

DEVELOPING A CURRICULUM FOR TEACHING ARTIFICIAL INTELLIGENCE LITERACY TO EDUCATORS

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Abstract

This paper addresses the burgeoning need for artificial intelligence (AI) literacy in the educational sector. We propose a novel curriculum designed to foster AI understanding among teacher educators. The curriculum is developed in collaboration with experts, drawing from a renowned competency model for AI literacy. It will first be implemented in a professional development course at the St. Gallen University of Teacher Education. The curriculum's effectiveness will be evaluated using a validated AI literacy test, also based on the same competency model. Additionally, a validated self-assessment scale for AI literacy and AI readiness will be employed for further evaluation. The presented study adopts a design-based research methodology, allowing for iterative development and evaluation of the curriculum. This approach ensures that the curriculum evolves through successive training cycles, integrating feedback and findings to enhance its relevance and impact. Moreover, the design-based research study aims to make significant contributions to practice and theory of AI literacy in education, addressing a critical gap in teacher professional development.

Keywords: AI literacy, curriculum development, design-based research.

1 INTRODUCTION

In the rapidly evolving landscape of technology, artificial intelligence (AI) has emerged as a pivotal force driving innovation and transformation across various sectors. As we navigate through this era of digital revolution, AI literacy becomes a critical component, especially in the field of education [1, 2]. Since AI continues to permeate various aspects of life, the role of educators in shaping the next generation's understanding and use of AI becomes paramount. This paper argues that AI literacy is no longer a luxury but a necessity for educators. Therefore, a strategic approach to integrate basic knowledge concerning AI into teacher training and professional development programs is needed.

In this paper, we will adopt the definition of AI literacy from Long and Magerko, who "define AI literacy as a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace." [3, p. 2]. At the tertiary level, understanding AI means being able to describe problems clearly and accurately. It is also important to understand how different problems are connected and how to apply effective methods to solve them. Lastly, knowing about specific aspects of problems, like how complex they are, is crucial for AI literacy at the university level [4].

A current systematic literature review [5] on AI in education detected a lack of teachers' knowledge on AI technologies. This lack of understanding hinders their ability to respond to student inquiries about AI and limits their effective use of AI for learning, teaching, and assessment purposes. Hence, the authors of this systematic literature review suggest future research to investigate how to foster AI literacy among educators and help them using AI for educational purposes. There are existing programs that focus on fostering AI literacy, but most of them target students [6, 7] and programs for teachers are scarce [8]. An AI literacy curriculum specifically designed for teacher educators is still lacking. To address this gap, in this paper we are investigating the question: What is an appropriate curriculum aiming at fostering AI literacy among teacher educators?

This paper is organized as follows: the next section outlines the methodological framework, which is then followed by a detailed presentation of the curriculum. In the end conclusions are drawn and future research activities are described.

2 METHODOLOGY

We have adopted design-based research [9, 10] as our methodological framework. According to Wang and Hannafin [9] design-based research is characterized to be (a) pragmatic, (b) grounded, (c)

interactive, iterative and flexible, (d) integrative and (e) contextual. In our research endeavor, we leverage the five key characteristics of design-based research to enrich both theory and practice. Firstly, our approach is pragmatic, aiming to contribute to both theoretical development and practical application simultaneously. The design of our research is grounded in relevant literature, such as the established competency model of AI literacy proposed by Long and Magerko [3], and is implemented in a real-world setting. The presented research project is interactive, iterative, and flexible, which is reflected in the collaborative development of the curriculum with content experts and practitioners, and an iterative cycle of analysis, design, implementation, and redesign. Moreover, our approach is integrative, employing various research methods and instruments throughout the entire research process. As the research evolves, applying mixed methods may be beneficial. Finally, our approach is contextual: We document the entire research process, including necessary adjustments to the initial plan, and the developed curriculum as well as the design principles are based on our specific setting.

2.1 Setting

The research project will be conducted at the St. Gallen University of Teacher Education in Switzerland, where the newly developed curriculum is scheduled for its initial implementation. This setting offers an ideal opportunity to evaluate the curriculum's effectiveness in a real educational context. The first application of this curriculum is in a professional development course about artificial intelligence at the tertiary level that started in December 2023. In this initial phase, 22 teacher educators are participating. This group of participants enables us to gain an initial understanding of the curriculum's impact. Additionally, this group of educators, with their diverse experiences and pedagogical insights, will not only engage with the curriculum but also contribute to its iterative refinement. The insights gained from these educators will be crucial in assessing the curriculum's efficacy and tailoring it to better suit the needs of its users.

