

Development of an Online Teacher Education System for Designing AI-integrated Lessons

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This study aims to develop an online system called AIESTEP (AI for Elementary and Secondary Education Platform) to support teachers in designing AI-integrated lessons for a teacher education program. The online system provides learning content and hands-on experiences, such as taking notes and reflecting on the learning content, reviewing existing cases, practicing data analysis and simple coding, and designing courses. The online system was tested through two pilot-tests with 96 practicing teachers and was revised based on the results of the pilot-tests.

Introduction

Integrating Artificial Intelligence (AI) in education will lead to another educational innovation. AI technologies have potential to influence the future of learning, whether positively or negatively (Roschelle et al., 2020). It is a matter of how we use AI technologies. In a good way, AI can support and guide students to discover their potential and enhance their competencies needed for the future society (Niemi, 2021). AI can also assist teachers in facilitating students' learning and creating authentic experiences (Matsuda et al., 2020; Pelletier et al., 2021). However, adapting AI technologies in education requires overcoming the challenges of the current educational context, such as lack of comprehensive policies for AI-powered education, teacher preparation, development of quality data systems, and ethics and transparency in data collection (UNESCO, 2019). Among these challenges, this study focused on teacher preparation on AI in education. Considering the positive impact of AI, there are many AI-based learning systems designed to assist students. However, there are not many systems available yet to help teachers (Office of Educational Technology, April 23, 2022). Teachers need time and resources to enhance their own experiences and competencies related to using AI in education.

Meanwhile, Korea has implemented a nationwide project in 2022 to enhance teachers' competencies in understanding what AI is and how it can be used effectively and efficiently in education. One of the primary goals of the project is to develop a teacher education program and an online system, and to implement the program for in-service teachers in K-12 education. The online system was developed as a supporting system that offers all users necessary information and practice skills for designing AI-integrated lessons in K-12 education.

The development of computer systems to support individuals' performance is not new. Electronic Performance Support Systems (EPSSs) are well-known systems that improve users' performance and provide on-the-job training. EPSS is popular in the corporate world (Mott-Wilburn, 2020). Although EPSS is not very popular in the education field, Moore and Orey (2000) developed and implemented an EPSS in an educational setting. The development of EPSS has been incorporated into the automated instructional design (ID) process although they provide different functions and elements of instructional development. However, they pursue the same goals to support educators and instructional designers for developing effective and efficient educational performance. Most EPSSs in the existing studies work for narrow and specific domains and results (Spector & Ohrazda, 2004; Sezer, 2021). There is a continuing need to develop support systems for learning and performance in education fields. This study highlights the potential of EPSS in the educational setting, especially for teacher education, and incorporates EPSS into AI technologies.

Many existing systems deliver teacher education courses with video and print-based materials. For example, Online Teacher Training supported by Oxford University Press, Coursera, Udemy, and K-MOOC in Korea provides digital content with short interactive videos, quizzes, and activities. In most lecture-oriented online systems, participants become passive learners most of the time. Not many online systems provide hands-on experiences for teachers to design lessons and courses. Teachers, as learners in training courses, need to actively design lessons and courses.

In this study, we developed a teacher education program and online education system to enhance teachers' competencies for designing AI-integrated lessons, which is called the AIESTEP (AI for Elementary and Secondary Education Platform). The online system provides opportunities for participants to actively engage in the training by taking notes, reflecting on the learning contents, reviewing existing cases, and practicing course design in the ID process. The training course in this study aims to enhance teachers' abilities to use AI tools and techniques in educational settings. The system allows participants to directly practice using AI and digital tools during the training. Participants can work through the ID process while they design the AI-integrated lessons, and then they can develop a lesson plan that can be implemented in their educational practices. During the training sessions, participants have chances to reflect their own learning and reviews learning outcomes produced by other participants. Finally, unstructured data generated by teachers is analyzed using artificial intelligence techniques to help them design lessons.

Purpose Statement and Research Questions

This study aims to develop an online teacher education system for designing AI-integrated lessons. The research questions are as follows: 1) What are the basic principles to support teachers in designing an AI-integrated lesson? 2) How do participants experience the online system that supports designing an AI-integrated lesson? To answer these questions, we developed an online system and analyzed participants' learning results produced throughout the teacher education program.

Methodology

We applied a rapid prototyping method to the instructional design model to develop the online teacher education system. First, we analyzed existing studies and operating online learning systems. Second, we developed a prototype of an online system that supports AI-integrated instructional design, and modified the online system based on reviews by professors, researchers, and teachers. Third, the system was pilot-tested with a total of 92 in-service teachers. The evaluation of the teacher education program and system was conducted in three ways: a participant satisfaction survey, an analysis of learning products, and participant interviews. Between the two pilot-tests, revisions of the online system were made.

