org/10.1016/j.compedu.2024.105224
Dimeli, M., & Kostas, A. (2025). The role of ChatGPT in education: Applications, challenges, and insights from a systematic review. *Journal of Information Technology Education: Research, 24*, 1–18. https://doi.org/10.28945/5422
Du, L., & Lv, B. (2024). Factors influencing students' acceptance and use of generative artificial intelligence in elementary education: An expansion of the UTAUT model. *Education and Information Technologies, 29*, 24715–24734. https://doi.org/10.1007/s10639-024-12835-4
Elmourad, T., Hadjiphanis, L., Christofi, K., Chourides, P., & Kythreotis, A. (2026). AI adoption in K–12 education: A model of skills transformation, productivity, and institutional readiness. *Education Sciences, 16*(2), 337. https://doi.org/10.3390/educsci16020337
Feng, H., Wang, Y., Wang, Y., & Fu, Z. (2026). Implementation of AI tools to improve English writing skills in secondary schools. *Sustainable Social Development, 3*(6), 8463. https://doi.org/10.54517/ssd8463
Filiz, O., Kaya, M. H., & Adiguzel, T. (2025). Teachers and AI: Factors influencing AI integration. *Education and Information Technologies, 30*(13). https://doi.org/10.1007/s10639-025-13463-2
Fock, A., & Siller, H. S. (2025). Generative artificial intelligence in secondary STEM education in the light of human flourishing: A scoping literature review. *International Journal of STEM Education, 12*, 67. https://doi.org/10.1186/s40594-025-00589-5
Fütterer, T., Bardach, L., Kuhn, J., Keller, S., & Gerjets, P. (2026). Enhancing school students' self-regulated learning through generative AI support: A randomized controlled trial. *Educational Psychology Review, 38*(1), 42. https://doi.org/10.1007/s10648-026-10133-8
Garcia Castro, R., Mayta Cachicatari, N., Bartesaghi Aste, W., & Llapa Medina, M. (2024). Exploration of ChatGPT in basic education. *Contemporary Educational Technology, 16*(3), ep511. https://doi.org/10.30935/cedtech/14615
Ginige, J. A., Rana, K., Tague, R., Lum, B., Foxwell, H., & Ienna, M. (2026). An Australian cross-sectional study exploring the potential role of generative AI in high school computer programming education. *Computer Science Education*. https://doi.org/10.1080/08993408.2026.2621720
Gupta, S., Mehta, V., Kam, R., Ehmann, C., Orgad, A., Kuang, E., Castro Barrantes, A., Posada, M., Shah, S., Prasad, N., Pai, T., Ho, E., Xi, S., Zhou, T., Li, E., Wan, S., Paranjape, S., Dearling, Z., Peng, S. G., Kaveti, A., Lowrance, G., Xie, A. Z., Xu, M., Hariram, A., & Muse, A. (2025). A teacher, a tutor, a friend: ChatGPT and the high school experience. *The Qualitative Report, 30*(5), 3686–3719. https://doi.org/10.46743/2160-3715/2025.7324
Huamani-Anco, Y., & Maraza-Quispe, B. (2025). Impact of ChatGPT on research skills in secondary education. *International Journal of Information and Education Technology, 15*(1). https://doi.org/10.18178/ijiet.2025.15.1.2218
Kamaghe, J. (2026). Generative AI as a partner for teachers in building personalised learning paths. *Research in Learning Technology, 34*. https://doi.org/10.25304/rlt.v34.3594
Kim, J. (2025). Perceptions and preparedness of K-12 educators. *Research in Learning Technology, 33*. https://doi.org/10.25304/rlt.v33.3448

Kong, S. C., Yang, Y., & Hou, C. (2024). Examining teachers' behavioural intention of using generative artificial intelligence tools for teaching and learning based on the extended technology acceptance model. *Computers and Education: Artificial Intelligence*. https://doi.org/10.1016/j.caeai.2024.100328

Kreijkes, P., Kewenig, V., Kuvalja, M., Tankelevitch, L., & Oates, T. (2026). Effects of LLM use and note-taking on reading comprehension and memory: A randomised experiment in secondary schools. *Computers & Education, 243*, 105514. https://doi.org/10.1016/j.compedu.2025.105514

Kwon, K., Yang, S., Kale, U., & Park, J. (2026). Generative AI in a high school English career preparation unit: Student interactions, perceptions, and ethical concerns. *Computers and Education: Artificial Intelligence.* https://doi.org/10.1016/j.caeai.2026.100588