2.2 Instruments

In this design-based research, a variety of instruments are employed to measure the effectiveness of the curriculum and its impact on the participants of the professional development course. A key instrument is the validated AI literacy performance test, developed by Hornberger and colleagues [11], which is utilized as both a pretest and posttest. This test is based on the AI literacy competency model of Long and Magerko [3] and designed to quantitatively measure any increase in participants' AI literacy competencies, providing a clear metric of the curriculum's effectiveness.

Additionally, a validated self-assessment scale, known as SNAIL (scale for the assessment of non-experts' AI literacy), developed by Laupichler et al. [12], is used as a posttest instrument. This scale allows participants to self-evaluate their comprehension and confidence in AI literacy, offering insights into their subjective learning experiences and perceived growth.

Furthermore, selected items from a study by Wang et al. [13] are incorporated to assess teachers' AI readiness. These items are specifically chosen to gauge the preparedness and attitude of educators towards integrating AI into their teaching practices. The combination of these instruments provides a comprehensive assessment framework, encompassing both objective and subjective measures, to thoroughly evaluate the impact of the curriculum on teacher educators' AI literacy and readiness.

It is important to note that in addition to the primary instruments mentioned – the AI literacy performance test [11], the SNAIL [12], and the specific items regarding AI-readiness [13] – the methodology remains open to the integration of other instruments and research methods as necessary. This flexibility is essential in design-based research, allowing for adaptations and enhancements to the evaluation process in response to emerging needs or unforeseen challenges. Such adaptability ensures that the research remains comprehensive and responsive, thereby providing a more robust and accurate assessment of the curriculum's impact on AI literacy and teacher AI-readiness. This approach underscores the iterative and responsive nature of design-based research, where tools and strategies can be modified to better align with the evolving context of the study [10].

3 CURRICULUM PRESENTATION

In this section, we will introduce the curriculum, including its learning objectives, the instructional approach, the content, as well as the resources and materials that will be utilized, providing a comprehensive overview of how this curriculum aims to enhance AI literacy among educators.

3.1 Learning objectives

The learning objectives for the participants in this program are multifaceted and encompass a range of competencies in the realm of AI. Firstly, participants will gain an understanding of the fundamental concepts of AI and its operational mechanisms. This foundational knowledge will be extended to explore various application fields of AI within the context of education, enabling the participants to identify and understand how AI can be integrated into educational settings. A key component of the program involves developing proficiency in the efficient use of AI generators, specifically in the area of prompt engineering, which focuses on designing input instructions to achieve desired outputs. Moreover, a critical component of the curriculum is the assessment of the potential benefits and risks associated with the use of AI in higher education. Participants will engage in critical discussions and analyses to draw meaningful conclusions for the design and implementation of AI at the tertiary level. Finally, the program includes practical elements, where participants will experiment with selected AI applications in their own university teaching settings, allowing them to apply their learned skills and knowledge in real-world scenarios.

3.2 Instructional approach

To support the participants in achieving the learning objectives, we use the research based *Tell Show Enact Do* (TSED) instructional approach [14].

The TSED approach is based on the need to combine different learning events to ensure effective instruction [15]. Tell (T) learning events deliver knowledge on the course topic. This is mostly done by a teacher or via instructional media like books or videos. Show (S) learning events present examples how experts use the course knowledge to solve problems. Enact (E) describes learning events in which learners gather authentic experiences on the course topic. In Do (D) learning events the learners perform activities, which require in-depth engagement with the course content.

Figure 1 shows how the TSED approach is embedded in the blended learning scenario of the presented course. At the kick-off event as well as in the online learning phase information on AI is presented (T). In the following face-to-face learning phase instructors demonstrate how AI can be used in the classroom by showing real-world-examples (S). Next, learners test AI learning materials and teach a lesson with AI in the trial phase (E). In the second face-to-face learning phase of the course learners reflect on their lesson and get feedback from their peers and the instructors (D).

