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Implications Of Artificial Intelligence In Adaptive Learning Assessment

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Abstract: The international scientific literature highlights how Artificial Intelligence in education is a particularly emerging sector in the field of educational technology (Panciroli, Rivoltella, Gabbrielli, Richter, 2020). This paper proposes a reflection on the transformative potential of Artificial Intelligence (AI) related to educational learning school assessment. The aim is to identify the tangible benefits deriving from its implementation in the educational context and this analysing the aspects of AI. The research focuses on exploring possible chances offered by the automation of the evaluation process and on the ability of personalized analysis of students' performance, highlighting the potential of machine learning algorithms.

Keywords: adaptive learning, artificial intelligence, inclusion, personalization, adaptive evaluation.

1. Introduction

In recent decades, information technology has permeated every part of society, contributing significantly to the evolution of education and learning stage. The advent of digital tools and resources has introduced new pedagogical approaches and teaching methodologies, and it radically transformed the way teachers and students access to educational process. Currently, artificial intelligence (AI) is the most evident expression and evolution of information technologies' application in the educational environment.

The initial use of these technologies in the educational stage has also affected areas relating to the automation of administrative processes and the management of teaching resources. However, over time, their influence has extended to the creation of dynamic and interactive learning environments. The ability to personalize the learning experience, adapting it to the individual needs of students, was a turning point.

At the same time, the introduction of artificial intelligence has taken educational innovation to a higher level. The ability of machines analysing data, understand learning patterns and adapt dynamically to the needs of students has opened new perspectives in the design of educational journeys. AI not only facilitates the assessment of students' skills, but it also contributes to the development of predictive

systems useful to identify potential learning difficulties according to a proactive perspective.

Starting from these reflections, through an analysis of the characteristics of AI, the aim is to identify the tangible benefits deriving from its implementation in the educational context and, in particular, in the adaptive learning environments. The research aims to intensify all the chances offered by the automation of the evaluation process and the ability of a personalized analyse of students' performance and students 'outcomes.

2. Educational implications of AI

According to a definition provided by UNICEF, agreed with the member states of the Organisation for Economic Cooperation and Development (OECD), artificial intelligence refers to:

«[...] to mechanical systems based on machines that can, with a previous set of man-defined targets, make predictions, recommendations or decisions that affect real or virtual environments. Artificial intelligence systems interact with us and act on our environment, directly or indirectly. Often, they seem to operate independently and can adapt their behaviour by learning about the context. » (UNICEF 2021)

Artificial intelligence technology refers, therefore, to intelligent machines created by humans and implemented through computer programs with autonomous perception, cognition, decision-making, learning, execution and social collaboration skills, which are engineered by human to obtain several operations or tasks that humans do not prefer to perform alone or that they cannot perform alone. Technology allows machines to simulate human intelligence, which resides in the cognitive abilities of human beings embodied in five dimensions: neurological, psychological, linguistic, cognitive and cultural (Drezewski and Solawa, 2021). Chassignol et Al. provide a two-sided definition and description of AI. They contemporary define AI as a field of study and as a theory. With respect to the first dimension, they define AI as an area of study in computer science whose activities aim to solve several cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition, and then the adaptation. As theory, Chassignol et al. have defined AI as a theoretical framework that guides the development and use of computer systems with the capabilities of humans, specifically, intelligence and the ability to perform tasks that require human intelligence, including visual perception, voice recognition, decision-making and translation between languages. The main problems of AI technology consist in acquiring the ability of reason, understand, plan, learn, communicate, perceive, move things, use tools and manipulate machines similar to or even beyond the capabilities of humans (Bin and Mandal, 2019).

Conducted by new theories and technologies such as mobile web, big data, supercomputing, sensor networks, and brain science, the development of AI technology has accelerated, presenting new features such as deep learning, interdisciplinary integration, human-machine collaboration, open source collective intelligence, which have a significant and far-reaching impact on economic development, social progress, and international, political and economic progress. New technologies such as artificial intelligence, the Internet, big data, cloud computing, virtual reality and the "Internet of Things" will further promote socio-economic, ideological and cultural development, as well as reforms in education and pedagogy (Liu et al., 2022a,b).

