Exploring the impact of the AI classroom on students' analytical and creative skills

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Abstract
Objectives: This text proposes a preliminary examination of the envisaged effects of AI teaching technology on student skill development. Prior work: The paper reviews the limited theoretical and empirical literature in the field, assessing limitations and possible future research trends. Approach: The current study employs a literature review method. Results: The outcomes of the review reveal research gaps, inconclusive empirical evidence and research trends. Implications: The expected implications of the investigation are theoretical, and future research avenues will be revealed. Value: The literature concerning AI teaching solutions is limited, and new insights that are still being developed can add value to the extant body of work.

Keywords: AI teaching, teacherless classroom, cognitive skills, creativity, future of education.

1. Introduction

Theoretical and empirical works about the role of artificial intelligence (AI) in education are scarce as the scientific community is catching up with the latest technological developments. Although the effects of AI on various social and ethical aspects are still unknown, the practical employment of generative AI technologies has been spreading in various sectors. In education, as in other fields, AI is expected to bring benefits but could also have undesirable effects. In most cases, smart technologies are employed to support people's work, and qualified personnel ensure oversight. Nevertheless, a new trend is already challenging the status quo, and new business models are being developed, overlooking the impact they may have on students' development. AI-powered teacherless classrooms are now available in several countries, like the UK and the USA. While AI-based solutions are expected to change society profoundly, the effect of AI teaching on students' skills has yet to be unveiled. Scientists are investigating the paradoxical nature of AI in education, discussing its beneficial and dark features [1]. Empirical studies on the quality of human vs AI-generated feedback on student tasks produce inconclusive results in certain areas of analytical and creative thinking [2, 3].

Traditionally, the sociocultural framework of schooling was proven to impact cognitive development significantly. The job content has changed, relying less on non-cognitive skills, while health and IQ (potential) have improved through generations. Furthermore, educational achievements are highly related to individual social status and societal economic growth. On the other hand, mass schooling influences individuals' neurocognitive maturation, as it regulates the age at which schooling begins, the education phases, methods, and content, and sets up expectations for independent learning. Schooling's sociocultural framework emphasises social interactions [4].

As established by research, schooling has certain effects on the brain, stimulating neuroplasticity (specialised learning develops specific brain areas, e.g., for spatial recognition, motor abilities, auditory, etc.). On the other hand, individuals with

neurodevelopmental conditions may require different ways of training. Schooling induces brain changes that are wider and deeper in literate vs illiterate individuals, the latter using different brain areas and skills to solve problems they are confronted with. For example, reading competencies are related to enhanced abilities for conceptualisation and interpretation [4].

Essential critical thinking skills students are taught traditionally include comprehending a reasoned argument and recognising erroneous or misleading assertions. To this end, one has to be sceptical about the reliability of the information source, its content, and the advanced conclusions. A fundamental factor grounding our true beliefs about the information we acquire is our trust in the source's reliability. Furthermore, the existence and extent of the supporting evidence should be critically assessed, and counter-evidence should be actively sought. According to Williams [5], a critical thinker should exercise an active and not passive role while analysing information or observing facts. One should recognise their inclinations, biases, and attitudes and try to remain objective when learning and applying what they have learned. In conclusion, students must develop their analytical skills to be able to master tasks associated with critical thinking and objectively assess the information quality in the learning and social environment.

Creativity is the outcome of an interplay between personal resources, techniques and skills, and internal motivation [5]. The individual resources could be the know-what and know-how a person has accrued over time, enhanced by novel manners, technologies, and abilities to employ knowledge. To create something, one also needs an intrinsic motivation aroused by interest, excitement, challenges, etc. The inclination to discover the truth, solve a challenging problem, take up new interests, uncover new insights from different fields, etc., can lead to new perspectives and approaches even to a stagnant issue. A disposition to playing games or avoiding overspecialisation could enhance it. Creativity can be triggered or amplified by seeing things from a different perspective, insightful exchanges between individuals with knowledge in different fields, restating a problem, unbounded thinking, etc. It can be argued, therefore, that ready-made “solutions” or reasoning offered by AI algorithms in the context of reduced social interactions could hamper students’ creativity.

2. Literature review

2.1. Envisaged benefits of AI in education

The AI classroom can leverage advantages provided by digital technology like ubiquitous availability, adaptative learning process (pace, modules, depth), and customised learning modules (according to preferences). It could also resolve challenges concerning learners’ gender and age, thus removing certain cultural barriers. An empirical study by Costa et al. [6] ran interviews with Psychology teachers in the USA and concluded that most of them utilise AI solutions (e.g., ChatGPT, Microsoft Copilot, Claude) as support in learning assignments. The primary motivation was to prepare students for future work environments and to enhance engagement and ethical and reflective use of AI.

