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AI and STEM
Is it Possible to Merge the Two Worlds? Determinants and Perspectives

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Abstract
Over the last three decades, discussions, rhetoric, recommendations have proposed numerous suggestions for the integration of AI in Education (AI Ed). Research on AI Ed focuses on its goals, how it is applied in teaching and learning sequences, how it is perceived by teachers and students as well as by policy makers. Other issues closely related to AI Ed are: a) the difficulty in defining AI due to the interdisciplinary nature of the field, b) the possibility of AI Ed for learning that is more adaptive, inclusive, and engaging, c) the effective encompassment of assessment, d) the predictive tools AI Ed provides, e) the relation of TPACK with generative AI, f) the epistemology of STEM with the impact of AI, and also g) ethics considerations.

Keywords
AI, Education, Generative AI, STEM, TPACK

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Introduction
The term: Interdisciplinary nature
The term "Artificial Intelligence (AI)" is difficult to be defined as it connected to many and various cognitive areas, like Neuroscience, Psychology, Sociology, Biology, etc. (see, e.g., Otero et al., 2023; Russell, 2021; Russell & Norvig, 2021). It is also well justified that there is no a universal accepted definition of AI (see e.g., Wang, 2019; Bhatnagar et al., 2018; Monett and Lewis, 2018). AI has its roots in Statistical Physics and is based on concepts from Physics like entropy, the Ising model, the Complexity theory, the Chaos theory. Initially, the research on AI was focused on how the computers were comparable with the human mind (see e.g., Wang, 2019; Turing, 2007; Feigenbaum and Feldman, 1963).

Wang(2019) states that the definition of AI should be extended in order to include cognitive actions and more specifically the process of problem-solving using technologies like machine learning and neural networks. (Zawacki-Richter et al., 2019). According to (Zawacki-Richter et al., 2019), "*AI and adaptive learning technologies are prominently featured as important developments in educational technology in the 2018 Horizon report*" (Educause, 2018). Baker and Smith (2019) indicate that AI should be connected with cognitive tasks like the actions taken by human minds and in particular learning and problem-solving (as cited in Zawacki-Richter, 2019). They also signify that in AI technologies like machine learning, natural language processing, data mining, neural networks and algorithms are included.

AI and more specifically the generative AI(in the form of neural networks) will be "*integrated*" with Education. In this framework, it is necessary to recognize and explore the strength and weak points and how these will be combined with effective teaching and learning sequences. These issues include in *AI Ed* but are-sometimes- loosely presented to teachers and students. This raises some dangerous effects for a rather shallow use of AI. This makes it inevitable for teachers and students to use the technology and the algorithms in AI tools.

Generative AI (GenAI)
According to UNESCO (2023) "*Generative AI (GenAI) is an artificial intelligence (AI) technology that automatically generates content in response to prompts written in natural-language conversational interfaces.*" Dirkin and Mishra (2010) state that it is critical to make clear how the GenAI tools are substantially different from the technologies already used. This makes it inevitable to understand how these tools could have a fundamental impact on education. Interactions with GenAI occur through language and there is a clear difference from previous technological tools. In addition, this interaction is based on the history of communication between the user and the GenAI tool. Using GenAI tools, we can easily create visualizations of large sets of data and thus we can make decisions about education policies and the design of new curricula (Misra et al., 2023).

AI Literacy
Research in education suggests that the term AI literacy indicates the new digital skills related to AI (see e.g., Ng et al., 2021a, b; Su & Yang, 2022).

AI and personalized learning
Research endeavors on personalized learning indicate how AI can serve for the development of personalized tools for pedagogical frameworks. (Vorobyeva et al., 2025). Baker and Smith (2029) propose the so-called "*learner-facing tools*" as a form of such as adaptive learning platforms that adapt content to learners' strengths and weaknesses. Information for personalized learning is achieved from learners' learning style and other skills.

AI and TPACK
One fundamental question is related to how TPACK looks like and what it means in the age of GenAI. Mishra et al., (2023) discuss the TPACK framework in relation to the effective use of the GenAI tools.

AI and STEM
Personalized platforms using AI could play a fundamental role in STEM education Personalization plays a pivotal role by employing tailored instruction in alignment with learners' individual needs (Li et al., 2025). However, we consider that another fundamental issue is how to combine the STEM interdisciplinary approach with the inherent nature of AI. We propose a reform of the so-called transversal concepts (NGSS, 2013) which reflect the interdisciplinary nature of STEM in order to merge these with the interdisciplinary nature of AI.

