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EDITORIAL

Generative AI in education: It wasn't that big of a deal... or was it?

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It seems that things have got back to normal. The great uproar that generative artificial intelligence raised almost two years ago has begun to weaken. The question we can ask ourselves is whether excessive expectations - and fears - were generated. My thesis is, as the title suggests, that although it has not been that bad, we cannot ignore its impact, either. Generative AI represents a turning point from which the world of education and didactics cannot move away; what this technology can do in the present, and what AI in general will represent for society, must be addressed.

The social relevance of AI appears reflected at an European level, which culminated before the summer with the passing of the *AI Act*, the European regulation on artificial intelligence. This act introduces a novel approach to regulating the use of AI based on risk levels. From this regulation, I highlight the definition of an AI system: "a machine-based system that is designed to operate with different levels of autonomy and that can show adaptability after deployment, and that, for explicit or implicit objectives, infers from the input information it receives the way to generate output results, such as predictions, content, recommendations or decisions, which can influence physical or virtual environments". An extensive definition, which seeks to cover everything, without leaving loose ends. In education, we are already beginning to feel the effects of these systems, and their influence will only grow in the future.

But let's go back to the technology that revolutionized the landscape through tools like ChatGPT: generative AI. These systems not only analyze data and make predictions, but are also capable of generating original content, from texts and images to writing computer code. What is surprising about generative AI is that it produces incredible results not from a deep understanding of the topic, but through statistical patterns, what we might call *competence without understanding*. However, this is how human intelligence emerged. As Daniel Dennett (2017) points out, since there can be competition without understanding and since understanding (the 'real' understanding") is expensive, nature makes intensive use of the principle of minimum knowledge and designs very capable, expert, and even cunning creatures that have no idea what they are doing or why they are doing it. The model does not understand content as a human would, but it is still capable of generating products that could easily seem made by an expert.

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This phenomenon has perplexed educators and researchers. AI's ability to generate coherent trials, solve complex mathematical problems, or even program, raises an essential question: how is it possible that a machine without true understanding can mimic such advanced human skills? The capacity of large language models (LLMs) is undoubtedly surprising, and their integration into education has aroused enthusiasm and apprehension at the same time (García-Peñalvo et al., 2024).

It's not that big of a deal

When ChatGPT came out, I carried out some home experiments, as it could not be otherwise, putting it to the test with logic exercises (Llorens, 2022). This August, with a more trained and reinforced ChatGPT, I decided to repeat some experiments, this time thinking about their usefulness to prepare for the course that was about to start. I selected ten activities that I consider basic and representative of the subject of Logic that I teach in the first year of Computer Engineering. I set myself two questions: 1) Can AI solve them correctly? 2) Can it generate similar activities that I could propose to my students? (This would open up an interesting possibility of assigning different activities to each and every student).

The answer to the first question is yes. Not only does AI solve the activities correctly, but when asked to justify his answers, the explanations were quite good. Today's ChatGPT has learned to first determine the steps to follow to solve the problem and then apply them to find the solution, just as prompt engineers have taught it throughout these almost two years of interacting with it. To make things more complicated, on some occasions I even converted the questions into images, with text and logical symbols, and still managed to recognize them and answer them correctly.

The answer to the second question is much more interesting. When, after solving an activity, I asked ChatGPT to generate five similar activities, things got worse. To make variations, ChatGPT often used synonyms that, in logic, are not always correct, or introduced new concepts that had not been seen in class, although they were valid in general terms. Sometimes he considered logical formulas as equivalent when they were not. This could be specific to logic and my subject, but it reveals an important limitation.

The most worrying thing happened when it generated questions whose answers were the number of interpretations. In one case, ChatGPT told me that the correct answer was op tion A: 2^{24}, reasoning correctly where 24 (number of atomic formulas) comes from. So far, so good, since it was indeed the correct answer. However, the option A that ChatGPT had initially posed was 2^{40}. Moreover, none of the four options proposed as an answer was correct. This completely undermines trust in ChatGPT for automatic question generation. How am I going to trust a system that writes to me as option A 2^{40} and immediately tells me the solution is 2^{24}, i.e. option A?

This result was not a surprise, at least for those of us who have been dedicated to artificial intelligence for years. As Ramón López de Mántaras (2024) points out, a key question is whether the large language models of generative AI understand and reason in a general way or simply retrieve and paraphrase the text patterns contained in the corpora used for their training. Subjecting them to counterfactual tasks is, without a doubt, an interesting way of evaluation.

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Indeed, it is a big deal

Generative AI has shown that, through training and statistics, it can replicate many of the cognitive tasks that until now we thought were exclusive to humans. This technical achievement is astounding and should not be underestimated. It has revealed a new dimension of learning and human skills: a machine, fed with large amounts of data, is able to mimic advanced capabilities without the need for understanding in the traditional sense.

However, this development also entails significant risks in the educational field. Among the most concerning ones is the potential impact on students' ability to think critically and creatively. If they rely on AI to generate texts and do work, we risk losing something essential: language is not only a vehicle for transmitting knowledge, but also a fundamental tool for creating knowledge. It is through the articulation of ideas through language that human beings develop their thinking. If students stop practicing this process, they could be compromised in their ability to think deeply and independently.

Teachers, therefore, face the challenge of integrating this technology without compromising the intellectual development of students. Generative AI cannot become a substitute for personal reflection and production. Although it can be useful for mechanical or repetitive tasks, if not managed properly, it could weaken one of the most important skills in integral training: the ability to transform thought into language, and language into new ideas.

Generative AI has surprised with its impressive technical capacity, but the real challenge lies not so much in what this technology can do, but in how we are going to use it in the educational field. If used correctly, it can free up time and energy for both students and teachers, allowing them to focus on more creative and analytical tasks. However, if we allow it to replace the process of creation and personal reflection, we run the risk of compromising something essential in humans: our ability to think.

The emergence of generative artificial intelligence in the field of education has raised as many expectations as it has raised concerns. We have been told that it would completely change the way we teach, learn and evaluate. However, after the initial enthusiasm, it is worth asking: has it really delivered on everything it promised? Or has it simply joined the long list of technologies that promise a lot, but transform little? Everyone has their own answer to these questions. My recommendation, however, is that we do not underestimate or despise this technology. AI touches the heart of our work as teachers: the development of our students' ability to think.

While we continue trying to solve this dilemma of enormous complexity, AI has already arrived in our classrooms. A group of expert teachers in the field, concerned about its impact on education, has developed the *Safe AI in Education Manifesto* (Alier Forment et al., 2024), which establishes seven fundamental principles for the ethical and safe use of AI in educational environments, aligned with the essential objectives of education. These principles seek to provide a framework to guide educators, educational institutions, developers and AI providers in the process of deciding whether, and how, AI should be used in education. The most interesting, novel and, in my opinion, useful thing about this manifesto is the checklist for evaluating

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and integrating AI tools in the educational field (*AI in Education Integration Checklist*). Fully complying with all these criteria will be complicated in the current situation, but checking them out when selecting AI-based tools can be very useful.

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