GENERALIZABLE FRAMEWORK FOR TRACING AND SUPPORTING SELF-REGULATED LEARNING IN K-12 DIGITAL LEARNING

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ABSTRACT

In parallel with the growing adoption of educational technology, personalization has come to focus as a means for improving the quality and effectiveness of the learning process (Kavčič et al., 2022; Li & Wong, 2020). Despite the acclaim that personalization through digital learning environments makes learning more meaningful, balances learner's interest and challenge, supports learner motivation, improves the creation of connections between different subject areas, and enables deep learning (FitzGerald et al., 2018; Li & Wong, 2019; Porath & Hagerman, 2021), several empirical studies also indicate that technological tools in education do not automatically lead to hoped results, and even hinder the actual learning (Bingham, 2017; Porath & Hagerman, 2021). It has been acknowledged that effective use of digital learning materials requires advanced self-regulated learning (SRL) skills (Kavčič et al., 2022). However, in many cases, adaptive educational technology takes the central role in leading the learning process without actively involving learners, which may harm the cognitive and meta-cognitive processes of SRL (Molenaar, 2022; Molenaar et al., 2021). This is particularly concerning as this hinders learner autonomy and the essential foundations of lifelong learning.

Over the last decades, the research focus on SRL has increased considerably (Panadero, 2017). SRL refers to the process where the learner actively leads one's learning process through planning, monitoring, and reflection across preparatory, performance, and appraisal phases of learning (Panadero, 2017; Puustinen & Pulkkinen, 2001). In parallel with the development of SRL conceptual frameworks, new approaches for measuring SRL are evolving. With AI and machine learning advancements, the focus is shifting from self-reported instruments towards extracting and interpreting online trace data based on real-time events, offering more objective and dynamic insights into SRL (Du et al., 2023; Molenaar, 2022). In this new wave of SRL measurement, intervention that supports SRL is intertwined with measuring the progress of students' SRL behavior (Panadero et al., 2016). This is closely related to open learner modelling (OLM), the computational process of visualizing trace data of a learner's knowledge and learning process, enabling better self-knowledge for a student (Hooshyar et al., 2020). However, approaches for

interpreting the trace data and using this as a basis for scaffolding the SRL process remain challenging and are the area of active research.

The purpose of the study

We will develop the learner modelling approach (e.g., Hooshyar, 2024) that supports student autonomy and effective learning of domain knowledge (i.e., Algebra 8th grade) while also scaffolding the development of SRL skills through opening the learner model that adaptively involves learners in regulating their own learning.

The following goals have been set:

1. To identify the most influential interventions for supporting SRL in K-12, and means for tracing and supporting SRL in digital learning environments.
2. To validate the SRL framework and interventions in digital learning environments to improve learning outcomes in the domain knowledge Algebra 8th Grade.
3. The goal is to develop a learner modelling approach and subsequently an open learner model that considers both domain knowledge (Algebra 8th grade) and self-regulated learning.
4. To evaluate the effectiveness of the proposed approach with a focus on the effect on learning outcomes, SRL skills, motivational beliefs and cognitive overload.

Methodology

To achieve the goals, a systematic literature review, a Delphi study to actively involve stakeholders, and several iterations with quasi-experimental research design are planned for developing the prototype that will be tested in OpiQ, the digital textbook provider.

Expected findings

As a result of this research a novel approach and a prototype for hybrid regulation for learning is developed. Hybrid regulation allows combining data with human insights, enabling real-time and adaptive transitions between teacher, learner, and technology (Molenaar, 2022). As a result, the learner's development is supported holistically, encompassing both the acquisition of domain knowledge and the learning of SRL skills.

Keywords: self-regulated learning, open learner modelling, hybrid regulation of learning, K-12 education.

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