ARTIFICIAL INTELLIGENCE AND LEARNING ACTIVITIES:

A MATCH MADE IN HEAVEN?

Henrik Køhler Simonsen & José Bidarra

Abstract

Artificial Intelligence in Education (AIED) may be described as the next big disruptor in higher education, however, AIED still remains evidence of a potential Balslev (2020). Practical experience with AI in higher education is very limited and potential pedagogical applications of AI has so far not been given much attention. The objective of this paper is to analyse and discuss concrete applications of AI to support different learning activities in higher education using the ABC Learning Design approach Young & Perovic (2016). The purpose of the paper is to contribute to research in the practical use of AI in higher education and to start the important theoretical discussion of AI applications from a pedagogical point of view. The paper is based on empirical data in the form of nine selected cases of AI use in higher education in Portugal, the United Kingdom and Denmark, respectively. The analysis demonstrated that there is a need for new views on the pedagogical use of AI in higher education. However, the paper goes further and outlines an AI Pedagogy Planner combining six overall learning activities with eight types of AI applications.

Keywords:

AIED, learning types, AI applications, AI pedagogy planner

Acknowledgements:

Introduction

The purpose of this paper is to analyse and discuss pedagogical applications of artificial intelligence in higher education and to answer the overall question: which AI applications support specific learning activities in higher education?

The study draws on empirical insights from a structured analysis of nine different cases, describing nine AI applications in higher education in Portugal, the United Kingdom and Denmark, respectively. The analysis of the nine cases focused on particular parameters that are relevant for pedagogical and/or didactical factors related to the actual use of AI in Education.

In a recent article offering a systematic review of research on artificial intelligence applications in higher education, Zawacki-Richter et al. (2019) ask a crucial question. Based on their comprehensive systematic review they ask: "where are the educators?"

This question has been raised before by Holmes et al. (2019) and in other variants by Rienties et al. (2020) and Simonsen (2020), and it is definitely about time that we discuss potential pedagogical approaches to artificial intelligence applications in higher education. The analysis of the nine cases used in this paper are related to the question raised. We will try to answer that and offer a theoretically based discussion of how elements from the ABC Learning Design Approach Young & Perovic (2016) can be combined with an emerging framework outlining

potential applications of different AI technologies, based on the three-tier classification developed by Luckin et al. (2016) and Holmes (2019).

So, the paper will first briefly introduce and discuss the different theoretical building blocks. Then it will provide an analysis and discussion of the nine cases and suggest an AI Pedagogy Planner, which may help educators select the right kind of AI application to support specific learning types. Finally, conclusions and reflections on further work will be presented.

AI Applications and Pedagogy in Higher Education

As already indicated, existing literature does not fully discuss the link between AI applications and potential learning activities in higher education. Holmes et al. (2019) do discuss how AI works in education and how different AI applications work in education, but they do not propose an overall pedagogical framework of which type of AI application can be used to support specific learning activities. Zawacki-Richter et al. (2019) even ask, "where are the educators?" and the educators have so far played an almost non-existing role in the development of AI applications for higher education.

That is unfortunate because we might miss the huge potential of AI applications without a clear pedagogical approach. Also Rienties et al. (2020) call for increased cooperation between different disciplines to gain the full potential, and Simonsen (2020) points out that we have not come very far when it comes to the actual practical use of AI in higher education. In a more critical view, Balslev (2020) downplays the application of AI in higher education and calls it "Evidence of a potential".

In other words, there seems to be a need for a specific approach to AI pedagogy, which focuses not only on what AI can do, but also on which learning activities and learning objectives can be supported by AI applications. That is the conceptual vision of this paper. However, it needs some solid building blocks and, for that purpose, the framework presented in Holmes et al. (2019), and later refined and expanded in Bidarra et al. (2020) should be presented.

The overall classification of learning and artificial intelligence suggests three overall types of AI in education. The classification is important as it divides the overall uses of AI in education into three areas being *Learning with AI*, *Learning about AI* and *Learning for AI*.
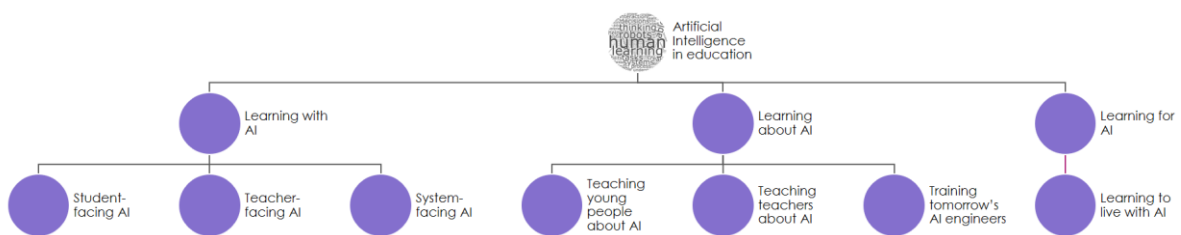

Figure 1. Learning with AI, learning about AI and learning for AI

This overall classification is useful when defining what type of learning we are aiming at, and as such the three categories form the basis of the AI Pedagogy Planner presented later.