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References

Baker, R.S. (2016). Stupid Tutoring Systems, Intelligent Humans. *International Journal of Artificial Intelligence in Education, 26*(2), 600–614. https://doi.org/10.1007/s40593-016-0105-0

Bhatnagar, S. *et al.* (2018). Mapping Intelligence: Requirements and Possibilities. In: Müller, V. (eds) *Philosophy and Theory of Artificial Intelligence 2017*. PT-AI 2017. Studies in Applied Philosophy, Epistemology and Rational Ethics, vol 44. Springer, Cham. https://doi.org/10.1007/978-3-319-96448-5_13

Casal-Otero, L., Catala, A., Fernández-Morante, C., Taboada, M., Cebreiro, B., & Barro, S. (2023). AI literacy in K-12: a systematic literature review. *International Journal of STEM Education*, 10, 29. https://doi.org/10.1186/s40594-023-00418-7

Dirkin, K. & Mishra, P. (2010). Values, Beliefs, and Perspectives: Teaching Online within the Zone of Possibility Created by Technology. In D. Gibson & B. Dodge (Eds.), *Proceedings of SITE 2010--Society for Information Technology & Teacher Education International Conference* (pp. 3811-3817). San Diego, CA, USA: Association for the Advancement of Computing in Education (AACE). Retrieved December 30, 2025 from https://www.learntechlib.org/primary/p/33974/.

EDUCAUSE (2018). Horizon report: 2018 higher education edition. Retrieved from EDUCAUSE Learning Initiative and The New Media Consortium website: Retrieved December 30, 2025 from https://library.educause.edu/~/media/files/library/2018/8/2018horizonreport.pdf

Feigenbaum, E.A., & Feldman, J. (1963). *Computers and thought*. McGraw-Hill.

Li, S., Zeng, C., Liu, H. *et al.* (2025). A meta-analysis of AI-enabled personalized STEM education in schools. *International Journal of STEM Education*, *12*(1), 58. https://doi.org/10.1186/s40594-025-00566-y

Mishra, P., Warr, M., & Islam, R. (2023) TPACK in the age of ChatGPT and Generative AI, Journal of Digital Learning in Teacher Education, 39:4, 235-251, https://doi.org/10.1080/21532974.2023.2247480

Monett, D., and Lewis, C.W. P. 2018. Getting clarity by defining Artificial Intelligence - A Survey. In Müller, V. C., ed., *Philosophy and Theory of Artificial Intelligence 2017*. Berlin: Springer. pp.212–214.

Ng, D. T. K., Leung, J. K. L., Chu, K. W. S., & Qiao, M. S. (2021a). AI literacy: Definition, teaching, evaluation and ethical issues. *Proceedings of the Association for Information Science and Technology, 58*(1), 504–509. https://doi.org/10.1002/pra2.487

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021b). Conceptualizing AI literacy: An exploratory review. *Computers & Education: Artificial Intelligence, 2*, Article 100041. https://doi.org/10.1016/j.caeai.2021.100041

NGSS Lead States. (2013). Next Generation Science Standards: For states, by states – Performance expectations and assessment rubrics. The National Academies Press. https://www.nextgenscience.org

Russell, S. (2021). The history and future of AI. *Oxford Review of Economic Policy, 37*(3), 509–520. https://doi.org/10.1093/oxrep/grab013

Russell, S., & Norvig, P. (2021). *Artificial Intelligence, Global Edition: A Modern Approach*. Pearson Deutschland.

Su, J., & Yang, W. (2022). Artificial intelligence in early childhood education: A scoping review. *Computers & Education: Artificial Intelligence*, Article 100049. https://doi.org/10.1016/j.caeai.2022.100049

Turing, A.M. (2009). Computing Machinery and Intelligence. In: Epstein, R., Roberts, G., Beber, G. (eds) *Parsing the Turing Test*. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6710-5_3

Vorobyeva, K. I., Belous, S., Savchenko, N. V., Smirnova, L. M., Nikitina, S. A., & Zhdanov, S. P. (2025). Personalized learning through AI: Pedagogical approaches and critical insights. *Contemporary Educational Technology,17*(2), ep574. https://doi.org/10.30935/cedtech/16108

Wang, P. (2019). On defining artificial intelligence. *Journal of Artificial General Intelligence, 10*(2), 1–37. Retrieved December 30, 2025 from https://cis.temple.edu/tagit/publications/PAGI-TR-9.pdf

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2023). Systematic review of research on artificial intelligence applications in higher education. I*nternational Journal of Educational Technology in Higher Education, 20*, Article 11. https://doi.org/10.1186/s41239-019-0171-0