The Artificial Intelligence revolution in times of technology denialism

La revolución de la Inteligencia Artificial en tiempos de negacionismo tecnológico

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ABSTRACT

Artificial Intelligence has been developing technically for decades, but it is in 2022 when the irruption of ChatGPT shakes the foundations of educational systems and all teachers, academics and people involved in one way or another in education. The need arises to know what it is, what it is for and what implications it can have on our systems, models and strategies in education. In this article we explain what Artificial Intelligence is and address some reflections on its educational impact. We also suggest in this article some Artificial Intelligence tools that may be useful to teachers, researchers, students and in general, to anyone interested in knowing a little better what this innovative technology -which we have called the "fourth educational revolution"- can be used for. Finally, we make some recommendations on their use in education.

KEYWORDS

Artificial Intelligence; Generative Artificial Intelligence; education; applications; technology denialism.

RESUMEN

La Inteligencia Artificial lleva desarrollándose técnicamente durante décadas, pero es en 2022 cuando la irrupción de ChatGPT hace temblar los cimientos de los sistemas educativos y de todos los docentes, académicos y personas involucradas de un modo u otro en la formación. Surge la necesidad de saber qué es, para qué sirve y qué implicaciones puede tener en nuestros sistemas, modelos y estrategias en educación. En este artículo explicamos qué es la Inteligencia Artificial y abordamos algunas reflexiones sobre su impacto educativo. Además sugerimos algunas herramientas de Inteligencia Artificial que pueden ser útiles a los docentes, a los investigadores, a los estudiantes y en general, a cualquier persona interesada en conocer un poco mejor para qué se puede usar esta tecnología innovadora que hemos denominado como la "cuarta revolución educativa". Por último, hacemos algunas recomendaciones sobre su uso en educación.

PALABRAS CLAVE

Inteligencia Artificial; Inteligencia Artificial Generativa; educación; aplicaciones; negacionismo tecnológico.

Main contributions of the article and future research lines

- Educational revolutions through the incorporation of technologies.
- Artificial Intelligence tools that can be used in education.
- Reflections on Artificial Intelligence and its safe and ethical use.
- Applications of Artificial Intelligence in education.

1. INTRODUCTION: ON REVOLUTIONS IN EDUCATION

Sticking to the RAE definition, a revolution means a "rapid and profound change". We can find a description of the evolution in the world of industry through four revolutions: mechanisation, electricity, information technology and the fourth, digitalisation. To make a simile, we could consider four revolutions in the world of education based on the analysis of the impact of technologies (Figure 1):

- In the last century we find a first revolution when in the 80's and 90's the interest in the use of videos and computers was focused (remember the Atenea and Mercurio programmes for the introduction of videos and computers in schools in Spain);

- It was in 1990 that Spain was connected to the Internet and from then on we began to talk about the importance of the network of networks in breaking down the walls of the classroom and transforming education in all spheres - formal, non-formal and informal;

- The end of the 20th century saw the arrival of web 2.0 and social networks, a moment in which consumers of digital information became producers of information and, in addition to its impact on all areas and educational contexts, interesting experiences with virtual communities and networked collaboration were promoted;

The fourth revolution we are currently experiencing has arrived with Artificial Intelligence (hereinafter AI) and Generative Artificial Intelligence (GAI), because although AI experiences have been developed for years, it is in 2022 when it has burst with force thanks to the public and viral launch of *ChatGPT*.

Figure 1.

Educational revolutions through technologies

But we are in the year 2023 and looking back, not all technologies have had the same impact. Has the school changed so much? Have technologies gone hand in hand with processes of have they really been revolutions... or small transformations in specific contexts and at specific moments? Do we teach differently in universities, in secondary schools, in colleges? Perhaps a critical analysis leads us to think that the revolution is not such, even the changes brought about by the Covid-19 pandemic have to some extent been reversed and we have returned in most educational institutions to the pre-pandemic situation. It could be considered a boomerang effect: we have made clear progress in digital teaching skills, but after the pandemic, we have returned to face-to-face and traditional teaching, and there are even many critical voices in relation to the use of technologies in schools.