Liu [7] posits that AI-supported blended learning can help develop analytical and creative abilities in students learning English as a foreign language by offering more autonomy, increasing motivation and pragmatism, and proposing new assessment methods.

Silapachote and Srisuphab [8] argue that introducing AI in engineering and computing classes enables practical problem-solving in an enjoyable manner through strategic AI games and quizzes and stimulating intellectual discussions. Kim and Kim [9] revealed that AI use in STEM disciplines as a model for scientific writing was perceived mostly positively as a teaching-supporting tool. However, some questioned the algorithm's transparency in making decisions.

Zheng et al. [10] examined the application of AI-assisted scenario simulation in medical students' learning about cardiovascular diseases. The empirical results showed improved student performance in both theoretical knowledge and clinical operations. Darvishi et al. [11] found that students' reliance on AI assistance supports task completion but does not lead to increased learning. Singh et al. [12] found, within the framework of a study involving American students, an increase in the accuracy, specificity, and utility of texts written with AI-provided hints. Nevertheless, the results were not statistically significant. Furthermore, students with better course performances returned comparable solutions. Overall, students did not express a preference for one method over the other, as they had enough motivation to learn independently. In practice, different methods with similar could be employed for different learners.

Huang et al. [13] took a qualitative analysis approach to study the impact of AI-supported teaching in a Chinese university and concluded that, under guided learning, such technologies enhanced personalisation, and student confidence and satisfaction. According to Zhi and Wang [14], teachers' psychological closeness and involvement, as well as the rapport between teachers and students, are positively associated with student engagement and motivation. The study showed that AI use marginally increases the latter (by 3%). In general, AI solutions can help teachers offer timely and personalised feedback that is adapted to students' needs. Advanced digital skills can translate into better use of technology to create a more dynamic and interactive learning environment.

2.2. Challenges related to AI in education

Various impediments affect the employment of AI solutions in teaching and learning, such as inconsistent policies, teacher and student proficiency in utilising such technologies, the AI's output quality, and ethical concerns [6].

In line with the prospects for the future of work, it is foreseeable that skills regarding collaboration and interaction with AI will be required sooner rather than later. At the same time, a fully AI-run educational space could generate other inequalities regarding competency standardisation or increase the digital divide. Since advanced AI classrooms are currently offered by private entities, the socio-economic aspects regarding access are a concern. Furthermore, language availability is still limited and advanced teaching technologies are not available to all.

One concern related to students' use of generative AI systems (e.g., chatbots like ChatGPT) regards the text output quality, which can be difficult to attribute and touches on academic and research integrity [15]. AI bots currently on the market (e.g., ChatGPT) can suffer from hallucinations, i.e., nonsensical statements [16]. Despite OpenAI's claims that ChatGPT

was developed to question incorrect premises and admit mistakes, AI's reasoning algorithms are obscure. In its technical report, OpenAI admits that ChatGPT 4, though capable of passing academic and professional exams at levels similar to top human performers, is not completely reliable, has a limited context range, can make simple reasoning errors, and does not learn from experience. Moreover, it can generate inaccurate information and harmful advice. Other foreseen risks include bias, disinformation, breaching privacy, facilitation of crime and security threats [17]. Researchers stressed the risk of bias and gender discrimination induced by smart technologies [18]. Another concerning phenomenon is the tendency to discriminate between educated and less educated enquirers. It became apparent that the AI algorithm provided lower-quality answers (this is known as "sandbagging") if the questions were written poorly (with typos, grammar errors, or seemed to have been copied from general-purpose sources) [19]. Discerning between pertinent and sound arguments and pseudo arguments can prove challenging, especially for untrained youngsters whose only goals are to finish their school projects quickly and without much effort and pass their examinations.

Researchers examined cases where AI systems engaged in regular, learned and not accidental user deception, as the algorithms were promoted to the market for business purposes (e.g., optimisation) instead of seeking truth [20]. Some of these cases were observed in games during AI training and involved cheating, manipulation, and repeating false beliefs. Moreover, organisations such as the FBI and Europol have already warned about the hacking of open-source AI for use in crimes, including scams, identity fraud, extortion, etc. [21, 22]. Governments undertake actions to prevent and combat the spread of cybercrimes on social media platforms [23].

