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Review

Impact of ChatGPT on High School Grade Point Average: A Comparative Study by Subject, School Type, and Socioeconomic Factors

Yoonhyumk Cho

Korea International School, Seongnam 135431, Korea; choyoonhyukwork@gmail.com

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Abstract: This review aims to investigate the influence of AI tools, particularly ChatGPT, on high school students' academic performance and related factors. AI has become increasingly used in education due to its capacity to enhance personalized learning and automate feedback. Its effectiveness varies depending on school type, socioeconomic factors, and the readiness of teachers and students. AI tools contributed to GPA improvements, especially for students with limited skills, though learning outcomes were influenced by school support, teacher engagement, and family and peer influences. Private schools with better infrastructure and teacher training presented more academic gains than public schools. Socioeconomic disparities, including family income and parental education, significantly affected students' ability to use AI tools effectively. Peer influence also affected students' perceptions and usage patterns, with collaborative and peer-led environments enhancing responsible use and engagement. While AI supports learning, overreliance must be avoided as it can deteriorate originality and lead to superficial understanding. By advocating for inclusive policies, teacher training, and longitudinal research, AI tools can be more effectively integrated, fostering human-centered and transformative educational experiences ethically and equitably.

Keywords: AI, ChatGPT, GPA, Socioeconomic effect, School type

1. Introduction

Artificial intelligence (AI) has been integrated into modern education as it enables personalized teaching, automates feedback, and supports learning in a variety of subjects. AI tools such as ChatGPT—developed by OpenAI—are favored platforms for students to be assisted in performing assignments, problem-solving, language practice, and so on. While AI tools benefit students in effective learning, their impact on academic performance, particularly grade point average (GPA), might vary across school types and socioeconomic factors, which remain underexplored.

In high schools, GPA strongly influences students' college admission and career development. Therefore, the effects of ChatGPT in two subjects are reviewed in this study: mathematics and essay writing in English. Mathematics is an essential subject to learn logical, problem-solving, and computational skills. Essay writing, on the other hand, requires critical thinking, structuring and presenting ideas, and effectively communicating with readers. These two subjects have experienced the most transformative influence in learning from AI tools. In this article, the effects of AI tool usage on high school students by school type (public and private), family background (income and parental education), and school- and peer-related influences (facility access, support, and teachers' readiness) are explored. By reviewing previous study results on the effects of AI tools on learning in terms of research designs, cross-sectional surveys, and controlled interventions, how learning outcomes and the mechanisms are affected by AI tool usage is discussed to provide a reference and direction for the following studies.

Having established the context for AI integration and its potential yet underexplored impact on GPA across varying socioeconomic and school contexts, the review aims to examine the specific influence of ChatGPT on two core high school subjects: essay writing and mathematics. The following section details the observed benefits and challenges of the tool's application in these foundational academic domains.

2. ChatGPT in Teaching Essay Writing and Mathematics

ChatGPT, developed by OpenAI, has been widely applied in education, offering opportunities and challenges. ChatGPT helps students engage and acquire knowledge effectively (Jo, 2024), enabling personalized learning. It benefits students and teachers but raises concerns about privacy and technophobia. In higher education, ChatGPT assists students and teachers in academic writing,

lesson planning, and assessment through its potential to automate tasks and improve student engagement (Lee *et al.*, 2024). However, over-reliance on ChatGPT must be avoided with a balanced integration with traditional teaching methods to maintain academic integrity. To effectively utilize ChatGPT and understand its limitations, teachers need to be trained on its technical use. It is essential to understand ChatGPT's capabilities and constraints, formulate ethical guidelines to prevent plagiarism, and ensure responsible use of ChatGPT for effective use of ChatGPT in education (Ren, 2024). Challenges to ChatGPT's implementation in education have been pointed out in many studies. Smith *et al.* (2024) identified data privacy and ethical considerations in AI adoption and proposed sustainable strategies for professional development and fair audits to align AI use with the ethical principles and long-term goals in education. ChatGPT has shown potential to enhance educational experiences and personalized learning. However, thoughtful consideration of ethical, technical, and pedagogical factors must be guided in using ChatGPT in education.

Understanding this dual capacity for both enhancement and risk in education necessitates a focused review of ChatGPT's utility and limitations in specific, high-stakes subjects like essay writing and mathematics.