Figure 2.

Image created with AI (Microsoft Bing) of "innovative teacher using digital technologies at School".

The illustration accompanying this text (Figure 2) is created with AI, specifically with Bing. I have asked the AI for an image of a teacher using digital technologies and AI to teach. It is curious to take a closer look at her. The teacher holds a tablet in her hand and on the table we can see a computer and a small robot. Despite the presence of these technologies, we still see a blackboard in the background and a classroom configuration that seems traditional to us, with the students at their desks and looking at a screen instead of a book. We have exchanged books for screens. It seems that the AI is somehow overcoming some bias, as the teacher is black. Perhaps AI is not being as dumb as we might think, and really innovation in technologies is staying at that: just using technologies, but without being aware of the implications they really have on teaching and learning processes.

2. TIMES OF TECHNOLOGY DENIALISM

A Despite all this, and even at the risk of being wrong, I believe that AI is not just another technology that will pass by on the back burner. AI is so revolutionary that it is going to force us to make changes in our teaching strategies and certainly in our assessment strategies. For university students, we are already seeing AI changing their personal learning environment (PLE). And the digital competences acquired during the past pandemic period will be for us all -teachers and students- will undoubtedly be very useful.

Although many of the news items on technology are certainly alarmist, others simply seek to draw society's attention to the changes we are experiencing and which will undoubtedly have an impact on all social sectors, from the world of employment to the economy, culture and education. What there is no doubt about is the interest and social concern around AI and some of the tools that have had the greatest impact on the news and media in recent months since the emergence of ChatGPT[1] in 2022.

And all this is happening at the same time as some of us watch with astonishment the renewal of the technology denialism movement, but we are not surprised in itself, because it is not new. There have

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[1] https://chat.openai.com/chat

always been different tendencies in the way technology has been analysed, and they have been reflected in two extreme attitudes that we know as technophilia and technophobia. Even before the advent of digital technologies, these two tendencies were seen in relation to media in general. Umberto Eco's analysis of the mass media, which he published under the title "Apocalyptic and Integrated" in 1964, had a great impact. While apocalyptics and technophobes have a negative view of the media and technologies, we find the optimistic view of technophiles and integrators. It is probably in the middle ground that we find the virtue.

Within the critical positions, we can find an extreme anti-technology stance and other more moderate positions of experts who reflect on the impact of technologies by analysing their negative consequences, but without forgetting their enormous possibilities. Thus, there are arguments against technologies that are undoubtedly reasonable and reasoned. An example of this is Shirky's (2014) explanation, who justifies that sometimes students who are with their computers in class - and therefore in multitasking mode - stop focusing on what is important. The author understands that in certain situations, the fact of using technologies impairs attention and it is necessary to know how to identify when technologies can help in class or when they are a distraction, an idea with which we could not agree more.

> _"Regarding teaching as a shared struggle changes the nature of the classroom. It's not me demanding that they focus - it's me and them working together to help defend their precious focus against outside distractions" (Shirky, 2014, p. 3)._

But it is ironic that in times of technology denialism in education, AI arrives. In other words, when the impact of digitalisation is most visible and it is most obvious that it is unstoppable, the anti- technology discourses in schools are once again making a strong comeback. I wonder what scientific data some of these movements are based on and whether they have really arrived.

From the point of view of equity and social equality, it is an absolute nonsense to deprive schoolchildren of formal training that will enable them to access the digital world, as not all households and families have the capacity and knowledge to teach safe, critical, effective and efficient use of digital technologies. A school without technology will create a new social divide, even more visible in today's age of AI.

Between the extremes of technological denialism and uncritical technology gurus, we need an "intelligent education" that, from reasonable and scientifically based positions, allows us to take advantage of the indisputable potential of digital technologies and, with them, of the new world of AI. We are going to delve into it to better understand what we are talking about and we are going to show some of its possibilities and tools.