The introduction, development and dissemination of artificial intelligence technology therefore affects the different stages of education, promoting effectiveness and efficiency in processes. Several studies have examined the connections between AI and education, identifying four different implications (Holmes et al. 2019):

- Learning through AI;
- Using AI to learn to learn;
- Learning about AI;
- Prepare for AI deployment.

Specifically, learning through AI involves the use of AI-based tools in teaching and learning and includes:

1. The use of AI to directly support learners with tools such as intelligent mentoring systems, exploratory learning environments, automatic writing assessment, chatbot and AI to support students with particular fragility or disabilities;
2. The use of AI to support administrative systems (such as recruitment, planning and management of learning processes);
3. Use of AI directly support teachers.

In the first case, the data is useful to know about how students learn, how learning progresses, and which learning design and activities are more or less effective. Such method is well known as learning analysis or educational data mining. AI learning, however, needs the empowerment of AI knowledge and related skills for all ages 'students (from primary, secondary, to college) and for their teachers, including AI techniques (e.g., Machine Learning) and AI technologies (e.g., natural language processing), along with statistics and the coding everything depends on (Miao and Holmes, 2021). Preparing for the use of AI, therefore, means ensuring that all citizens are prepared for the possible impacts of AI on their lives, helping them understand issues such as AI ethics, data bias, and the respect of privacy.

In addition, it is important to think on and to consider the potential for using intelligent mentoring systems during learning processes. In fact, several studies have highlighted how intelligent tutoring systems represent a revolutionary breakthrough in learning, radically transforming the way students interact with teaching material (Guo L., Wang D., Gu F., Li Y., Wang Y., and Zhou R., 2021). Compared to traditional methods based on textbooks and lessons, such systems offer an interactive and adaptive learning mode, which is personalized on the individual needs of students.

The interactive approach of intelligent mentoring systems involves the use of multimedia content that engages students in innovative methods. This new way, not only makes learning more engaging, but it also allows a deeper and long understanding of concepts, thanks to the ability to learn through different sensory stimuli. One of the most significant aspects of these systems is their ability to diagnose the strengths and weaknesses of each student. Through the analysis of learning data, programs can identify areas that require more attention and adapt lessons accordingly. This targeted personalization ensures that students receive optimal teaching, specifically addressing their gaps and exploiting best their skills. It is evident how in recent years artificial intelligence has been widely applied in many areas, including education (Luckin et al., 2016), with proportional increases in research and applications of education through AI (AIED). The AIED adaptive learning and assessment applications are, in fact,

used to improve educational effectiveness and efficiency (Chassignol et al., 2018; Kurshan, 2016), assess the effect of teaching, adapt teaching and problem-solving in real-time strategies (Shute & Psotka, 1996) and provide a better understanding of student knowledge acquisition (VanLehn et al., 2007; Beal et al., 2010).

In conclusion, learning programmes based on advanced technologies represent an important evolution in education. Their ability to deliver interactive, personalized, and data-driven learning opens up new horizons for students around the world. These tools not only improve the quality of teaching, but they also transform the very nature of the learning experience. Interactivity stimulates the engagement of students, making the learning process more participant and rewarding. Personalization allows individuals to progress according to their mode and rhythm, focusing on areas that require more attention and leveraging their distinctive abilities. At the same time, the data analysis provides a clear prospect of students' performance, allowing a constant and targeted adaptation of the educational journey. These advancements not only foster better assimilation of knowledge, but also contribute to the development of fundamental skills such as critical ability, problem solving and adaptability. In an ever-changing world, where rapid learning is essential, these tools are key to preparing students for the challenges of the future.

3. Artificial Intelligence and adaptive learning

The adaptive learning is demonstrated when digital tools and systems create personalized learning itineraries, i.e. sequences of designed activities according to the individual characteristics of each student, such as strengths, weaknesses and pace of learning (Taylor, D., Yeung, M., Bashet, A.Z., 2021).

The idea of an adaptive learning application dates back to the 1950s, but with current technological advancement, opportunities have widened considerably. These systems can be used for various purposes, ranging from problem solving to concept learning and student assessment (Becker, S. et al. 2018).

