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## Learning Artificial Intelligence Through Open Educational Resources

Frédéric Alexandre, Marie-Helene Comte,  
Aurélie Lagarrigue, and Thierry Viéville

**Abstract** This chapter discusses the creation and impact of a Massive Open Online Course (MOOC) titled ‘Artificial Intelligence with Intelligence (IAI)’ aimed at fostering a culture of AI understanding and participation in ethical debates. The chapter first addresses the rationale behind developing the MOOC and the importance of citizen training in AI, particularly concerning ethical considerations surrounding algorithmic decision-making. This chapter also emphasises the need to reevaluate human intelligence in the broader context of AI advancements and probes the transformative nature of AI across various domains of

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life. Three perspectives are considered concerning the integration of AI in education: adapting the learning experience, using AI as a scientific tool for studying human learning, and critically examining its problems. Citizen education is crucial to understanding the scientific and technical elements of AI, especially in the context of algorithmic decision-making ethics. The chapter's focus on AI and citizen education is key. It emphasises the need for critical thinking to understand how AI technologies affect daily life. The chapter advocates AI training to help people understand how AI works and generate informed opinions about its potential and limitations.

**Keywords** AI literacy · Citizen education · MOOC · Online learning · Ethics

## Introduction

AI in education can be approached from three parallel perspectives. First, it can be used to adapt the learning experience by designing tools that take into account different learner characteristics or the digital learning analytics resulting from their interaction with systems. Such systems could have the potential to support some teachers' tasks and allow them to intervene in more complex aspects of student learning. Secondly, AI can be used as a scientific tool to better understand human learning phenomena, by modelling the learner. Finally, AI can be considered from a critical perspective. This chapter presents these three complementary, but not mutually exclusive, perspectives to better understand the challenges of AI in an educational setting.

The latest research combining education and digital sciences makes it possible to understand the potential and limitations of artificial intelligence (AI) in the education domain. This research highlights the potential for designing AI systems that can enhance their learning capabilities and foster critical thinking (Roux et al., 2020; Viéville, 2019). Furthermore, it underscores AI's capacity, as an instructive entity, to understand the intricacies of human learning as well as its ability to build more proficient users of these ubiquitous tools (Viéville & Guitton, 2020).

## AI as an Adaptive Learning Tool

Learning can be made adaptive through the use of algorithms that analyse student learning analytics, such as quiz results or software usage data, to adapt to individual learners by modifying difficulty levels or curating content. Other adaptive systems can be made using external cameras or brain–computer interfaces, which allow algorithms to further analyse behaviour through sensors. This principle of adaptation is at the heart of digital pedagogy and is often integrated alongside gamification strategies where the learner participates in an educational game either solo or in collaboration with other learners (Giraudon et al., 2020).

The KidLearn Project offers a variety of learning activities whose multiple variants involve the addition or subtraction of whole or decimal numbers designed and implemented by mathematical didacticians. These variants are organised in the form of a graph of increasing difficulty, respecting Vygotsky’s concept of the proximal zone of development (Vygotsky, 1978). This concept posits that optimal learning, as evidenced by a student’s performance over time, occurs in a zone that is neither too challenging, which can lead to discouragement, nor too easy, which can result in boredom. In a similar fashion, this concept can be applied utilising algorithms that automatically adapt to the learner. These elements can be integrated into the algorithm, which will automatically adapt to the learner’s progression (Oudeyer et al., 2020).

While the development of these applications remains limited, the ongoing scientific research provides a crucial stage for initial reflection, aiding in understanding the processes of knowledge acquisition and appropriation. Indeed, to implement this adaptive approach systematically, it is essential to formalise both the knowledge and know-how, or practices, to be taught. This necessitates the explanation and structuring of task types and problem-solving techniques. Moreover, it is necessary to ensure that the learning process is not burdened with extraneous cognitive tasks unrelated to the activity itself. Adaptive learning should also occur within a context bound by equipment availability, personnel training, and screen usage limitations.