3. AND ARTIFICIAL INTELLIGENCE (AI) ARRIVES

In their work, Bonami et al. (2020) introduce us to a brief history of the origins of AI, recalling McCarthy and Turing as precursors. Barrera (2012) also mentions them in a more detailed historical overview. Whatever the source, all the authors recognise an evolution that takes us from the middle of the last century to the present time with this revolution that starts with the public dissemination of _ChatGPT_ in November 2022.

We must be aware that AI has been present in our lives for all these years. Isaac Asimov's 1950 novel _"I Robot"_ defined what are considered to be the three basic principles of robotics and the relationship of human dominance over robots. One of the most curious and famous experiments on AI was the

Kasparov vs. Deep Blue chess match, which, in case anyone doesn't know, started with Kasparov winning in 1996, but in 1997 Deep Blue won [2]. From then until today, numerous developments have been showing us how AI is helping us in our lives using natural language processing that has evolved from the possibilities of talking to a machine (Siri or Alexa, for example) to the potential of talking TO a machine (as we do with *chatbots*) and even showing its ability to CREATE (the IAG).

Recognising that it is difficult to find a generalised consensus with a single definition, in González-Calatayud et al. (2021) we start from the idea that AI integrates the concept of intelligence - understood as a human capacity- and the adjective artificial -as a process linked to machines-. Curugullo (2020) defines it as artefacts capable of interpreting information from the environment and even acting rationally and autonomously in certain situations. Gileta et al. (2020) understand it as a field of technical developments aimed at solving problems that require in one way or another a thinking process similar to that of human beings, hence the reference to intelligence. Gileta et al. highlight two of its branches: *machine learning* and deep *learning*. We have asked ChatGPT about these concepts, first in academic language and then in popular language, which also serves as an example of a possible educational use of these tools to find different ways of expressing concepts and ideas (see Figure 3).

Figure 3.
Machine learning versus Deep learning (according to ChatGPT)

ChatGPT 3.5 ∨

You
Explain in academic language the difference between machine learning and deep learning.

ChatGPT
Abstract:

Machine Learning (ML) and Deep Learning (DL) are subsets within the field of artificial intelligence (AI) that share fundamental principles but differ in their approaches and capabilities. ML refers to the construction of models that can learn patterns and perform tasks without being explicitly programmed. In contrast, DL is a specific form of ML that uses deep neural networks to model and solve complex problems.

Detailed definitions:

1. Machine Learning:

- Definition: Machine Learning is a paradigm of artificial intelligence that involves building computational models capable of learning patterns from data and improving their performance on specific tasks without explicit human intervention.
- Focus: It focuses on the development of algorithms and models that can generalise patterns from training data and apply that knowledge to make predictions or decisions on new data.

2. Deep Learning:

- Definition: Deep Learning is a sub-discipline of Machine Learning that uses deep neural networks to model and solve complex problems. These neural networks have multiple layers (depth) that allow them to learn hierarchical representations of data.
- Approach: It excels at using deep neural network architectures, such as convolutional and recurrent neural networks, to tackle tasks ranging from computer vision to natural language processing.

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[2] For chess fans, it is described in detail at https://es.wikipedia.org/wiki/Deep_Blue_versus_Garri_Kasparov.

Generative Artificial Intelligence (hereafter, GAI) can be simply understood as "a branch of artificial intelligence that automatically generates content in response to written prompts" (Vice-Rectorate for Educational Innovation, 2023, p. 6). Among the best known, we find the famous and already mentioned *ChatGPT* or others such as *Bing* or *Bard*.

The European Commission in 2018[3] already showed its concern to analyse the impact of AI and design common strategies for all member countries. In 2020, it published its "White Paper on Artificial Intelligence"[4] in which concerns about ethics, security, data protection and the need for a regulatory framework in this regard appear. In recent years, various documents have been produced that point to the European Community strategy on AI[5].

In the European context, work is underway on the "EU Artificial Intelligence Act"[6], a regulation on artificial intelligence that seeks to try to ensure the security and data protection of European AI users, as well as the transparency of companies developing AI.

