Artificial Intelligence in Education as Lifelong Learning: What Should be Learnt?

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Abstract: The rapid development of tools and techniques in the field of Generative AI (GenAI) has affected many sectors. One of these sectors is definitely education, where teaching, learning, assessment, curricula and policy document need to be revised and updated. Many research studies also highlight the necessity for teacher professional development regarding Artificial Intelligence in Education (AIED), as AIED is also a field under constant development and will need continuous upskilling during the coming years. There are now teacher training courses in fundamental AIED available, and more are under development. There seems to be a consensus regarding what an introduction course in AIED should comprise, but not regarding which topics continuation courses should follow-up related to continuous lifelong learning. With the heutagogical idea of asking the learners about what to learn, this question was posted to participants in a course on fundamental AIED. In a discussion forum, course participants gave their suggestions and commented on other course participants' postings. Moreover, the forum postings were supplemented with suggestions and comments from email conversations between the authors and course participants. According to the concept of Open Coding, forum postings and email conversations were analysed and divided into the categories of: AI didactics, GenAI tools for teaching, Prompt engineering, Audio generation and Voice cloning, Customisation of AI models, AI and disinformation, Applicable takeaways and AI sustainability and ethics. All of the categories were found to be relevant in a second Axial coding reanalysis. The category Applicable takeaways was found to be the axial category that ties all of the categories together for a meaningful course design. The conclusion is that a continuation course, as in introductory courses on AIED, must contain both theoretical parts with themes such as AI sustainability and ethics, but also concrete applications such as AI didactics to fulfil the aim of Applicable takeaways. Finally, it could be difficult to involve all the categories in just one or two continuation courses. However, as mentioned earlier, AIED should to be seen as continuous lifelong learning.

Keywords: Artificial Intelligence in Education, AIED, AI, Lifelong Learning, Teacher Professional Development

1. Introduction

The current Artificial Intelligence (AI) spring, with a rapid development of Generative AI (GenAI) tools affects different areas to different extents. The same is true for professional development in AI and GenAI. In more technical areas, there is a need for specialised training with a specific focus on AI tools and techniques. This paper has a focus on general teacher professional development in Artificial Intelligence in Education (AIED). Several research studies have highlighted the need for broader professional development that involves subject matter experts, teachers and instructional designers (Kumar et al. 2024; Meli et al. 2024). There are also research studies pointing out the necessity for continuous professional development in AIED (Meli et al. 2024; El Din 2025; McGury et al. 2025), and that professional development is best provided on an institutional level (Bannister & Carver 2024). In recent years, the advancements of AI have had direct impact on all levels of education (Tyson & Sauers 2021). Fullan et al. (2024) point out the strong potential of AI, involving “enormous potential to improve learning, teaching, pedagogical innovations, assessment, and educational administration through intelligent tutoring systems, chatbots, robots, learning analytics dashboards, adaptive learning systems and automated assessment” (p 340). However, Neumann et al. (2023), see challenges and opportunities in AIED. Challenges involve the limited knowledge of how students utilize AI, uncertainties in evaluating AI in school, varying perceptions of acceptable use, increased time demands for assessments, and the unknown potential of AI. Conversely, opportunities lie in enhanced student support, fostering creativity, and potential for driving and advancing educational innovation. This means that AI introduces a wide range of ethical, moral, and practical challenges for all actors in education (Strzelecki 2023).

Many universities have been rapid to respond to these calls for professional development in the past few years and have launched teacher training courses on fundamental AIED as a form of professional development. These courses have been implemented and are now more under development. There seems to be a consensus on the need for introductory courses and a fundamental content in AIED for educators on all levels. However, which

topics the continuation courses should provide in follow-up courses is unclear. According to the heutagogical idea of asking the learners about what to learn, the question was posted in a course on fundamental AIED at one university, which is described in the next section. What course participants found to be important topics for further learning was also discussed in webinars at the end of the course, in order to capture the need for new content in a continuation course.

The main research question to answer in the study was: "What topics are important to involve in continuing courses on artificial intelligence in education?". Moreover, this paper also presents ideas for how this learning should be structured, employing Communities of Inquiry (CoI) and the ideas of shifting professional development to institutional development.