The next theoretical building block is the emerging framework outlining existing AIED technologies based on Holmes et al. (2019). This approach has been updated and streamlined by Bidarra et al. (2020) and is shown below in Figure 2.

The upper section of figure 2 outlines whether the solution in question supports learning with AI, learning about AI or learning for AI and the lower section outlines a non-exhaustive list of different AI applications Holmes et al. (2019).
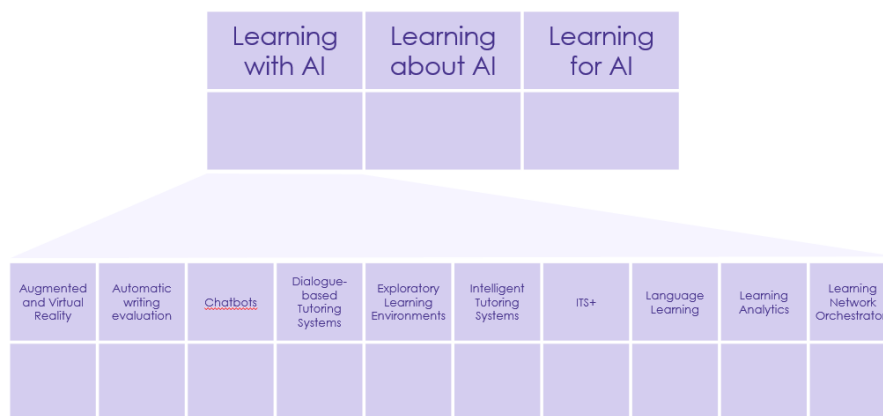
Figure 2. Framework of AI learning types and AIED technologies

These two theoretical building blocks make it possible to categorize the overall purpose of an AI application and to present an overall description of the AI solution in question.

However, we still miss a recognized pedagogical approach that allows us to describe systematically what AI applications to use when supporting specific learning activities and reaching specific learning objectives. We need the third theoretical building block.

For that purpose, we selected elements from the ABC Learning Design method Young & Perovic (2016), which builds on Laurillard's six learning types Laurillard (2012). The ABC Learning Design approach is a method where educators work together in teams to design a visual storyboard outlining the structures and sequences of learning activities, which are required to meet specified learning outcomes.

For this discussion, only the overall learning types or activities are used. The six learning types or activities outlined in the ABC Learning Design method Young & Perovic (2016) include:

- Acquisition
- Collaboration
- Discussion
- Investigation
- Practice
- Production

The definitions of each learning type can be found in Young & Perovic (2016) and are written on the actual cards used in the ABC Learning Design method.

These three building blocks constitute the theoretical basis of this paper and before we turn our attention to the AI Pedagogy Planner, we must present the nine cases that form the empirical basis of this paper.

Nine Cases on AI in Higher Education

One of the research objectives of the AI in Teaching project (AIT) supported by ERASMUS+ (KA203-2019-002) was to identify and analyse cases in Portugal, the United Kingdom and Denmark, respectively.

The AIT group has identified nine cases, which are listed by country and shown below in Figure 3.

