Transdisciplinary perspectives on validity: bridging the gap between design and implementation for technology-enhanced learning systems

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SUMMARY IN ENGLISH

Technologies that help to enhance our educational environments can be found everywhere. Some examples are the electronic whiteboards and tablets that enhance classroom interaction, online peer feedback platforms that enhance student collaboration, and, as was the case in the GEIGER project forming the foundation for this dissertation, a mobile application that enhances the educational experience of SMEs trying to learn about cybersecurity. A question we can ask about technology-enhanced learning (TEL) environments is: Do they achieve what they were intended to achieve? We tackle this question by collecting, analysing, and structuring insights through a transdisciplinary approach resulting in artefacts with the potential to impact science and society.

When we ask what a TEL solution is intended to achieve, we touch on the phases of problem investigation and treatment design that form the first two elements of the engineering cycle. As part of our problem investigation phase, we develop a systematic review methodology called SYMBALS (Chapter 2), which we then use to investigate the problem domain for the TEL use case of GEIGER (Chapter 3). We use our findings as input for the treatment design phase, where we employ insights from behavioural theory to design an educational cybersecurity application for SMEs (Chapter 4) and demonstrate experimentally how this application can use external cyber threat intelligence to enhance the educational experience of users (Chapter 5).

In the third phase of the engineering cycle – treatment validation - we turn to the question: How exactly can we show that an intervention achieves what it was intended to achieve? In technical terms, how can we argue for the validity of a TEL intervention. Validity is a multi-faceted concept which is treated differently in different academic disciplines, and we need to recognise it as such. We begin by building a case for taking a holistic perspective in the validation of TEL, supported by a review of the literature and an epistemological analysis (Chapter 6). We expand on this case by conducting a systematic review to improve our understanding of the validity criteria landscape in TEL (Chapter 7), and then combine our earlier insights with a multi-grounded action research approach to develop a comprehensive validation framework for TEL solutions (Chapter 8).

Treatment implementation constitutes the fourth and final phase of the engineering cycle; a phase that can potentially initiate a new cycle, with a new problem and new research questions. We demonstrate through technical experiments and expert interviews how federated learning, a privacy-preserving machine learning technique, could yield an improved implementation of solutions such as GEIGER, by preserving student privacy in educational environments (Chapter 9).

This dissertation represents a pivotal first step towards holistic TEL validation. Validation that aids accelerated, but also responsible and trustworthy, impact. If our validation strategies are misguided, our innovations will follow this misguided path. We cannot accept such a future.