Furthermore, as AI technology's maturity is still to be achieved, it cannot comprehend the text it produces and sometimes articulates nonsensical content, which can be harmful, especially for youngsters. Some known cases include a teen's suicide following interactions with Character.AI, a chatbot which allows users to develop life-like artificial personas that can be perceived as close relationships and become addictive [24]. Another recent incident involved Google Gemini chatbot, which suddenly answered a teen's unrelated question with the message "…You are not needed…..Please die" [25]. Such interactions can be particularly harmful for young, undiscerning users and vulnerable individuals.

3. Methodological considerations

This exploratory study examines the topic of AI teacherless classrooms, a new development in education. A literature review approach is justified in the first stage to gauge the theoretical and empirical framework for studying this matter and identifying trends and gaps. Inquiries were conducted in the Scopus and Web of Science databases, starting from the terms "AI" or "Artificial Intelligence" and "teacherless" and "classroom." No result was found. The search was then extended and refined to encompass research regarding the effects of AI in education by applying relevant criteria such as language (English), disciplines, sources and technologies for 2020 to 2024, as advanced AI tutoring solutions were previously unavailable. In the end, only 164 articles in the Web of Science database and 154 in Scopus were retrieved regarding the education field, as most of the extra

literature was represented by the computer sciences domain and included primarily conference papers. After checking the abstract, even less literature applied to our topic was available.

Given the lack of directly applying research, we continued by examining the online information about the newly introduced teacherless AI-run classrooms and revealing possible issues. Then, by extending the research framework to relevant aspects revealed by the limited literature on AI tutoring solutions in education, we highlight the main conclusions and establish future research avenues.

4. Discussion and conclusions

The first AI teacherless classroom in the United Kingdom started in September 2024 at David Game College [26], where twenty secondary-level students are educated on an AI platform by employing VR headsets. The tuition fee for the Sabrewing Programme is 27,000 £. According to the school's management, this way, students can benefit from individualised teaching, as AI can identify strengths and weaknesses more accurately than teachers. Trained "coaches" take care of the students' progression and wellbeing. Critics see the programme as an experiment and the school as seeking cheap teacher replacements while dehumanising education [27]. AI teacherless classrooms are provided in the USA by Alpha School in various locations. Similarly to the British college, the American school employs "guides" to oversee children's activities, not to teach them. Parents paying 40,000 $ per year rely on AI to teach their children. The school offers AI-led, one-on-one experiential learning, including life lessons such as running a small business with help from digital assistants [28].

The literature review on the effects of AI on students' skills revealed mixed empirical results, and the research is still very limited. Moreover, the critical literature assessing the available AI tutoring solutions from various perspectives, e.g., technological, regulatory, cognitive, educational, and ethical, highlighted several misgivings. Table 1 summarises the main identified benefits and challenges of AI in education.

Table 1. Overview of identified benefits and challenges for the AI classroom

AI teacherless classroom	Benefits	Challenges
	Adaptation	Social, psychological and cultural impact
	Customisation	Education for individuals with specific needs
	Instant access to knowledge	Impact on cognitive development effects unknown
	Entertaining	Impact on creativity and personal expression impact unknown
	Human-AI collaboration skills for future jobs	Passive learning and over-reliance on AI
	Neutrality and objectivity	AI reliability
	Increasing motivation to learn, engagement and confidence	Cybersecurity
	Teaching support	Transparency
	Ubiquitous availability	Digital divide
		Lack of/inconsistent regulatory frameworks

	Student and teacher digital skills Competency standardisation Language availability Ethical and legal concerns like academic integrity, privacy, discrimination, harmful content and crime facilitation Dehumanising teaching

Source: Author's own work

The extant AI applications used in education have important limitations. They cannot undeniably be considered reliable sources of information, do not provide accurate references about the source of the information they leverage to answer various queries, and their decision-making algorithms are not transparent. AI technologies are developed and trained using various online resources but lack the ability to distinguish sources supported by strong evidence and well-reasoned arguments since they cannot understand the context. Moreover, they are prone to errors, can spread misinformation, and facilitate crime. AI algorithm development is plagued by biases [29] and can spread misinformation and hate speech online, as Microsoft's Tay Twitter bot proved [30].