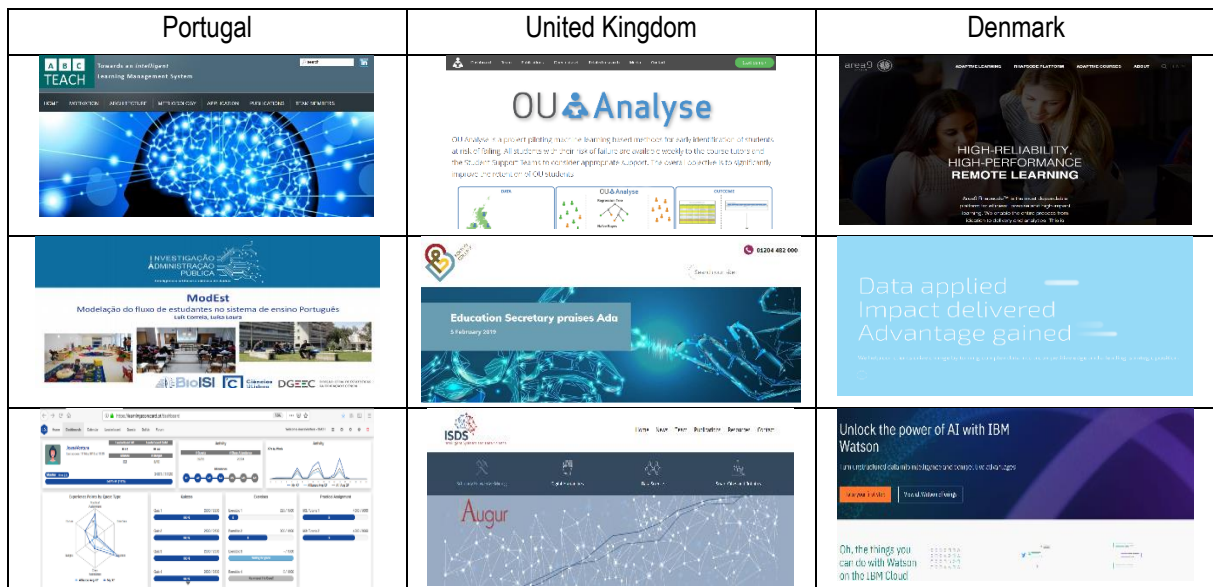| Portugal	United Kingdom	Denmark

Figure 3. Screenshots of the nine cases

All nine cases were taken from higher education and were analysed using the following items:

- Context
- Description of AI application
- Categorization of AI application
- Actors (Students-Teachers-Researchers-Decision-makers)
- Conclusion

Based on this study it was possible to analyse the nine cases and categorize them by AI learning type and AI applications. Figure 4 below shows the nine cases categorized using first the AI learning types and secondly the AI application types.

	ABCTeach	ModEst	LearningScorecard	OUAnalyse	ADA-Chatbot	KMI	Area9	SDU	DKEA
AI Learning Types									
Learning With AI	X	X	X	X	X	X	X	X	X
Learning About AI									
Learning For AI									
AI Applications									
Automatic Writing Evaluation									
Chatbots					X				
Dialogue-based Tutoring Systems									
Exploratory Learning Environments									
Intelligent Tutoring Systems	X	X	X				X		X
Language Learning									
Learning Analytics				X		X		X	
Augmented/Virtual Reality									

Figure 4. Categorization of the nine cases

The results show that all nine cases are under the *learning with AI* category, and that there was 1 chatbot application, 3 learning analytics applications and 5 intelligent tutoring system applications. Furthermore, the analysis showed that none of the nine cases was based on pedagogical considerations, which was a finding, which supports the call for including educators in AIED development Zawacki-Richter et al. (2019). Although the sample is small, it points to a need for combining pedagogical considerations with AI.

AI Pedagogy Planner

The idea of using a design approach in building programmes has had a huge impact on educators and researchers all over the world, and in this case, inspiration to develop the AI Pedagogy Planner came from Bower (2008), Laurillard (2012), Salmon (2013) and Fung (2015). Let us first outline how the ABC Learning Design method works.

The actual process used in the ABC Learning Design method is based on a practical and hands-on approach where educators are asked to develop a programme using a storyboard and cards. The storyboard structures the programme in question in a timeline and the cards are placed in the desired sequence to support the learning objectives in question. On the front of the learning type card the overall type of learning activity appears and the educator places several learning type cards on the storyboard, structuring the overall learning programme. All these choices are of course made to support the learning objectives of the programme. Once satisfied with the overall approach, educators then flip the learning type cards and select or define the actual learning activities on the back of the card in question. Having gone through this process all pedagogically relevant choices have been made and educators can now start developing the specific didactical activities in the classroom or the LMS in question. The same idea has been used in the AI Pedagogy Planner, which is shown in Figure 5 below.

Again, the underlying idea was to develop a practical tool for educators when working with AI in higher education. In line with the ABC Learning Design method, the idea is to make pedagogically relevant decisions in a specific sequence.

The AI Pedagogy Planner is a so-called decision tool, where you start with the inner white wheel. First, you select the type of learning that you want to work with at a particular stage in your curriculum design by turning the inner wheel either left or right. The abbreviations ACQ, COL, DIS, INV, PRA, and PRO are the six learning types listed in the left-hand side of Figure 5.

Having selected the learning type, then it is time to select the AI learning types Holmes et al. (2019) and Bidarra et al. (2020). The educator now selects the AI learning type in question, that is, whether it is *Learning with AI*, *Learning about AI* or *Learning for AI* by turning the second light-grey wheel. The abbreviations LWAI, LAAI and LFAI are the three AI learning types listed in the left-hand side of Figure 5.

