

Learning Analytics for Personalization in Blended Learning Environments for Science Teaching

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by

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Summary

Blended learning provides rich opportunities for personalization, as it offers teachers and students a variety of learning activities of various modalities and communication channels to choose from. In sharp contrast to that, blended learning received much less attention within the Artificial Intelligence in Education research community than fully online learning environments, which are less suitable for K-12 education contexts. The present study addressed this gap by studying effective means for supporting personalized learning in K-12 blended-learning environments for science teaching. This was done both holistically by researching and developing system-level solutions, and reductionally by delving into specific aspects of these solutions .

To do that, the research started with studying K-12 science teachers' specific needs and difficulties in adapting their pedagogy and identified key pedagogical scenarios that can be enhanced by Artificial Intelligence-powered Technology (AI-EdTech). Second, the research proposed novel machine learning methods that provide the algorithmic backbone for implementing the identified pedagogical scenarios. Third, the research studied Learning Analytics (LA) applications that communicate the machine learning analysis to teachers. And fourth, the research identified the critical role that human factors play in teachers' successful adoption of AI-EdTech and

proposed the first-of-its-kind instrument for measuring teachers' trust in AI-EdTech. It also demonstrated how appropriate professional development programs (PDP) can prepare science teachers to work with AI-EdTech, raise their trust in AI-powered recommendations, and, as a result, increase their willingness to integrate such technology into their teaching practices .

A practical contribution of this research is two novel AI-EdTech tools: AI-Grader and GrouPer. AI-Grader is a tool for automated formative assessment of constructed responses to open-ended questions, the first to apply Natural Language Processing to automated assessment of open-ended questions in Hebrew. GrouPer is a teacher-facing LA tool for diagnosing students' knowledge profiles and assisting the teacher in assigning adapted learning sequences to each profile. Both tools are already integrated into PeTeL, a free learning management platform serving about a thousand science teachers in Israel, and are being used by over a hundred science teachers .

To conclude, the contribution of this study is three-fold. First, it presented a successful end-to-end research approach to the conceptualization, development, and deployment of teacher-oriented AI-EdTech, by incorporating science education, AI, and human-computer interaction into a holistic solution. Second, it identified trust as a key factor involved in the acceptance of AI-EdTech by teachers, provided an instrument for measuring it, and produced guidelines for AI-readiness PDPs. Finally, it led to the development of two AI-EdTech tools that already make a practical contribution to science education in Israel.