2. The Introductory Course

The introductory course was designed and developed to be run as a 7,5 ECTS standalone distance course open for all persons with general entry requirements for higher education. In the first two course iterations, the majority of participants were working in different educational contexts, and many of them were working full-time. A course that is given at a department of education should have a focus on pedagogical and didactical aspects of education or AIED. However, to better understand the more general aspects of AIED, the course was also outlined to involve technical, administrative and ethical aspects of AI. Early in the course development process, the course was divided into four main sections:

1. Introduction and tool testing
2. AI in Education
3. Multimodal AI
4. Discussion webinars as knowledge cafés

To support the course sections above, the course was designed to involve a mix of teacher-led synchronous activities, online workshops, group discussions, and asynchronous self-studies. Moreover, these activities and six mandatory assignments were created to meet the learning objectives that are listed in the section below.

The overall aim of the course was to present, discuss and apply fundamental tools and theories in the field of AIED. After course completion, the participant should be able to:

- Understand and explain the history and development of AI and AIED
- Analyse and discuss the main opportunities and challenges of AIED
- Evaluate and discuss different tools for detection of AI generated texts
- Explore and apply different GenAI modalities such as text, images, sound and music
- Compare, discuss and reflect over how GenAI could affect and enhance teaching and learning activities and assessment in various educational contexts

A course that was built around the overall objective of combining practical and theoretical aspects of AI for a deeper understanding of AIED was expected to be useful even after course ended (Mozelius 2025).

3. FAITH – Institutional Development

In the Swedish context, the case presented in this paper is an institutional development project called Frontline application of Artificial Intelligence and Technology-enhanced Learning in Higher education (FAITH) (Mozelius et al. 2024). This project is located at the Department of Education, Mid Sweden University and runs for three years. The project focuses on developing new teaching practices and courses by implementing AI tools in the department's educational operations. Teachers at the department are involved in several activities to support the defined goals of the project. The main activities in the institutional development plan include participating in a professional development course held by AIED experts; creating a development plan, including a design that implements AIED; implementing the plan in courses; learning from try-outs and reiterating lessons learnt the next try-out. The results of the try-outs are also discussed and disseminated at institutional development seminars. In the project, the teachers involved develop new courses and revise existing courses.

FAITH is also a professional development project running between 2024-2026 with the aim of stimulating the further development of institutional teaching and education programs. In the project, teachers and department staff are expected to work and develop educational operations to adapt to the emerging field of AI. The integration of AI and technology-enhanced learning is a main objective, and the FAITH project will take advantage of ongoing higher education pedagogical development initiatives with collaborating universities. Thus, the

project strives to increase the understanding and competence in AI and technology-enhanced learning (Jaldemark et al. 2024). In professional development efforts, design-based research is a key methodology which involves iterative and cumulative development processes (Jaldemark, Håkansson Lindqvist, & Mozelius 2019). The project consists of three phases: preparation, implementation and evaluation. Preparation included detailed planning, forming a steering group, and recruiting key competencies for the group team. The project team involves a mix of AI and technology-enhanced learning experts and program managers. All of the members of the project team will implement and evaluate the project to achieve both educational and institutional development.

4. Teaching AI in Education Through the Lens of a Critical Community of Inquiry

In the evolving landscape of post-secondary education, the rise of generative AI brings both promise and complexity. For graduate students in education—experienced, pedagogically grounded, and future-focused—this moment offers a unique opportunity: to shape not only how AI is used in the classroom, but also how it is understood, critiqued, and ethically applied across disciplines.

As AI becomes increasingly embedded in educational systems, the need for pedagogically grounded frameworks to guide its development and application is more urgent than ever. The Community of Inquiry (CoI) framework provides a shared model of pedagogical leadership that supports directed and peer teaching, deliberative dialogue, and the development of metacognition and critical reflection. This framework offers a rigorous foundation for evaluating and applying AI tools through processes that foster deep and meaningful learning.

In Canada, the FAITH for-credit graduate seminar was offered at a Canadian post-secondary institution. To orient students to the course and its activities, they were introduced to the CoI conceptual framework and its applications. Norms for participation, along with agreements on practices and timelines, were collaboratively established.

Students were informed that the course was designed around the CoI framework developed by Garrison, et al. (2000). In this temporary learning community, each member was expected to actively support the learning and teaching of others. Weekly asynchronous discussion forums were hosted on the learning management system, complemented by bi-weekly synchronous web meetings to foster real-time engagement across social, cognitive, and teaching domains. Participation contributed to course grading. Originally developed in the context of early text-based online learning in the late 1990s, the CoI framework integrates quality educational practices, the practical inquiry model, and distance education theory. It remains the most widely referenced and applied model for online learning due to its simplicity and versatility (Bozkurt 2019).