2.1. Essay Writing

ChatGPT and other AI tools assist students in brainstorming ideas, organizing essay structure, enhancing vocabulary, and performing grammar corrections in essay writing. AI tools help them generate outlines, suggest transitions, and critique students' drafts. Kim *et al.* (2024) found that students who used ChatGPT for at least two writing assignments per week improved their average GPA by 0.31 points in a single semester. Students with lower-level writing skills, particularly improved their GPAs. Using the feedback of AI tools, students enhanced their confidence in writing and understanding rhetorical strategies. ChatGPT functioned as a supplemental tool, and students improved their essay writing with the feedback and iterative revision of teachers. However, overreliance without understanding the underlying principles led to limited improvement but not long-term gains. ChatGPT showed higher coherence and clarity in essays (Khalifa and Albadawy, 2024). However, originality decreased slightly, raising concerns about overreliance. Since plagiarism detection tools failed to detect AI-generated content, the evaluation criteria needed to be refined.

ChatGPT's ability to adapt tone and style in sentences helps students prepare for standardized tests such as the Scholastic Assessment Test in the United States of America (USA) or essays for college applications. These essays require technical proficiency and personal voice, which AI tools still cannot emulate and have limitations. While ChatGPT improves mechanical accuracy and flow, students might fail to add personal thoughts, leading to formulaic or impersonal results.

2.2. Mathematics

AI tools still show challenges in helping students in mathematics, as this subject requires symbolic reasoning, error-checking, and often graphical and multi-step solutions. Nevertheless, AI tools provide step-by-step solutions and equations with explanations, which assist students in understanding concepts and modeling problem-solving processes.

Micabalo *et al.* (2024) conducted a randomized controlled trial with 1,200 students from 20 schools. The group that used ChatGPT in mathematical homework increased the average GPA by 0.18 points, especially in algebra and geometry. Students in advanced placement (AP)-level courses showed less improvement due to the complexity and abstract nature of advanced mathematics. The most prominent advantage of learning mathematics is its ability to explain mathematical concepts in easy language. For students struggling with terms or notation, ChatGPT helps translate complex ideas into easy formats. However, ChatGPT occasionally provides incorrect steps or misapplies formulas, which can mislead students who rely on its answers without cross-checking. To mitigate this problem, schools have integrated AI-assisted mathematics learning platforms that integrate ChatGPT with structured error-checking systems, such as Wolfram Alpha or Desmos. This harmonized approach provides students with concept explanations to ensure their computational accuracy. The programs with such integrations enhanced students' conceptual understanding and decreased dropout rates in math-intensive courses. Moreover, ChatGPT simulates peer tutoring experiences, encouraging metacognitive strategies where students explain their problem-solving logic back to the AI. This dialogic interaction helps solidify learning and reduce math anxiety—a significant barrier to student success (Micabalo *et al.*, 2024).

While subject-specific analysis confirms that AI tools contribute to measurable GPA gains, these benefits are not consistent. In the subsequent sections, individual subject performance is reviewed to the institutional and pedagogical variables that significantly mediate the effectiveness of AI tool usage, examining differences across school types and the pivotal role of teacher readiness.

2.3. Summary of Previous Results

The quantitative impact of ChatGPT on academic performance in the reviewed subjects is summarized in Table 1. The results illustrate that the degree of improvement varied based on the student's initial skill level and the complexity of the course material,

while both subjects showed positive gains. The results showed that ChatGPT's main strength is its ability to enhance educational experiences and personalized learning by assisting students with brainstorming, structuring essays, and providing step-by-step explanations in mathematics. However, its limitation exists in over-reliance, which might decrease their originality in writing and the occasional provision of incorrect steps or misapplied formulas in mathematics.

Table 1. Result summary of impacts of ChatGPT on academic performance.

Subject	Reference	Intervention	Observed GPA increase	Remark
Essay writing	Kim *et al.* (2024)	Students used ChatGPT for at least two writing assignments per week for one semester.	0.31 points on average.	Improvements were particularly significant for students with lower-level writing skills.
Mathematics	Micabalo *et al.* (2024)	Randomized controlled trial with 1,200 students using ChatGPT for mathematical homework.	0.18 points on average.	Gains were most prominent in algebra and geometry , but less so in AP-level courses due to complexity.