Given this context, the use of AI in education should be subject to better scrutiny, policies, and regulatory frameworks to guarantee the observance of ethical principles such as those provided by the EU AI Act (2024) to ensure security, accountability, and privacy [31, 32]. Norms for compulsory revealing the "identity" of the creators (human vs. AI) should be imposed [19]. In line with the EU AI Act [33], AI technologies for education pertain to the high-risk category and are subject to thorough assessment. They must comply with transparency and copyright requirements. AI-generated or altered content must be marked, and developers must prevent illegal use.

In education, high standards for AI technologies are necessary, considering their impact on human development and well-being, particularly the youth. Education institutions should carefully consider and implement adequate policies for AI employment to ensure positive outcomes in the learning process and prevent misuse. To this end, teacher and student skills in working with generative AI must improve. Given the development trends of AI technologies and the market context, one can expect an abundance of such solutions in the near future. Examining how the AI classroom could affect students' reasoning competencies and creativity is essential. Since the workplace of the future envisages extended employment of AI solutions and collaboration between AI and humans, students and job seekers, in general, should be acquainted with the advantages and disadvantages of AI algorithms and be ready to mitigate the latter [34, 35].

Before switching to teacherless AI classrooms, the influence of AI on students' cognitive and psychological development should be scientifically investigated. Research should assess the impact of AI applications on students' analytical competencies, creative and social skills, and ethical behaviours. Longitudinal studies should focus on the long-term effects of AI in education, while cross-sectional research could examine comparative student performance with and without AI assistance to reveal the motivations for adopting AI tutoring and its effectiveness in the learning process. Conceptual papers could develop

a framework for AI use in education, and its impact on teaching, and empirical research can determine the required competencies both students and teachers need for beneficial and safe utilisation of AI. Moreover, scholars should ponder the ethical aspects of AI use in education since academic integrity, bias and discrimination, and a new dimension of the digital divide are justified concerns.

References

[1] W. M. Lim, A. Gunasekara, J. L. Pallant, J. I. Pallant and E. Pechenkina, "Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators," *The International Journal of Management Education,* vol. 21, no. 2, p. 100790, July 2023.

[2] S. K. Banihashem, S. K. Banihashem, N. T. Kerman, O. Noroozi, J. Moon and H. Drachsler, "Feedback sources in essay writing: peer-generated or AI-generated feedback?," *International Journal of Educational Technology in Higher Education,* vol. 21, no. 1, p. 23, April 2024.

[3] M. Koivisto and S. Grassini, "Best humans still outperform artificial intelligence in a creative divergent thinking task," *Sci Rep,* vol. 13, no. 1, p. 13601, September 2023.

[4] D. P. Baker, D. Salinas and P. J. Eslinger, "An envisioned bridge: Schooling as a neurocognitive developmental institution," *Developmental Cognitive Neuroscience,* vol. 2, pp. S6-S17, February 2012.

[5] S. W. William, Making Better Business Decisions: Understanding and Improving Critical Thinking and Problem-Solving Skills, Califronia: SAGE Publications, Inc, 2001.

[6] C. Costa, N. Husain-Habib and A. Reiter, "Integrating AI Into Education: Successful Strategies, Ideas, and Tools From Psychology Instructors," *Society for the Teaching of Psychology,* 2024.

[7] C. Liu, "AI blended teaching in business English based on deep learning theory," in *2020 International Conference on Image, Video Processing and Artificial Intelligence,* Shanghai, 2020.

[8] P. Silapachote and T. Srisuphab, "Teaching and learning computational thinking through solving problems in Artificial Intelligence: On designing introductory engineering and computing courses," in *IEEE International Conference on Teaching, Assessment, and Learning for Engineering,* Bangkok, 2016.

[9] N. J. Kim and M. K. Kim, "Teacher's Perceptions of Using an Artificial Intelligence-Based Educational Tool for Scientific Writing," *Frontiers in Education,* vol. 7, p. 755914, 2022.

[10] K. Zheng, Z. Shen, Z. Chen, C. Che and H. Zhu, "Application of AI-empowered scenario-based simulation teaching mode in cardiovascular disease education," *BMC Medical Education,* vol. 24, no. 1, 2024.

[11] A. Darvishi, H. Khosravi, S. Sadiq, D. Gašević and G. Siemens, "Impact of AI assistance on student agency," *Computers & Education,* vol. 210, no. 1, p. 104967, 2024.

[12] A. Singh, C. Brooks, X. Wang, W. Li, J. Kim and D. Wilson, "Bridging Learnersourcing and AI: Exploring the Dynamics of Student-AI Collaborative Feedback Generation," in *Proceedings of the 14th Learning Analytics and Knowledge Conference,* Kyoto, 2024.