The CoI is a socially collaborative, constructivist framework that outlines the core elements of meaningful online learning. It dynamically supports the development of community and the pursuit of intellectual inquiry in any educational setting. The framework comprises three essential elements, or presences:

1. Social Presence (SP): The ability of participants to identify with the community, communicate purposefully in a trusting environment, and build interpersonal relationships by projecting their individual personalities.
2. Cognitive Presence (CP): The extent to which learners construct and confirm meaning through sustained reflection and discourse within a critical community of inquiry.
1. 3.Teaching Presence (TP): The design, facilitation, and direction of cognitive and social processes to achieve personally meaningful and educationally valuable learning outcomes.

Subsequent research introduced a fourth element, Emotional Presence, which underpins the original three. Defined as “the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry, as they relate to and interact with the learning technology, course content, students, and the instructor” (Cleveland-Innes & Campbell 2012), emotional presence is especially relevant in the context of AI’s disruptive impact. Emotional presence enables authentic reactions and discussions.

Throughout the course, discussion forums and synchronous meetings were guided by the principles of deliberative dialogue to support all four presences: social, cognitive, teaching, and emotional. AI can be taught through the lens of the Community of Inquiry, but equally important is aligning AI tools with the goals of deep and meaningful learning.

Recent research has explored how generative AI (GenAI) can be designed to support the CoI model. For example, AI can enhance cognitive presence by prompting learners to reflect, integrate, and resolve complex ideas through

adaptive feedback and inquiry-based scaffolding (Melisa et al. 2025). Similarly, social presence can be supported by AI-driven conversational agents that foster respectful discourse and peer engagement. Teaching presence is amplified when AI assists educators in designing and facilitating learning experiences, offering real-time analytics and personalized interventions.

However, as Holmes et al. (2021) argue, ethical intentions alone are insufficient. The integration of AI into education must be guided by a commitment to fairness, transparency, and learner agency. The CoI framework provides a pedagogical and ethical compass, ensuring that AI tools may be effective content providers and aligned with the values of collaborative inquiry and critical thinking.

A practical example of this integration is the use of AI chatbots designed with CoI principles to support informal and formal learning through structured dialogue and reflection. These tools demonstrate how AI can be used not just to deliver content, but to co-construct knowledge in a community of learners. The CoI framework challenges developers and educators to move beyond efficiency and automation. It invites a reimagining of AI as a partner in the learning process; one that supports the human dimensions of education: dialogue, reflection, and shared meaning-making.

5. Method

The study presented in this paper was carried out with an action research approach with the idea of a concrete and systematic approach "that enables teachers to investigate their own teaching and their student's learning" (Nolen & Putten 2007, p 401). There are various types of action research, where this study belongs in the British tradition of action research described by Norton (2009 p 71), as an approach "that links research to improvement of practice and is education orientated". The authors' overall objective was that the conducted research should have a positive impact on the future design of the involved courses. Moreover, educational action research is an approach where researchers can have the dual roles of being not only researchers, but who are also involved in the educational context that is researched. In this study, one of the authors was the main teacher in the introductory course that data were collected from, and two of the authors were involved in the creation of the syllabi for both the introductory course and the planned continuation course.

5.1 Data Collection

Data were collected from forum postings in discussion fora in two versions of the introductory course described above. Participants gave suggestions and commented on other course participants' postings where they gave their opinion on the importance of creating continuation courses on AIED. The data from forum postings have been supplemented with suggestions and comments from email conversations between the author and course participants in both course iterations, and in the second iteration this topic was discussed in groups in one of the course webinars.

5.2 Data Analysis

The described mix of collected data have been analysed according to the Grounded theory analysis method of data being 1) fractured and labelled, and 2) conceptualised around a central category (Moghaddam, 2006). In the first analysis phase, well-known under the term of Open coding, data were broken down into units of meaning and later aggregated to categories as outlined by Khandkar (2009). The Open coding was conducted by the first author, but was also discussed with the other authors to find relevant preliminary categories based on the identified codes and subcodes that were identified in the interview answers. The next phase of the Axial coding was guided by the Grounded theory idea of "coding that treats a category as an axis around which the analyst delineates relationships and specifies the dimensions of the category" (Bryant & Charmaz 2007 p 603). In the Axial coding, the preliminary categories from the Open coding were reassembled into more abstract conceptual categories around the central axis of 'Higher education transformation for lifelong learning'.