3. AI Tool Usage in School

3.1. Public and Private Schools

Public and private schools in the USA and European countries have presented significant differences in learning outcomes with AI tools. In general, private schools tend to offer more structured technology integration, greater access to digital tools, and closer teacher supervision than public schools.

A cross-sectional analysis of 3,400 students from private schools in 15 states of the USA revealed that AI usage by students increases the average GPA by 12%. Private school students who regularly used ChatGPT gained 0.38 GPA points higher in writing and 0.23 in mathematics than those who did not, while public school students with regular ChatGPT usage gained 0.28 and 0.15 points in writing and mathematics. Such a difference was attributed to institutional support. The private schools in the study frequently offered workshops on ethical AI usage, facilitated teacher-student collaborations in using AI tools, and provided an appropriate environment with high-speed Internet access and smart devices. Furthermore, most of the schools employed AI coordinators to ensure that students and teachers could maximize AI tool usage (Ma, 2021). In contrast, the public schools had insufficient infrastructure and teacher or student training, and bandwidth limitations in accessing the Internet, which led to unsupervised and limited usage of AI tools. Additionally, misuse or academic dishonesty was observed with limited policies. Nevertheless, innovative public schools launched grant-funded pilot programs to integrate AI tools. For instance, the “AI for All” initiative in Texas public high schools enabled teachers to be trained on AI-related pedagogy and provided Chromebooks to underprivileged students. The initiative increased students’ writing performance by 17% and increased engagement in mathematics classrooms (Ma, 2021).

School infrastructure plays a pivotal role in effective AI tool usage. Schools with updated libraries, digital laboratories, and dedicated staff for technology integration showed efficient implementation and better student learning outcomes. In contrast, schools lacking these facilities had problems with device-sharing and inconsistent access. Schools with AI-ready environments demonstrated 18% higher test scores in subjects where ChatGPT was used as a supplemental tool than those without such an environment. These schools reported fewer cases of academic dishonesty, suggesting that structured implementation supported ethical use, too. School leadership also plays a crucial role. Principals and superintendents who prioritize digital equity and innovation support teachers and students in adopting new technologies. AI-related clubs, project-based learning with ChatGPT, and cross-disciplinary AI applications enrich the student learning experience, especially in history and biology (Adewale *et al.*, 2024).

3.2. Teacher’s Readiness

Teacher motivation is a crucial yet underexplored factor in effective AI integration in education. UNESCO indicated that teachers at schools offering regular AI workshops and incentives were more likely to implement structured AI exercises. Students in these schools increased their average GPA by 0.29 points, compared with 0.12 in schools where AI integration was optional or unregulated (UNESCO, 2025). Teachers with higher salaries reported higher job satisfaction, which contributes to more creative

lesson planning, better classroom management, and a greater willingness to explore AI-based tools. In contrast, underpaid and overworked teachers often viewed AI as a threat to their authority or as an added burden. Schools with higher teacher salaries often attract more qualified staff and offer professional development in emerging technologies. Teacher unions and advocacy groups have required AI training programs as part of professional licensing requirements. Several states in the U.S. and provinces in Canada have introduced AI literacy modules into teacher credentialing programs (Ontario Tech University, 2005; Collie, Martin, and Gasevic, 2024).

The institutional support and teacher readiness detailed in the previous section reveal systemic disparities in AI adoption and efficacy. Extending this analysis, the critical role of extracurricular socioeconomic factors, including access, digital literacy, and national economic context, is reviewed to examine the opportunity for, and the outcome of AI tool usage among high school students.

4. Socioeconomic Factors Influencing AI Tool Usage in Education

Access to devices and high-speed internet is a critical factor in AI tool adoption by students and schools. Wealthier students and well-funded schools have better access to technology, while those from underprivileged conditions face limited or no access, leading to educational inequalities (van Dijk, 2020; Warschauer and Matuchniak, 2010). Digital literacy is closely related to socioeconomic status. Students with better access to digital resources at home tend to develop competencies in using technology, including AI-enhanced educational tools (Livingstone and Helsper, 2007; Ng, 2012). School investment is essential to purchase and maintain advanced AI systems and provide training for effective use. A lack of such investment retards the usage and acceptance of AI tools in education and causes socioeconomic disparities. Socioeconomic disparities affect students and teachers considerably. Schools with abundant funds continually provide tutoring and training programs on AI integration for students and teachers, while those with constrained budgets lack such training resources (Ertmer & Ottenbreit-Leftwich, 2010). Parental support and an appropriate home learning environment are also critical in integrating technology and education. Parents' attitudes toward education and technology are largely influenced by their socioeconomic background and impact students' ability to utilize AI tools effectively (Selwyn, 2004). AI tools are usually developed in globally dominant languages such as English. Students from other linguistic backgrounds found these tools less useful, even with their localizations (Li and Lalani, 2020).