The positive effects of machine learning are numerous. Primarily, we notice that adaptive learning positively enhances learner engagement, as

diverse interactions with the content provide additional opportunities for comprehensive understanding. Indeed, the fact that the difficulty level of a learning experience can be adapted to an individual learner makes it possible to limit or even avoid discouragement or weariness. Also, unlike a human, the machine does not ‘judge’, which can help maintain the learners’ engagement. However, this type of learning may require a substantial effort on the teacher’s behalf if the design does not take into account the student’s cognitive load. There is also the risk that students may lose sight of the intended learning goals if the gamification aspects are too prominent.

Adaptive tools incorporating AI principles should allow teachers to devote more time to students who need it most, while the rest of the class engages in self-directed learning activities. These tools also allow teachers to shift away from traditional knowledge transmission methods, such as self-assessed multimedia content and automated training exercises, and focus more on other pedagogical approaches such as project-based learning. Compared to non-adaptive digital tools, i.e. those without machine learning, the degree of autonomous learning can be significantly higher and more widely applicable, incorporating comprehensive skills development paths. These tools also meet a need in the context of distance learning situations and prompt a reevaluation of how school work time is currently organised.

However, it is also crucial to highlight the potential misuse of this data: the pervasive tracking and categorisation of learners, the temptation to reduce the number of school staff, and the exacerbation of inequalities related to illiteracy (Allemang et al., 2020). Attention should also be paid to how these digital learning practices might blend or merge with other online behaviours, such as shopping, streaming videos, or reading, thereby influencing or altering their original purposes.

## AI as a Model for Understanding Human Learning

The ability to collect and interpret learning analytics could lead to improved learning, whether these metrics are used by the learner or by the teacher for self or external regulation (Romero, 2019). The use of learning analytics could also make it possible to better understand human learning methods in the long term. These learning insights can be detected using software by measuring mouse movements or finger clicks, keyboard input, or by sensors used in teaching situations with or without a computer (e.g. camera, microphone, accelerometer, or GPS). Exploiting these measures requires not only the formalisation of the learning task itself but also the modelling of both the task and the learner, not holistically, but within the framework of a specific task.

The use of learning analytics in digital learning environments makes it possible to model the learning task, but also the learner's activity within the task. Machine learning algorithms rely on fairly sophisticated models. These mechanisms are not necessarily confined to supervised learning, where answers are adjusted from examples provided with the solution, but also work by 'reinforcement' where the system infers causes that explain the positive (called rewards<sup>1</sup>) or negative feedback during learning by building an internal model of the task to be performed. These models are operational in that they make it possible to create effective algorithms that adjust their parameters. One might wonder if such models can effectively represent aspects of human learning. In neuroscience, these computational models already represent our brain's functional processes as calculations or information processing mechanisms at the neuronal level, thereby augmenting our comprehension of such cognitive functions.

This area of using computer science and AI as formalisation tools to model human learning, called 'computational education science' (Romero et al., 2020), is still in its infancy, but has already revealed its

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<sup>1</sup> In the context of reinforcement learning, the concept of 'rewards' encompasses both positive and negative outcomes. This extends beyond the traditional understanding of reinforcement in psychology, which typically associates reinforcement with positive outcomes only.