Larger Grounded theory analysis often involves a third phase. This third phase is sometimes referred to as Confirmatory coding (Cleveland-Innes & Campbell 2012), and sometimes as Selective coding (Walker & Myrick 2006). In this third phase, where the identified categories in the second phase are revised and integrated with a description of their interrelationship is not a part of this study, and rather a potential for future work.

5.3 Ethical Considerations

In almost all types of action research, authors must consider the dual roles of being researchers as well as part of the studied context. A duality that was relatively easy to handle in this limited study, but the risk for bias is always present. As pointed out by Nolen and Putten (2007, p 403): "*When the researcher is a member of and plays a role in the system under investigation, issues surrounding role definition, role ambiguity, and role conflict are often significantly greater than when a researcher enters the school as an objective outsider".*

According to the principle of informed consent, all course participants were informed at the very start of the courses that selected parts of the course activities would be part of research studies. With the general respect of informant integrity, all course participants were kept as anonymous as possible and data have been collected without saving any personal information.

6. Findings and Discussions

As reported in Mozelius (2025), the first evaluation of the introductory course was mainly positive considering the university standard questions that are presented in Table 1.

Table 1: Answers in the standard questionnaire.

Question	1.Very poor	2.Poor	3.Sufficient	4.Good	5.Very good
1. What is your overall impression of the course?				75%	25%
2. Have the course aim and the learning objectives been clear and relevant?			12.5 %	50%	37.5%
3. To what degree have the learning objectives been aligned to the content?			12.5 %	62.5%	25%
4. How to you estimate your pre-knowledge at the course start?		25%	12.5 %	12.5 %	50%
5. How was the support and help from the teachers (when needed)?				50%	50%
6. How do you see the course regarding structure, assessment, communication standard, teachers use of language, and accessibility (based on the aspects of gender, ethnicity, sexual orientation, age and disability)?				50%	50%

Regarding Question 2. and 3., there have been minor updates for course iteration 2 and 3, and regarding Question 4, the pre-knowledge level was clearly higher in course iteration 2. At present, the university standard evaluation for course iteration 2 is not yet, but participants have given their opinions in forum postings and in webinar discussions.

A main challenge brought up by several course participants, is the time shortage for full-time working professionals, and how to combine the scheduled course activities and group work with schedules in workplaces. Both first course iterations had a high percentage of full-time working teachers. A suggestion from some of those teachers was a summer course, which has now been realised in iteration 3 of the introductory course.

Regarding the research question on important topics to involve in continuing courses, the suggestions from participants in the two first iterations were quite similar. The result from the initial Open coding analysis gave the categories of AI didactics, GenAI tools for teaching, Prompt engineering, Audio generation and Voice cloning, Customisation of AI models, AI and disinformation, and AI sustainability and ethics. Many participants stressed the need for concrete AI-aligned teaching and learning activities that could be used in their daily work after the course duration. In the Axial coding, this was included as the central axial category 'Applicable takeaways'. The outcome from the analyses could also work as a guiding blueprint for the development of the first continuation course that is sketched in the next section is illustrated in Figure 1. All the aligned categories could be seen as takeaways that course participants after a completed course could apply in their everyday work-life or study-life.