Marzano, D., Maniglio, R., Senese, A., & Diolaiuti, G. (2026). Generative artificial intelligence in education: Models, frameworks, and curriculum proposals. *Curriculum Journal*. https://doi.org/10.1002/curj.70034

Meyer, J., Jansen, T., Schiller, R., Horbach, A., & Fleckenstein, J. (2024). AI-generated feedback in secondary education. *Computers and Education: Artificial Intelligence, 6*, 100199. https://doi.org/10.1016/j.caeai.2023.100199

Ocak, C., Kopcha, T. J., Hodges, C. B., Sadik, O., & Ozogul, G. (2026). How artificial intelligence will reshape education: Conversations with the educational technology community. *TechTrends, 70*, 330–345. https://doi.org/10.1007/s11528-025-01149-y

Ofosu-Asare, Y. (2025). Ethical framework for generative AI use in education. *International Journal of Information and Learning Technology*. https://doi.org/10.1108/IJILT-06-2024-0113

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Revista Española de Cardiología, 74*(9), 790–799. https://doi.org/10.1016/j.recesp.2021.06.016

Pardede, S., Simamora, S., & Sinaga, D. (2026). ChatGPT in secondary education: A multi-theoretical case study from a developing country. *Education as Change, 30*, 20308. https://doi.org/10.25159/1947-9417/20308

Santos, M., Lozano, A., & Fontao, C. (2025). Influence of ChatGPT in secondary education. *Journal of Technology and Science Education, 15*(2). https://doi.org/10.3926/jotse.3190

Sorhaug, J. O. (2026). Prompting for scaffolding: A thematic analysis of K-12 students' use of educational chatbots. *Journal of Writing Research, 17*(3). https://doi.org/10.17239/jowr-2026.17.03.04

Starr, L. J., & Wickam, M. J. (2026). Understanding secondary educators' readiness and pedagogical content knowledge for artificial intelligence integration. *TechTrends, 70*, 391–397. https://doi.org/10.1007/s11528-025-01151-4

Tai, T.-Y., & Chen, H. H.-J. (2024). Improving elementary EFL speaking skills with generative AI chatbots: Exploring individual and paired interactions. *Computers & Education, 220*, 105112. https://doi.org/10.1016/j.compedu.2024.105112

Tang, D., Ding, R., He, M., Wang, Y., & Cheng, K. (2026). Intelligent teaching design assistant for primary mathematics: A large language model-driven framework with retrieval-augmented generation and problem-chain pedagogy. *International Electronic Journal of Mathematics Education, 21*(1), em0862. https://doi.org/10.29333/iejme/17447

Tierens, T., Decuypere, M., Hartong, S., & Alirezabeigi, S. (2025). Schooling the artificially intelligent writer. *Postdigital Science and Education, 7*(4). https://doi.org/10.1007/s42438-025-00585-6

Ugras, H., Ugras, M., Papadakis, S., & Kalogiannakis, M. (2024). ChatGPT-supported education in primary schools. *Sustainability, 16*(22), 9855. https://doi.org/10.3390/su16229855

Wu, D., & Zhang, J. (2025). Generative artificial intelligence in secondary education: Applications and effects on students' innovation skills and digital literacy. *PLOS ONE, 20*(5), e0323349. https://doi.org/10.1371/journal.pone.0323349

Zammit, J. (2025). Secondary school teachers' experiences with generative AI. *Technology, Knowledge and Learning, 30*(4). https://doi.org/10.1007/s10758-025-09861-7

DECLARATIONS

AUTHORSHIP CONTRIBUTION

The author declares that Conceptualization, Data curation, Formal analysis, Research, Methodology, Project administration, Resources, Validation, and Writing – proofreading and editing were carried out with the necessary attention to ensure the research meets appropriate standards of rigor.

FUNDING

This research received no specific funding from public agencies, private institutions, or nonprofit organizations. Its development was fully assumed by the author within the framework of academic and research activities.

CONFLICT OF INTEREST DECLARATION

The author states that there is no conflict of interest, financial or personal, that could have inappropriately influenced the preparation, analysis, interpretation, or presentation of the results of this study.

DECLARATION ON THE USE OF ARTIFICIAL INTELLIGENCE

The author declares that generative artificial intelligence tools were employed during the writing process solely as support for linguistic tasks, such as style improvement, syntactic organization, and grammatical correction. In no case were these technologies used to generate original scientific content, interpret results, or substitute the academic and ethical judgment of the authors. Full responsibility for the integrity, validity, and originality of the manuscript rests exclusively with the author, in accordance with good editorial practices and internationally recognized ethical principles of scientific publication.