

AI in learning: Intelligent digital tools and environments for education

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Artificial intelligence (AI) is changing the world. It is ubiquitous in almost all domains of life. We have applications of AI, for example, in medicine and healthcare, traffic and transportation, industry, and knowledge production, as well as in sport and entertainment. We can also see that AI will radically change teaching and learning in schools and educational institutions and extend educational settings for learning in and beyond the traditional classroom. AI also causes a radical disruption of work, arouses many fears and misunderstandings of its power, and will require deep changes in the concept of expertise and the nature of future innovations.

Beijing Normal University and the University of Helsinki have been engaging in productive cooperation in the Sino–Finnish Joint Learning Innovation Institute (JoLii) since 2016. One important theme of research cooperation has focused on AI. JoLii has organized workshops and conferences on AI-related themes since 2018, seeking to understand what AI means in learning and education. In these conferences and workshops, Finnish and Chinese researchers, along with researchers from the USA, have explored new scenarios of what AI means in learning. The joint triangle conferences for Intelligent Digital Tools for Learning and Education were organized at Stanford University in October 2018, the University of Helsinki in February 2019, and Beijing Normal University in June 2019. During these conferences and workshops, researchers emphasized the need to start research systematically and to understand how AI is changing human learning and educational settings, and how humans and machines are learning together. Researchers recognized that we are just at the beginning of research about AI in learning because changes will be so revolutionary. In education, interactive digital tools have been used for more than twenty years, and in fact, so-called teaching machines were available even in the early decades of the 20th century. However, tremendous developments in technology and machine learning have opened up totally new scenarios. Therefore, this special issue has been raised from these collaborative conferences and from the need to take the first steps in that research domain.

The call for the special issue was opened in autumn 2019. However, COVID-19 came in 2020 and caused

many delays in all academic activities because of the high pressure on scholars to work remotely in exceptional conditions. Even during this very stressful time, we were very privileged to find committed peer reviewers from Finland, China, and the USA. After rigorous reviews, seven articles were accepted for this special issue. Some of the articles focused more on learning processes (Li, Y. et al., 2021, this issue; Niemi & Niu, 2021, this issue), and some focused on teaching and pedagogy with intelligent digital tools (Chen et al., 2021, this issue; Li, B. et al., 2021, this issue; Stipancic et al., 2021, this issue).

Moreover, some articles seek ways in which schools and education should prepare students, educational institutions, and their teachers for AI-based learning environments (Timonen & Ruokamo, 2021, this issue; Väättäinen & Ruokamo, 2021, this issue). Furthermore, a commentary that reflects on the findings of these articles more deeply and on what we can learn from them draws a picture about AI from a learning science perspective (Niemi, 2021, this issue). It also brings into discussion ethical issues of AI in learning and education, as well as urgent questions of how we can create trustworthiness in AI use and make machine learning more explainable.

This special issue not only provides strong evidence of the changes that are coming to learning and education because of AI, but it also points out that we can prepare students and teachers for new learning environments and create new conditions for learning and education together.

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