In countries such as the US, Germany, and the United Kingdom (UK), their high gross domestic product (GDP) leads to the broad implementation of AI tools in education, while in developing countries, Internet access is limited due to a lack of budget and basic digital infrastructure. Education technology has been mainly developed by countries with a large high-speed Internet coverage and strong government support. Low-income countries have insufficient infrastructure, which hinders digital learning (UNESCO, 2025). Several countries remain skeptical of digital instruction due to traditional educational values, limited digital strategies, or political instability. To address such challenges and the technology divide, government-level funding, localized AI development, and public-private collaboration are needed to broaden linguistic inclusion, mitigate digital divides, and provide affordable access to technology, especially in under-resourced regions.

To fully grasp the complexity of the digital divide, a detailed examination of how family background and peer networks translate socioeconomic status into concrete usage patterns and academic results is required.

5. Family and Peer Influence on AI Tool Usage

5.1. Family's Influence

Household income is a significant predictor of a student's access to and effective use of AI tools. High-income families are more likely to have multiple smart devices, stable broadband, and quiet study environments. The OECD AI and Education Pilot Survey (2024) presented the results of a survey with 7,800 high school students across 9 countries. Students from households earning above the median income showed a 0.42 GPA increase after three months of ChatGPT usage, compared with 0.15 for students in low-income households. The students in low-income households reported more challenges in interpreting ChatGPT responses and distinguishing helpful suggestions from errors. Without guidance, these students misused or misunderstood AI-generated feedback. Companies and nonprofit organizations have recognized this disparity and have offered AI literacy boot camps and subsidized devices to students in low-income households. However, without consistent mentorship and ongoing follow-up, these interventions are likely to have limited long-term impact.

Parents' educational levels significantly shape students' learning environments and critical thinking skills. Children with college-educated parents used ChatGPT in a more nuanced way, focusing on feedback incorporation and synthesis. Ni *et al.* (2025) surveyed students' ChatGPT usage patterns and categorized their performance improvement by parental education level. Students with at least one parent holding a bachelor's degree improved their GPA in writing by an average of 0.34 points and in mathematics by 0.19 points, compared with increases of 0.21 and 0.11 of students whose parents had only a high school education. College-

educated parents were more likely to supervise their children's AI usage, suggest revision skills, and help them identify errors in AI tools' responses. In contrast, students with less-educated parents were likely to accept ChatGPT responses without question. Therefore, programs to involve parents in digital learning are required to address such challenges, as parents who are engaged in and empowered by AI tools guide their children to use AI tools in more informed and responsible ways.

5.2. Peer's Influence

Peer relationships significantly affect how students engage with AI tools. Current research has revealed that while younger participants were primarily influenced by social media, older participants were influenced by their peers (Menon and Shilpa, 2023). The influence of peers on other college students is a significant predictor of ChatGPT usage. Students who perceived that their peers valued and frequently utilized ChatGPT were more likely to adopt it. The popularity of chatbots among undergraduates has influenced undergraduates than graduates. Graduates are more likely to be independent than undergraduates, who have formed cohesive peer networks. This reveals a pattern of AI tools among younger students, indicating the paramount effect on their education (Menon and Shilpa, 2023). Younger students were more likely to have a greater intention to utilize chatbots than older students, indicating that age correlates with ChatGPT usage (Korchak *et al.,* 2025)