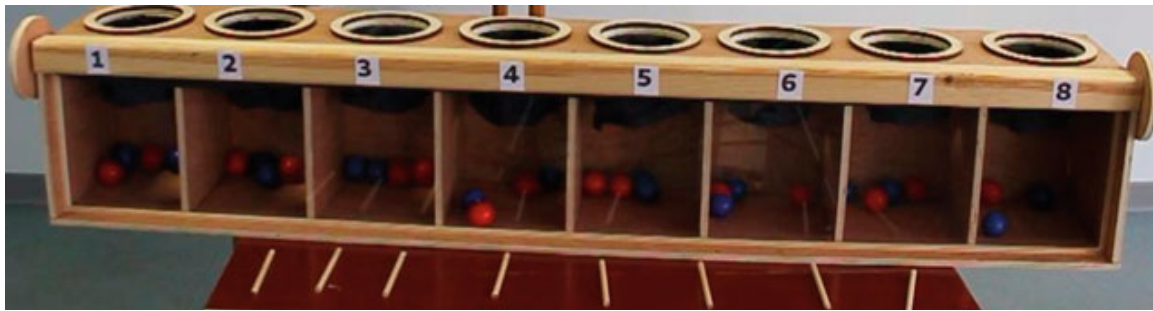
potential for the learning sciences. This is why research is carried out in a transdisciplinary manner utilising both digital sciences and cognitive neurosciences to explore these potentialities.

## AI and Citizen Education

In order to ‘master’ the digital technologies in the sense of Giraudon et al. (2020) and understand their application (Atlan et al., 2019; Romero, 2018), it is important to be initiated into the scientific and technical functioning of hardware and software computing objects. In a similar fashion, the integration of AI technologies into our daily lives calls for the development of critical thinking in young people (Viéville & Guitton, 2020).

It is important to understand that in AI, the outcome of data processing by the algorithms is not solely tied to their programming. The desired functions are not implemented only using instructions, but also by providing data from which the parameters are adjusted to obtain the desired calculation. Depending on the degree of program autonomy, there may even be unintended consequences as has been the case in chatbot systems that have learned, through poor quality corpora, to produce unethical comments on social media. Legally, it is also important to be familiar with the implications of interacting with a ‘cobot’ or a robotic mechanism in our daily lives. Consider, for example, a medical machine whose function would be to help inform therapeutic decision-making in response to different degrees of urgency. This situation, and others like it, stress just how much the chain of responsibility between design, construction, installation, configuration, and use is infinitely more complex than the behaviour of a non-autonomous machine.

AI training should help develop the knowledge and skills necessary to comprehend how AI works and enable individuals to develop informed opinions on the capabilities and limitations of its use. It is in the face of these challenges that the MOOC Artificial Intelligence with Intelligence was created as a way to familiarise educators with computer science in a non-technical manner and illustrate how AI can contribute to developing skills (Alexandre et al., 2021). Educational tools exist and continue



**Fig. 3.1** An example of an unplugged activity for experimenting with a reinforcement learning algorithm

to be developed that gradually introduce learners to the operation of AI. Figure 3.1 shows a minimalist ‘machine’, developed by Pixees and built by Snzzur.fr, that utilises blue and red balls to simulate the use of algorithms in an ‘unplugged’ game. The game’s construction plans are freely available and can be inexpensively reproduced using basic tools. It has been established that learning computer science principles in an ‘unplugged’ way, i.e. removing oneself from machine interactions to actively focus on the underlying concepts, makes it easier to understand the working mechanisms of AI.

## A Shift in Our Way of Thinking

Since the beginning of computing, we have seen our way of learning and teaching evolve. For example, is it still necessary to learn calculation when calculators are readily available? While it may be essential for understanding arithmetic operations, the need to become proficient calculators is lessened in the face of ubiquitous technologies. On the other hand, we will always need to calculate orders of magnitude to ensure that the calculation is relevant and that we have not made any errors when posting or obtaining the result.

These changes in human activity are found as we automate processes that are a matter of human intelligence. When we are content to use AI algorithms without seeking to understand their main operating principles and their implications for our lives, we risk losing individual and collective intelligence. We will become reliant on their mechanisms,



thinking less for ourselves, and developing less of the critical spirit essential to the formation of autonomous and enlightened citizens. This is the whole point of understanding how AI works (Roux et al., 2020). If, instead, we seek to understand and master these processes, then the possibility of delegating what, in human intelligence, is mechanisable can offer us the chance to consciously free ourselves from automaticities in order to devote our intelligence to higher-level goals and more humanly important issues.

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