[13] H.-W. Huang, D. C.-E. Teng and J. A. N. Z. Tiangco, "The Impact of AI Chatbot-Supported Guided Discovery Learning on Pre-service Teachers' Learning Performance and Motivation," *Journal of Science Education and Technology,* November 2024.

[14] R. Zhi and Y. Wang, "On the relationship between EFL students' attitudes toward artificial intelligence, teachers' immediacy and teacher-student rapport, and their willingness to communicate," *System,* vol. 124, p. 103341, 2024.

[15] B. C. Stahl and D. Eke, "The ethics of ChatGPT – Exploring the ethical issues of an emerging technology," *International Journal of Information Management,* vol. 74, p. 102700, 2024.

[16] C. S. Smith, "Hallucinations Could Blunt ChatGPT's Success," *IEEE Spectrum,* 13 March 2023.

[17] OpenAI, "GPT-4 Technical Report," 4 March 2024. [Online]. Available: https://arxiv.org/abs/2303.08774.

[18] B. Zankova, “Smart societies, gender and the 2030 spotlight - are we prepared?,” *Smart Cities and Regional Development (SCRD),* vol. 5, no. 3, pp. 63-76, July 2021.

[19] E. Perez, S. Ringer , . K. Lukošiūtė, K. Nguyen, E. Chen and et.al., “Discovering Language Model Behaviors with Model-Written Evaluations,” *arXiv,* 2022.

[20] p. S. Park, S. Goldstein, A. O'Gara, M. Chen and D. Hendrycks, “AI deception: A survey of examples, risks, and potential solutions,” *Patterns,* vol. 5, no. 5, p. 100988, May 2024.

[21] M. Kan, “FBI: Hackers Are Having a Field Day With Open-Source AI Programs,” PC MAG, 28 July 2023. [Online]. Available: https://www.pcmag.com/news/fbi-hackers-are-having-a-field-day-with-open-source-ai-programs.

[22] Europol, “Chat GPT The impact of Large Language Models on Law Enforcement,” Europol Public Information, Luxembourg, 2023.

[23] A. F. Rahmat, C. Vrabie and G. B. Soesilo, “Exploring the Cybercrime Prevention Campaign on Twitter: Evidence from the Indonesian Government,” *Smart Cities and Regional Development (SCRD),* vol. 7, no. 2, pp. 9-24, 2023.

[24] K. Payne, “An AI chatbot pushed a teen to kill himself, a lawsuit against its creator alleges,” AP/Associated Press, 26 October 2024. [Online]. Available: https://apnews.com/article/chatbot-ai-lawsuit-suicide-teen-artificial-intelligence-9d48adc572100822fdbc3c90d1456bd0.

[25] M. Carroll, “Google's AI chatbot Gemini tells user to 'please die' and 'you are a waste of time and resources,” Sky News, 20 November 2024. [Online]. Available: https://news.sky.com/story/googles-ai-chatbot-gemini-tells-user-to-please-die-and-you-are-a-waste-of-time-and-resources-13256734.

[26] David Game College, “Introducing the Sabrewing Programme,” 2024. [Online]. Available: https://www.davidgamecollege.com/news-events-media/latest-news/item/840/introducing-the-sabrewing-programme .

[27] Independent School Management, “London independent school opens AI classroom,” 2 September 2024. [Online]. Available: https://independentschoolmanagement.co.uk/news/london-independent-school-opens-ai-classroom/.

[28] Alpha School, “A school where kids crush academics in 2 hours, build life skills through workshops, and thrive beyond the classroom,” [Online]. Available: https://alpha.school/.

[29] C. O'Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, Penguin Books Ltd. Kindle Edition, 2016.

[30] P. Lee, “Learning from Tay’s introduction,” Microsoft, 2016.

[31] C. K. Y. Chan, “A comprehensive AI policy education framework for university teaching and learning,” *International Journal of Educational Technology in Higher Education volume,* vol. 20, no. 1, 7 July 2023.

[32] N. Hashmi and A. S. Bal, “Generative AI in higher education and beyond,” *Business Horizons,* vol. 67, no. 5, pp. 607-614, 2024.

[33] European Union, “Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and,” 2024. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:L_202401689.

[34] Y. Walter, “Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education,” *International Journal of Educational Technology in Higher Education,* vol. 21, no. 1, February 2024.

[35] H. O. Khogali and S. Mekid, “The blended future of automation and AI: Examining some long-term societal and ethical impact features,” *Technology in Society,* vol. 73, May 2023.