Results

As a result, the teacher education program was structured into two domains and 10 sections. The first domain focuses on understanding AI, and includes basic knowledge and skills on AI technology and data science, as well as ethical issues related to AI. The second domain is focused on how to design lessons with AI, and covers core steps for designing lessons such as defining learning objectives, selecting relevant learning content, teaching and learning strategies, and assessment strategies.

The AIESTEP was developed based on the teacher education program, and the following principles were applied to support teachers in designing AI-integrated lessons. First, participants need to work on an authentic task. Second, they can access various information and resources related to lesson design. Third, design guidelines as scaffolding strategies are provided throughout the design process. Fourth, collaboration with other participants is recommended. Fifth, participants can use AI's suggestions on learning topics, questions that provoke students' thoughts, and teaching materials. The system is divided into four main modules: 1) AI basics, 2) Introduction to instructional design, 3) Lesson design, and 4) Showcase. The AIESTEP provides tutorials for knowledge and skills for AI and ID process, examples for AI-integrated lesson plans, resources useful for designing the lessons, and tools for designing the lessons as shown in Table 1. Table 2 indicates main activities of the ID process that participants can perform to design the AI-integrated lessons using the online system.

Table 1

Key components of the online system

Components*	Detail of component
Tutorials	Definition and basic principles of AI Data collection and analysis ID process Digital tools
Examples	AI-integrated lesson plans
Resources	National curriculum Learning materials
Tools	Templates of ID

* The name of the components was adapted from the study by Ugur-Erdogmus & Cagiltay (2018)

Table 2

Main activities of the ID process supported by the online system

ID process	Main activities
Analysis	- Analyzing learning content - Identifying learning setting including learning time and places, and digital devices and tools
Design	- Stating learning objectives - Selecting teaching and learning methods - Selecting evaluation methods before, during and after lesson
Development	Selecting or developing teaching and learning materials
Implementation	After training, carrying out the lesson and taking video clips
Evaluation	Peer evaluating in teacher communities of practices

The AIESTEP was developed using a Python web-framework. The AI technology applied to the system is LLM (Large Language Model). It is designed to receive keywords from users and to make prompts automatically based on the entered keywords, thereby generating the expected information. AI technology is applied to suggest four things useful for lesson design: 1) Academic standards written in the national curriculum requested by teachers as users; 2) Multimedia resources relevant to learning topics selected by teachers; 3) Questions that provoke learners' thoughts relevant to the learning topics; 4) Teaching materials for the learning topics.

Referring to the research question 2, we analyzed participant experiences with a survey, learning product of the teacher education program. First, the satisfaction of the participants with the education program and system was rated at 4.68 out of 5 in total. Second, reflection notes written by participants indicated the difficulties and benefits of the ID process supported by the online system. Some difficulties that the participants faced are lack of time to design a lesson in collaboration with other teachers with different subjects, linking knowledge and skills of AI to school subjects, designing learning strategies adaptive to learners, and combining the learning topics of different subjects to one integrated topic. However, they pointed out some benefits, such as the impressive experience of the online system to support the training, reflection with note-taking throughout the whole process, collaborating with other teachers, and saving and retrieving the learning results during training. Third, the participants rated their lesson plans based on the suggested criteria on the quality of the AI-integrated lessons. Their self-assessment resulted in 4.91 out of 5 in total.

Based on the participant reflection and learning products, we revised some learning content and functions of the system. For example, we developed and provided more online content for explaining the knowledge and skills of AI and data science, and added more exemplary cases of AI-integrated lessons. Also, we specified some guidelines about how to combine content about AI with school subjects.

Conclusions

There is no doubt that integrating AI in education can transform current education. It is a matter of how we incorporate AI in educational settings. In this study, we developed an online system that aims to help teachers learn about AI and design lessons with AI. One of the biggest limitations in the system was to focus less on learners in the design process. Although the training program in the study included learner analysis and guided learner-centered design, the online system had little function to support learner focus in AI-integrated lessons. For further studies, the AIESTEP developed in the study must be validated on a larger scale. To enhance the efficiency and effectiveness of the AIESTEP, generative AI technology should be applied to automate all steps and activities of the ID process. Using the Langchain framework, every data produced by teachers and students can be used for designing quality courses and lessons, and developing various educational resources with multi-modal formats.

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