Next, it is time to select the actual AI application, which the educator can use to realize the didactical learning activities required. The educator now turns the outer dark grey wheel and selects the AI application(s), which support(s) the selected learning type in question.

Once the learning type, the AI learning type and the equivalent AI applications have been selected, the educator flips the decision tool and gets concrete pointers to actual exercises, practical learning activities and AI tools that may be used to realize the learning outcomes of the programme in question on the back of the AI Pedagogy Planner. The abbreviations AWE, CB, DBTS, ELE, ITS, LL, LA and AR/VR are abbreviations of different AI applications listed in the left-hand side of Figure 5.
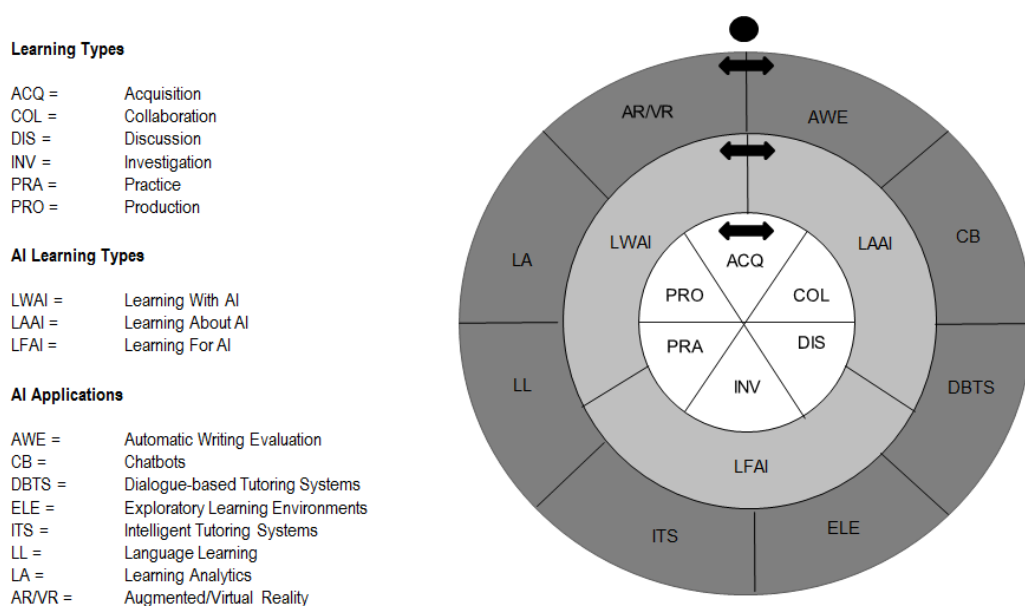
Learning Types

ACQ =   Acquisition
COL =   Collaboration
DIS =   Discussion
INV =   Investigation
PRA =   Practice
PRO =   Production

AI Learning Types

LWAI =   Learning With AI
LAAI =   Learning About AI
LFAI =   Learning For AI

AI Applications

AWE =   Automatic Writing Evaluation
CB =   Chatbots
DBTS =   Dialogue-based Tutoring Systems
ELE =   Exploratory Learning Environments
ITS =   Intelligent Tutoring Systems
LL =   Language Learning
LA =   Learning Analytics
AR/VR =   Augmented/Virtual Reality

Figure 5. AI Pedagogy Planner

Conclusions and further work

This paper analysed and discussed pedagogical applications of artificial intelligence in higher education and examined how AI applications may support specific learning activities in higher education. The discussion was based on nine cases of AI applications in Portugal, the United Kingdom and Denmark, respectively and pointed towards a decision support tool called the AI Pedagogy Planner. It is argued that this specific decision support tool may help educators select the right AI applications for the right learning types realizing the right learning activities.

During the analysis of the nine cases, it was found that all nine cases could be categorized as learning with AI and that five out of eight AI applications can be described as intelligent tutoring systems. It was also found that none of the nine cases included detailed theoretical considerations on how the solutions in question could be used pedagogically. We contend that the decision support tool based on a picker wheel approach to AIED could be used in practice by educators to facilitate pedagogically based decisions in the process of building the curriculum in higher education. Educators should lead AI – educators should not be led by AI.

Consequently, further research in AIED needs to involve educators to ensure that AI applications in AIED will be pedagogically based and will be integrated in the daily teaching activities in the physical classroom or in the virtual learning environment Luckin & Holmes (2017).

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