Students are pressured to utilize chatbots when they observe their peers to prevent the feeling of being left out (Menon and Shilpa, 2023). This indicates the role of peer perception in technology adoption in education. When peers endorsed and regularly used AI tools, a conducive environment was created for colleagues to use them favorably (Abdalijaleel *et al.,* 2024; Albayati, 2024). When introducing a peer assessment with the ChatGPT model in STEM education, students significantly improved knowledge construction, critical thinking, problem-solving, and creativity compared with those using traditional methods. Previous research results showed that positive peer assessment of AI tools enhanced students' learning experiences using them (Wu *et al.*, 2024). Peer discussions also affect students' perceptions of ChatGPT. Conversations about the ethical implications of AI usage, data privacy concerns, and the potential for academic dishonesty fostered students' understanding of AI tools and encouraged responsible and informed usage (Xu *et al.*, 2024). Students tend to mirror their peers' behaviors concerning AI tool usage. For instance, when a peer group actively utilized ChatGPT for brainstorming or summarizing content, other students were more inclined to adopt similar practices. This behavior increased the frequency of the use and applications of AI tools, highlighting the impact of peer behavior on individual choices (Wu *et al.*, 2024). Peer influence plays an important role in students' adoption and utilization of AI tools. By fostering collaborative environments. By encouraging peer-led discussions and integrating peer assessment models, responsible and effective AI usage by students can be harnessed.

6. Conclusion

AI tools such as ChatGPT offer a powerful and personalized supplement to high school education, with clear evidence of their ability to enhance students' academic performance, particularly in areas like essay writing and mathematics. However, the findings of this review suggest that the most pressing consequence of AI integration is not its technological potential, but its role in deepening existing educational inequalities. The data reveal a pronounced "triple divide" that influences the extent to which students benefit from AI-assisted learning.

First, institutional disparities play a critical role. Private schools, which are more likely to possess advanced digital infrastructure, employ specialized AI coordinators and require teacher training, consistently report greater GPA improvements than public schools. This indicates that institutional readiness is a necessary condition for realizing the academic advantages of AI. Second, socioeconomic factors significantly affect students' ability to engage with AI tools. Students from higher-income households and those with more educated parents are better equipped to interpret AI-generated feedback and apply it effectively. In contrast, students from low-income backgrounds often struggle to discern errors and make use of AI in a meaningful way, which limits the benefits of personalized learning and contributes to widening achievement gaps. Third, the effectiveness of AI is deeply contingent on human and pedagogical factors. The presence of well-prepared teachers and supportive peer relationships is essential for fostering collaborative learning and encouraging responsible, reflective use of AI. In under-resourced schools, where teacher instruction is often lacking, AI adoption correlates with minimal academic gains and an increased risk of academic dishonesty.

In the future, it is required to ensure their ethical, equitable, and pedagogically sound integration, beyond simply adopting AI technologies. This requires a proactive, human-centered approach. Policymakers and educators must prioritize investments in digital infrastructure, guarantee affordable access, and implement comprehensive AI literacy programs for both teachers and students. Ethical guidelines must be formulated to address issues such as academic integrity and data privacy, promoting the use of AI as a tool for critical thinking and revision rather than a substitute for human instruction. Furthermore, future research should move beyond short-term academic metrics and investigate the long-term effects of AI-assisted learning on non-cognitive skills such as

creativity, motivation, critical thinking, and knowledge retention. The future of education is not merely AI-powered, instead, must be AI-informed, AI-enhanced, and above all, centered on human development and equity.