This evolution has been made possible thanks to machines' ability to analyse data in real time, adapting learning activities according to students' responses and performance. In essence, adaptive learning is a flexible and personalised approach, taking full advantage of the potential of digital technologies to improve the effectiveness of teaching.

The continuous advancement of information technology and artificial intelligence has expanded the opportunities for personalization in education, allowing learning paths, which are better targeted and adapted to the individual needs of students. This, not only makes learning more effective, but it also creates a more inclusive educational environment, in which each student can progress optimally.

Intelligent tutoring systems, mentioned above, are distinguished by their personalization and advanced interactivity. They do not only provide real-time feedback during problem- solving processes, but they operate on two distinct levels: one micro, where they adapt feedback based on the student's immediate actions, and a macro, where they make decisions about a new problem that will be presented later (Groff, J., 2017).

At the micro level, these mentoring systems utilize dynamic feedback, adapting it in real time to students' responses and actions as they tackle problems. This allows a better, immediate and targeted learning, correcting errors and guiding the student through the process of resolution.

At the macro level, intelligent mentoring systems can decide what problem to present later. This ability, which intelligently select activities, helps maintain a consistent and challenging learning flow.

Unlike simpler tutoring systems, which use decision trees to obtain feedback, with predefined rules, nowadays-advanced systems go further. They use machine-learning techniques to adapt dynamically their behaviour, according to the student's learning evolution over time. This means that the system can learn from student inputs, continuously adjusting its responses and decisions, thereby improving the effectiveness of teaching in the long run.

Therefore, the use of machine learning allows these intelligent tutoring systems to offer a highly personalized learning experience.

Adaptive learning systems are not limited to mentoring, but can extend to better exploratory forms of learning. One example is exploratory learning systems, which give students the opportunity to explore a learning environment on their own and select topics that interest them.

Regardless of the type of approach, all Adaptive Learning Systems must provide continuous support to students until they are able to perform tasks independently. Adaptive learning is, therefore, a powerful tool to provide a tailor-made education focused on the individual development of students.

In the artificial intelligence (AI) system for education are integrated several advanced techniques for learning analysis, recommendation, understanding and acquisition of knowledge. These techniques are based principally on machine learning, data mining and knowledge models. The educational ecosystem of AI is usually composed of three fundamental components: educational content, data, and intelligent algorithms (Chen, Lin, 2020).

The AI adaptive learning system is structured around different models to improve students' autonomous learning skills. Among these, the learning model plays a fundamental role, since it is based on the behavioural data generated during the learning process of the students.

First, the learning model analyses students' thinking and skills to assess their learning skills. Knowledge analysis then maps students' mastery, creating a detailed representation of their knowledge. Student patterns establishes connections between learning outcomes and various factors, including teaching materials, resources, and teaching behaviours.

In parallel, the knowledge pattern builds a map of the knowledge structure, including details such as specialist knowledge, rules to avoid common mistakes and misunderstandings. The combination of these two models, the field of knowledge model and the student model, guides the teaching model. The latter determines the rules for accessing the field of knowledge, allowing instructors to customize teaching strategies and actions.

During the evolution of education, the artificial intelligence system is able to adapt to the actions of students, offering help based on teaching theories integrated into the mentoring model. The user interface also plays an important role in exposing students' performance through different inputs such as voice, typing and clicks, providing output in the form of texts, figures, cartoons, and virtual agents.

Finally, the advanced human-machine connection offers functions related to artificial intelligence, including natural language interaction, speech recognition, and student emotion detection. This advanced interaction facilitates more engaging and

personalized learning, allowing the system to adapt to the needs and reactions of students in real time. In summary, the integration of these models and technologies in education promotes effective and personalised learning (Chen, Lin, 2020).

4. AI and adaptive evaluation

As discussed in the previous paragraphs, AI systems based on adaptive learning acquire an increasingly significant role in supporting teachers and improving the efficiency of the educational process. The analysis of the program and the material of the learning courses managed by these systems allows the creation of personalized content, adapted to the individual needs of students. Such personalization, not only enriches the learning experience of students, but also frees teachers from repetitive tasks, allowing them to focus on more critical and complex aspects, such as monitoring student performance.

