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EDITORIAL

Artificial intelligence and education: A pedagogical challenge for the 21st century

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ABSTRACT

Background/purpose – Education in the 21st century faces a series of challenges, including training in mobile and ubiquitous contexts, and the improvement of the didactic processes associated with online and face-to-face teaching. For this, teachers and students can and should take advantage of the potential of tools based on artificial intelligence.

Materials/methods – This study is a review article, which presents a brief literature review on the possible applications and functionalities of artificial intelligence in education.

Practical implications – One of the prominent emerging challenges in education consists of proposing models and propositions for the integration of artificial intelligence into teaching and learning processes, based on solid didactic and pedagogical principles. Meeting this challenge appropriately and effectively may help to create more flexible, personalized, and sustainable learning environments.

Conclusion – The integration of artificial intelligence within education should be approached from a strong pedagogical approach in which not only algorithms should converge, but also emotions and appropriate values.

Keywords – Artificial intelligence, education, didactics, pedagogy, sustainability.

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1. INTRODUCTION

Artificial intelligence (AI) has appeared over recent years within multiple proposals in different professional, academic, and social scenarios. Today, it seems almost normal to talk to Siri or to say "Ok Google," interact with a chatbot in order to access a service, or to ask questions on certain automated web pages. However, the use of artificial intelligence is still incipient, with, on average, only 6% of European Union nations utilizing technology based on artificial intelligence; but in the coming years its growth is expected to be exponential (Eurostat, 2021). Initially, AI was defined as "making a machine behave in ways that would be called intelligent if a human were so behaving" (McCarthy et al., 1955). Today, AI refers to systems that use technologies such as in data mining, computer vision, language recognition, natural language generation, machine learning, deep learning to gather or use data, and to predict, recommend or decide, with varying levels of autonomy, the best action to achieve (Eurostat, 2021). Artificial intelligence can be based on purely software systems, for example:

- Chatbots and virtual assistants based on natural language processing;
- Facial recognition systems based on visual or language recognition systems;
- Software for machine translation;
- Data analysis based on machine learning; and,
- Neural Nets for Deep Learning, etc.

It seems that that "with all of these developments, the limits of artificial intelligence remain the limits of transposability of meaning into number" (Cope et al., 2020, p. 4). From our perspective, there are two key principles upon which artificial intelligence is based: (1) "Autonomy": The ability to perform tasks in complex situations without constant guidance from the user, and (2) "Adaptability": The ability to improve task execution by learning from experience. These two concepts are fundamental principles when defining a pedagogical paradigm that provides an adequate response to the different current and future proposals based on artificial intelligence. There is no doubt that the objective going forwards will be based on how to think of better ways to integrate AI into education, rather than just knowing where to "click."

Twenty-first century pedagogy, like any discipline, must adapt its principles to the new social and technological realities of the day, and look to provide solutions and proposals that ultimately aim to improve teaching-learning processes, and for the development of the skills and knowledge today's students need in order to succeed in their personal and professional life, and also in terms of their citizenship. Teachers in the 21st century face a series of challenges in relation to didactics and the methods to be expanded in both face-to-face and online teaching environments, where borders are becoming increasingly blurred. In this sense, the incipient proposals from artificial intelligence may be seen as hopeful, but also perhaps worrying, with issues pertaining to data protection, emotions, and sustainability, etc. all needing due consideration Since the tsunami of technological innovation in education, pedagogy and didactics have always been secondary to these events and to the plethora of digital recourses. It is therefore necessary to rethink the didactic and pedagogical model in which to support the use of technology, both within and outside of the classroom. Technology alone does not offer improvement in education, not without a strong didactic component, and proposals based on AI will therefore require significant didactical modifications.

2. LITERATURE REVIEW

2.1. Pedagogy and artificial intelligence

Students of the 21st century do not learn in the same way as those of the 20th century. Whilst this phenomena has occurred at all stages of history and society's educational development, this has become even more prominent considering the irruption of technology and the Internet in human daily life. Nowadays, what is substantial is not what is known, but "how it is known" and "how to put AI into practice" (Competency-based Curriculum). In this sense, the present and future of a pedagogy based on AI should rethink education's methodological and assessment models. AI could help in the designing of learning environments that are more enriching, personalized, and adapted to functional diversity, with active methodologies that encourage self-regulated learning: learning analytics, big data, conversational agents, blockchain, multi-format contents, gamification, etc. AI may be welcomed as an opportunity to reinforce the quality of education, with a more sustainable model that fits more with the recommendations of UNESCO's "2030 Agenda for Sustainable Development" (SDG 4), which mentions the need "to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" and "to build systems that are inclusive, equitable and relevant to all learners" (SDG-Education 2030 Steering Committee Secretariat, n.d.). Along these lines, the following presents certain proposals in this area:

