AI4STEM Education Center
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AI-based Assessments in STEM Education Conference: Potential, Challenge, and Future

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Introduction. This conference brought experts in areas of STEM domain-specific learning, assessments and measurement, learning technologies, computer sciences, and pedagogy to discuss and address the challenges of applying AI in revolutionizing STEM assessments and identify future research directions. It generated knowledge of integrating AI-based STEM assessment practices with domain-specific learning theories, validity theories and assessment design principles, technology integration theories, and pedagogical theories focusing on assessment practices. By working with globally well-known experts in assessments, AI, and STEM education, this conference tackled the critical challenges in four identified areas. The participants shared empirical findings, as well as challenges identified in the research, with a broad audience. By collaborating together, the conference identified the potential solutions to the challenges and future research directions to increase the broad use of AI-based assessments in STEM education. The proceeding book, *Uses of Artificial Intelligence in STEM Education,* will be published by Oxford University Press.

Theme 1. AI and Domain-Specific Learning Theory

To better serve knowledge-in-use science learning, innovative assessments such as those involving AI should incorporate domain-specific learning theories. With learning theories developing for many years, these prominent advances, accompanied by the learning goals presented in the NGSS (NGSS Lead States, 2013), need to be incorporated into innovative AI-based assessment practices. Five chapters are included in the book.

Theme 2. AI and Validity Theory and Assessment Design Principles

Given that the involvement of AI may affect many aspects of assessment practices, it is essential to re-examine the validity theory that is commonly applied in conventional assessments. Without considering the validity risks, one may draw invalid conclusions from the assessment results. In this regard, Zhai et al. (2021a) have provided a framework to account for the cognitive, instructional, and inferential validity of ML-based science assessments. The framework could serve as a foundation for developing and validating future innovative assessments that are aligned with the NGSS (NGSS Lead States, 2013). We received four chapters in this theme.

Theme 3. AI and Technology Integration Theory

Technologies support the development of assessment practices. However, technology can be useful only if it is situated within authentic task scenarios and integrated with appropriate learning goals (Neumann & Waight, 2020). The development of effective AI-based assessment tasks should also follow principles so that the technology could serve the purposes of the assessment practices. Successful implementation of AI-based assessments should consider how to apply these principles to better integrate all technologies involved in the assessment practices. Four chapters were received on this theme.

Theme 4. AI and Pedagogical Theory with Assessment Practice

Research has indicated that teachers usually lack the necessary pedagogical content knowledge to engage students in effective assessment practices, particularly with regard to the NGSS-aligned innovative assessments (Harris et al., 2019). In the case when automatic feedback is available for students' scientific practices, teachers may need to consider and adjust their roles in teaching and identify approaches to better supporting students (Zhai, 2021). Empirical evidence is needed to understand how to effectively incorporate pedagogical theories with innovative AI-based assessment practices. We received nine chapters in this theme.

Theme 5. AI and Big Data

AI provides a unique avenue to tackling STEM education problems with complex constructs, various variables, and big data. Machine learning approaches in science education have shown great potential for solving problems based on big data set, with the potential to uncover cognitive processes, track learning trajectories, etc. We received two chapters on this theme.

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