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References

1. Abdaljaleel, M., Barakat, M., Alsanafi, M., et al. (2024). A multinational study on the factors influencing university students' attitudes and usage of ChatGPT. *Scientific Reports, 14*, 1983.
2. Adewale, M. D., Azeta, M., Abayomi-Alli, M., et al. (2024). Impact of artificial intelligence adoption on students' academic performance in open and distance learning: A systematic literature review. *Heliyon, 10*, e40025.
3. Albayati, H. (2024). Investigating undergraduate students' perceptions and awareness of using ChatGPT as a regular assistance tool: A user acceptance perspective study. *Computers and Education: Artificial Intelligence, 6*, 100203.
4. Collie, R. J., Martin, A. J., & Gasevic, D. (2024). Teachers' generative AI self-efficacy, valuing, and integration at work: Examining job resources and demands. *Computers and Education: Artificial Intelligence, 7*, 100333.
5. Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*, 255–284.
6. Jo, H. (2024). From concerns to benefits: a comprehensive study of ChatGPT usage in education. *International Journal of Educational Technology in Higher Education, 21*, Article 35.
7. Khalifa, M., & Albadawy, M. (2024). Using artificial intelligence in academic writing and research: An essential productivity tool. *Computer Methods and Programs in Biomedicine Update, 5*, 100145.
8. Kim, J., Yu, S., Detrick, R., et al. (2024). Exploring students' perspectives on Generative AI-assisted academic writing. *Education and Information Technologies, 30*, 1265–1300.
9. Korchak, A., Murshidi, G. A., Getman, A., et al. (2025). (标题缺失，需补全). *Innovations in Education and Teaching International*. Advance online publication.
10. Lee, J., Kim, S., & Park, Y. (2024). Transforming education with AI: A systematic review of ChatGPT's role in learning, academic practices, and institutional adoption. *Computers & Education: Artificial Intelligence, 5*, 100123.
11. Li, C., & Lalani, F. (2020). The COVID-19 pandemic has changed education forever. This is how. Available online: https://www.weforum.org/stories/2020/04/coronavirus-education-global-covid19-online-digital-learning/ (accessed on April 16, 2005).
12. Livingstone, S., & Helsper, E. J. (2007). Gradations in digital inclusion: Children, young people and the digital divide. *New Media & Society, 9*, 671–696.
13. Ma, J. K.-H. (2021). The digital divide at school and at home: A comparison between schools by socioeconomic level across 47 countries. *International Journal of Comparative Sociology, 21*, 115–140.
14. Menon, D., & Shilpa, K. (2023). "Chatting with ChatGPT": Analyzing the factors influencing users' intention to use the OpenAI's ChatGPT using the UTAUT model. *Heliyon, 9*, e20962.
15. Micabalo, A., Ofianga, A., Ormita, E., et al. (2024). The Impact of AI-Powered Study Tools On The Academic Performance and the Motivation of Higher Education Students. Available online: https://www.researchgate.net/publication/386045165_THE_IMPACT_OF_AI-POWERED_STUDY_TOOLS_ON_THE_ACADEMIC_PERFORMANCE_AND_THE_MOTIVATION_OF_HIGHER_EDUCATION_STUDENTS_Submitted_by (accessed on April 16, 2025).
16. Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education, 59*, 1065–1078.
17. Ni, M., Zaremohzzabieh, Z., Zarean, M., et al. (2025). The Role of Family Functioning And Parental Attitudes In Predicting Adolescent Adoption of AI Technology. *Journal of Theoretical and Applied Information Technology, 103*, 569–582.
18. OECD. (2024). Artificial Intelligence and Education: Access and Equity. Available online: https://www.oecd.org/education/ai-access-report-2024 (accessed on April 16, 2005).
19. Ontario Tech University. (n.d.). Artificial Intelligence for Teaching and Learning. Available online: https://ontariotechu.ca/programs/continuous-learning/education/ai-in-education/index.php?utm_source=chatgpt.com (accessed on April 16, 2005).
20. Ren, L. (2024). Use ChatGPT in Teaching and Learning: Opportunity and Challenge. *Advances in Social Behavior Research, 11*, 91–95.
21. Selwyn, N. (2004). Reconsidering political and popular understandings of the digital divide. *New Media & Society, 6*, 341–362.

22. Smith, A., Johnson, B., & Lee, C. (2024). Challenges of implementing ChatGPT on education: Systematic literature review. *International Journal of Educational Research Open, 8*, 100401.
23. UNESCO. (2025). UNESCO highlights the role of artificial intelligence in education at Congreso Futuro 2025. Available online: https://www.unesco.org/en/articles/unesco-highlights-role-artificial-intelligence-education-congreso-futuro-2025?utm_source=chatgpt.com (accessed on April 16, 2005).
24. van Dijk, J. (2020). Usage Inequality. In J. van Dijk (Ed.), *The Digital Divide* (pp. [页码缺失，需补全]). Hoboken, NJ, USA: Wiley.
25. Warschauer, M., & Matuchniak, T. (2010). New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education, 34*, 179–225.
26. Wu, T.-T., Lee, H.-Y., Chen, P.-H., et al. (2024). Integrating peer assessment cycle into ChatGPT for STEM education: A randomised controlled trial on knowledge, skills, and attitudes enhancement. *Journal of Computer Assisted Learning, 41*, e13085.
27. Xu, S., Su, Y., Zhang, Y., et al. (2024). Understanding learners' perceptions of ChatGPT: A thematic analysis of peer interviews among undergraduates and postgraduates in China. *Heliyon, 15*, e26239.