2.1.1. Personalized learning paths

A proposal for a more personalized, interactive design would be one that empowers students to manage their own study sequence in the form of a learning pathway that could be individualized to take into account their learning objectives (Cohen, 2018). The learning scenarios must be configured flexibly for discontinuous sequences that favor a modular configuration of content blocks. The student can then select the pathway that best suits them, or which best fits their personal learning objectives; or a combination of modules from amongst the different pathways in order to create their own (Dewan et al., 2019). This type of decision-making process can generate increased student involvement, boost motivation, and help to reduce the high drop-out rates associated with certain courses, as students tend to feel that their learning pathway is more suited to their interests rather than being part of an enclosed, encapsulated product that does not allow for either flexibility or personalization.

2.1.2. Machine learning

Well-publicized examples of machine learning are Netflix or Spotify, or in how Siri and Alexa respond to users' requests, and of course, machine learning tools have even famously defeated world champions in Chess and Go. This type of machine learning is based on data analysis that recognizes patterns and creates inferences for a new dataset from which it has not previously been trained (Alenezi & Faisal, 2020; Ball et al., 2019). This technique is based on reinforced learning, supervised learning, and non-supervised learning (Carvalho et al., 2019). In reinforced learning, the machine learns by trial and error mechanisms until it finds the best way to resolve a problem. In supervised learning, the machine labels data, for example, in descriptions of videos and photos, enabling it to identify these same images in other databases and catalogues them. In non-supervised learning, the machine searches for similarities in databases in order to create its own patterns (for instance, facial recognition).

2.1.3. Learning analytics

Of all the AI-based strategies and techniques, one of the easiest and most useful to implement are dashboards with functionality based on learning analytics. Recent experiments in the field relate to techniques associated to k-nearest neighbor classifier. These techniques constitute a supervised learning model that can also be used in regression, and can be used to predict or estimate success or drop-out rates (Reckase, 2009), and collaborative filtering (CoF) semantic analysis techniques have also been employed in experimentation (Lan et al., 2014). Thus, learning analytics can help predict when a student may be about to abandon their course, and can help contribute to reducing high drop-out rates, just as it can analyze academic results to identify students who are likely to be highly motivated. A course design can be modified from the moment it starts being delivered, where analytics identify cases where there are perhaps alternatives on offer that may respond better to the development of different student patterns. Data visualization can then be effective when presented to students as a form of feedback on their work. Verbert et al. (2013, 2014) found that results presented in the form of a dashboard can help students to reflect on their academic development, whilst enabling researchers and course designers to observe student behavior patterns.

2.1.4. Conversational and pedagogical agents

Conversational agents are AI-based programs that apply written or spoken code in order to enable person-to-machine interaction (Colace et al., 2018; Fryer et al., 2019); for example, Microsoft's Cortana or Apple's Siri, which function within the operating system as virtual oral communication assistants. Chatbots can also be used for certain administrative and information-related actions, such as within discussion forums, and can be programmed for specific themes so as to promote a more dynamic environment with automatic tutoring. Pedagogical agents can be utilized in activities that require greater effort and dedication, such as dynamization and forum filtering, and may also be used to identify planning and assessment errors (Vázquez-Cano et al., 2021). This type of artificial orientation can be used with other programs too, such as Bazaar Collaborative Reflection, that promote pedagogical consultation activities in synchronous discussion forums.

2.1.5. Blockchain

Blockchain techniques and their use in Massive Open Online Courses (MOOCs) can generate a system of MOOC certification, so that each user can receive a unique signed digital certification of their course work. The certificates generated by these techniques are stored securely and permanently. In terms of a student's CV and subsequent access by a potential or current employer, or by an academic or educational institution; for example, when the student obtains a mobility grant or transfers elsewhere for personal, professional, or academic reasons, authorized third-party access to a student's certificates presents an authentic and unequivocal business application and benefit (Chen et al., 2018; Schmidt, 2015). This technology is being perfected under various proposals for application within education, with one of the most significant being from MIT, with a pilot program that offers students the chance to receive their certificates on their smartphones via the Blockcerts Wallet app that uses Bitcoin's blockchain technology.

3. CONCLUSIONS

AI promises big changes in the near future. Some changes in the field of education are already beginning to be felt and intuited. It is, however, necessary that both current and future proposals are devised and constructed according to didactic principles that allow for the full advantage of AI's potential to be exploited so as to generate more sustainable, diverse, and accessible learning environments for all students.

DECLARATIONS

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