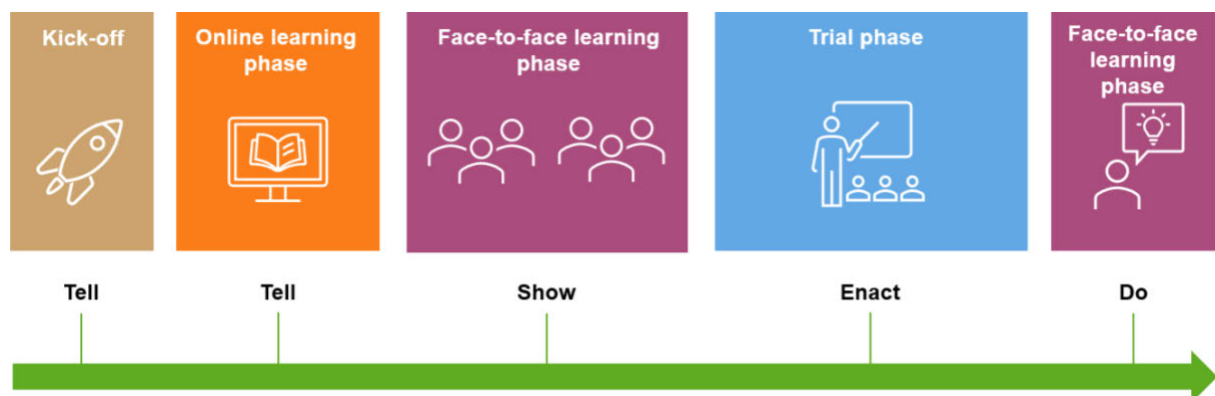


Figure 1. Embedding of the TSED approach in the blended learning scenario.

3.3 Content

For setting up the content of the presented professional development program, a literature review was conducted to identify key concepts that have been integral to the success of similar programs in this domain. Furthermore, our content experts contributed additional significant topics for our target group, thus enriching the curriculum's scope and depth. Table 1 provides an overview of the course content, which has been thoughtfully developed to enhance AI literacy. Notably, the course is structured to align with all the competencies regarding AI literacy outlined by Long and Magerko [3], ensuring its relevance and alignment with contemporary educational standards. Table 1 also delineates the respective AI literacy competencies associated with each course module.

Table 1. Course Overview and Competency Mapping.

<i>Module</i>	<i>Content</i>	<i>Addressed competencies</i>
Module 1: Introduction to AI	Fundamentals of AI: Definitions, AI technologies, and applications History of AI Overview of various AI techniques and applications	Recognizing AI Understanding intelligence Interdisciplinarity Generals vs. Narrow Representation
Module 2: Data literacy	Collection, processing, and storage of data in AI Different types of data (structured, unstructured, and semi-structured data)	Data literacy Learning from data Sensors
Module 3: Machine learning (ML)	Fundamentals of ML: Supervised, unsupervised, and reinforcement learning Algorithms of ML (e.g., linear regression, decision trees, k-nearest neighbor) Evaluation of ML Models (e.g., accuracy)	Decision-making ML steps Human role in AI Programmability
Module 4: Deep learning and neural networks	Fundamentals of deep learning Structure of neural networks Training deep learning models Applications of deep learning	Action & reaction
Module 5: Ethics and responsibility	Ethical aspects in AI research and application Bias and fairness in AI systems Data protection and security in the context of AI	AI's strengths & weaknesses Critically interpreting data Ethics
Module 6: AI in education	Adaptive learning systems and personalization AI-supported assessment and feedback Advantages and disadvantages or challenges of AI applications in education Prompting Current developments in AI: Research, innovation, and trends	Imagine future AI

3.4 Resources and materials

The resources and materials for the professional development program are primarily given in an online course designed for the self-regulated learning phase (see Figure 1). This course is structured to provide a comprehensive understanding of AI through various mediums. Participants are expected to dedicate approximately eight hours to engage with these resources, which include a diverse range of educational materials such as instructional videos, in-depth textual content, and interactive websites. These materials are carefully curated to offer a multifaceted perspective on AI, catering to different learning styles and preferences. The online format not only facilitates flexibility and convenience for the participants but also ensures that they have different opportunities to delve deeply into the subject matter at their own pace, thereby enhancing their learning experience and ensuring a thorough grasp of AI concepts and applications in education.

4 CONCLUSIONS

To sum up, the presented research embarks on the critical mission of enhancing AI literacy among teacher educators. Based on a literature review we designed and implemented a curriculum, tailored to embed AI knowledge and skills relevant to the educational sector.

The design-based research approach is providing us with a flexible methodological framework. It allows us to adaptively tweak the course content and the instructional design in response to emergent needs and feedback. As this research progresses, we anticipate further modifications to the curriculum. These adjustments will aim to align more closely with the evolving landscape of AI technology and its pedagogical applications. A significant theoretical contribution of this research will be the development of design principles for setting up AI literacy courses for educators. These principles could be seen as a further development of the design principles for AI courses presented by Long and Magerko [3].

While this paper marks an initial step towards AI-enabled education, it also opens avenues for further research. For instance, the curriculum could be implemented and refined in other contexts. Continuous exploration and innovation are essential to keep pace with the rapidly evolving field of artificial intelligence.

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