The ability of artificial intelligence systems to generate and examine tasks and performance is an additional benefit. The automated process not only saves time for teachers, but can also ensure a more objective and consistent evaluation, eliminating potential human bias in the evaluation process.

In individualized teaching and autonomous learning, artificial intelligence solutions are particularly valuable.

However, it is crucial to address the emerging problem of human bias in AI with related to education. The use of pre-set criteria and benchmarks aims to reduce this risk, but it is important to continue monitoring and improving algorithms to avoid unwanted discrimination. The integration of artificial vision-based artificial intelligence systems, capable of analysing handwritten documents, for example, represents a step forward in the mitigation of prejudices, as well as providing effective control over plagiarism. The fundamental role of evaluation feedback in adaptive learning is amplified by the use of artificial intelligence in intelligent mentoring systems. The ability of algorithms to analyse student responses in real time represents a significant advance in offering prompts and personalized feedback.

Analysis of responses by artificial intelligence allows you to identify promptly areas where students have difficulties. This not only promotes active learning, but also helps to understand the mistakes made. This timely correction process is essential to avoid the formation of wrong habits and to consolidate the correct understanding.

Instant feedback is a powerful lever for self-correcting students: allowing them to understand and solve mistakes, now promotes more effective and sustainable learning over time. In addition, artificial intelligence can systematically track students' progress over time, providing useful data to teachers for an accurate assessment of individual skills and difficulties.

The ability to personalize education to the data collected allows teachers to adapt their pedagogical approach to address specific areas of improvement for each student.

However, it is essential to consider the need for human supervision throughout the process. Artificial intelligence can refine feedback efficiently, but to understand the nuances, emotions, and human complexity is still an authentic skill that only belongs to teachers. A balanced approach that exploits artificial intelligence for its analytical capabilities, but that preserves the human role for pedagogical guidance, will be essential to maximizing the benefit of these technologies in education.

In summary, we can see that the focus of the educational approach to evaluation is still changing. In the past, the focus was mainly on measuring students' outcomes

through final and certificated assessments. However, continuous monitoring during the learning process, known as formative evaluation, is becoming increasingly valuable. This assessment takes place using current and contextual data, and the main goal is to provide useful information to improve ongoing learning.

The collection and visualization of data are oriented to inform students, teachers and other actors of the educational context. The aim is to stimulate reflection on active learning processes. For example, student learning experience data can be used to develop personalized support strategies, adjust ongoing educational designs, or to monitor and improve the learning process over time.

The introduction of systems based on artificial intelligence and Learning Analytics devices in educational environments aims to improve teaching and learning practices. This requires the use of data in educational decisions, but it is important to overcome the traditional idea of data as an assessment tool. Therefore, the correct approach should be the evidence-informed one, based on reliable data and contextualized to the specific situations detected by education operators; this differs from the evidence-informed approach, which may not take into account, instead, the specific and complex context of educational experiences (Galliani, 2019). The ultimate goal, therefore, is to use the data as a support to improve continuously educational practices, rather than just as an assessment tool.

5. Conclusions

In conclusion, the growing absorption of artificial intelligence systems in education encourages prospects and improves the efficiency and effectiveness of teaching. The personalization of educational content based on advanced data analysis allows learning strictly related to the individual needs of students, enriching their experience. In addition, automation in the generation and evaluation of tasks allows teachers to focus on more complex and strategic aspects of the educational process. Therefore, it is essential to adopt an evidence-informed approach to the use of data, which considers the specific context of education, in order to maximize the benefits without neglecting the complex challenges related to the educational environment. Therefore, the goal is to leverage data as a dynamic tool to improve continuously educational practices, promoting better effective learning and customized to the needs of students. In addition, the implementation of AI-based systems is a valuable resource for reducing the educational gap, enabling large-scale personalization and dealing with the different and several skills of students. This digital transformation in education cannot only improve accessibility and inclusivity, but it can also promote an innovative and future-oriented learning culture.

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