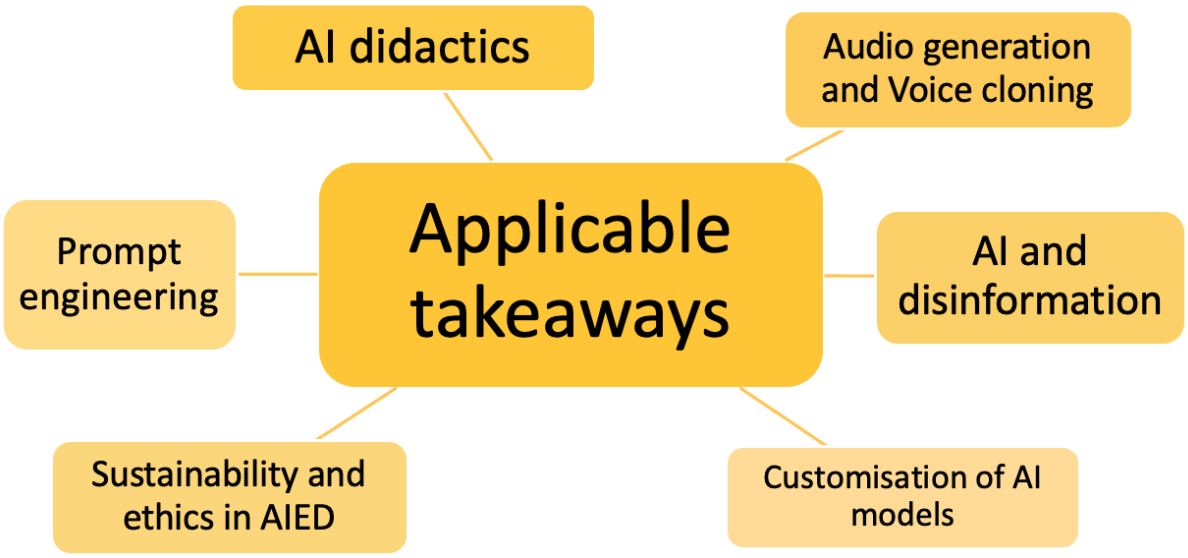

Figure 1: Suggested applicable takeaways for continuation courses.

It has been argued that prompt engineering will be of less importance for the future improved versions of AI-bots, however, the selected course literature has sections on prompt engineering. The course assignments on 'AI didactics' could also involve prompt engineering in the construction of lesson plans and assignments. 'Audio generation and Voice cloning' could preferably be combined with activities on ' AI and disinformation', but also used in the course activities on 'AI supported accessibility'. Moreover, the category of 'AI and disinformation' could be an important aspect of 'Sustainability and ethics in AIED'. Regarding the remaining category of 'Customisation of AI models' two interesting concepts to present and discuss would be Socratic dialogues (Orynbassarova & Porta 2024), and the Study Buddy idea (Durgungoz & Kharrufa 2025). Finally, several participants have brought up that AIED should be multimodal and not only about generating text.

7. A First Sketch for a Continuation Course

Similar to the introductory course, the first continuation course should stimulate active learning with a mix of lectures, workshops, seminars and individual work combined with group work. The overall course aim should be to present, apply and discuss how artificial intelligence techniques could be sustainably implemented in different educational contexts. Course content should be built around the concepts of prompt engineering, AI supported construction of multimodal teaching and learning activities, construction of assignments with clear instructions for the allowed use of AI, and social, financial, environmental and ethical aspects of generative AI. After a completed course the participants should be able to:

- Apply and reflect over different prompting strategies for multimodal generative AI
- Create and critically review a series of lessons in a chosen educational context with AI generated teaching and learning activities
- Create assignments that assess these teaching and learning activities, and to clearly describe how and when AI is allowed in the student solutions of the assignments
- Explore and describe how different AI techniques could increase inclusion and accessibility in technology enhanced learning
- Analyse and discuss social, financial, environmental and ethical aspects sustainability aspects of generative AI

Finally, course development should be conducted as a part of the described FAITH project, and build upon the theoretical framework of Communities of Inquiry.

8. Conclusion

In conclusion, it can be noted that the introductory course has worked out relatively well, although there are, as always, parts to redesign and improve. The continuation course should, in the same way as introductory courses in AIED, contain both theoretical parts on themes such as AI sustainability and ethics, but also concrete hands-

on activities AI to fulfil the aim of Applicable takeaways. AIED is a rapidly emerging field where it is difficult to involve all the categories in just one or two continuation courses. Thus, AIED should definitely be seen as continuous lifelong learning, with applicable takeaways as an important main concept in the course design. Part of the redesign could be to move the more theoretical parts of the introductory course to the continuation course, and to have more hands-on activities first and theory later. However, considering lesson planning and assessment it seems to make sense to start with theory, and to later apply the theory.

Beyond answering the research question about what topics are important to involve in continuing courses on artificial intelligence in education, the study also provided two ideas on how this should be carried out. Firstly, this is conducted on the staff level, in collaboration with the project team in the FAITH initiative, where we also will compare how AIED has been implemented at our Canadian partner university. Secondly, on the teacher and student level, as a Community of Inquiry, it will be important to further discuss and refine the cognitive, social and teaching presences in the courses.

9. Future Work

Both the involved courses will be given in several iterations during the coming year with the same types of evaluations and follow-up activities as presented in this paper. It is the authors' intention is to attend next year's ECEL conference as well, to further discuss the complex and shifting field of AIED. What we see as an important part of the iterative redesign is to have a continuous dialogue with other teachers and researchers in this field.

Ethics and AI Declaration

Data were collected with informed consent, and no AI tools have been used in any part of this paper.

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