4. ARTIFICIAL INTELLIGENCE AND ITS IMPACT ON EDUCATION

"Unesco asks governments to coordinate and integrate *ChatGPT* in education" (26/5/2023, *Infolibre*[7]). This headline is one of many that we have been reading in recent months, at the same time as the anti-technology messages that we have mentioned above are appearing and generating a lot of social alarm.

Unesco (2019)[8], at the Beijing meeting on artificial intelligence and education, insists on the need to use digital technologies to promote "effective and quality" learning, being aware of "the urgency of reaffirming and renewing this commitment as we move into an era characterised by the widespread application of artificial intelligence" (p. 29). In 2021, a guide on AI and education[9] points out its

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[3] https://eur-lex.europa.eu/legal-content/ES/TXT/HTML/?uri=CELEX:52018DC0795&from=DA
[4] https://op.europa.eu/es/publication-detail/-/publication/ac957f13-53c6-11ea-aece-01aa75ed71a1
[5] https://digital-strategy.ec.europa.eu/es/policies/european-approach-artificial-intelligence
[6] https://www.europarl.europa.eu/news/es/headlines/society/20230601STO93804/ley-de-ia-de-la-ue-primera-normativa-%20over-artificial-intelligence
[7] https://www.infolibre.es/politica/unesco-pide-gobiernos-integrar-chatgpt-educacion-priorizando- security_1_1507411.html
[8] https://unesdoc.unesco.org/ark:/48223/pf0000368303
[9] https://unesdoc.unesco.org/ark:/48223/pf0000379376

potential for education management, for teaching, for learning, for assessment, for teacher training and in general, for the improvement of education in the coming years. Nor should we forget the importance of ethics[10] in relation to the use of AI and its multiple and diverse applications.

In 2022, experts participating in the Educause Horizon Report[11] indicated that the most important technology in education in the coming years will be Artificial Intelligence for two reasons: on the one hand, AI applied to learning analytics and on the other hand, AI as a tool for learning. The authors stress the importance of ethical aspects in the use of AI and ask *"Are we ready yet?"* (Educause, 2022, p. 21).

UNESCO's initiative on the importance of teaching AI in schools focuses not only on AI as a tool for learning, but also on learning more about the possibilities of AI and preparing for the impact that AI will have on our lives. It is, in short, the now classic media literacy approach from which the idea of teaching with media (instrumental perspective of technologies as tools), teaching for media (instrumental perspective of technologies as tools), teaching for media (instrumental perspective of technologies as tools), teaching for media (instrumental perspective of technologies as tools) and teaching for media (instrumental perspective of technologies as tools) are defended (the focus on technologies as content) and teaching from the media (the approach to informal learning contexts mediated by technologies).

Beyond the theoretical discourse on the educational possibilities of AI and beyond the opinion of international organisations on the need to train for the use of AI, it is a reality that AI has been used in education for some time now.

In a review of advanced technologies for STEM education (Arabit-García et al., 2021), we collected examples of AI for different stages of education. In primary education, the work of Pareto (2014) was cited, in which the author used AI to work with mathematical concepts; Lane (2021) uses examples of AI to work with *machine-learning* and Scratch; Emerling et al. (2020) and Underwood (2017) analysed the potential of voice-guided smart devices.

At the secondary stage, we find experiences such as that of Auccahuasi et al. (2018) with an interactive AI tool to improve mathematical reasoning or Cui et al. (2019), who used an adaptive learning platform.

In university education, there are examples such as Binh et al. (2021) and Krechetov and Romanenko (2020) with intelligent tutoring systems and the systematic review carried out by González-Calatayud, Prendes-Espinosa and Roig-Vila (2021), thanks to which we were able to verify the interest that AI-supported tutoring and assessment systems (summative and formative) have aroused in recent years. Forero-Corba and Negre Bennasar (2023) also agree that most AI applications are being developed at secondary and university levels, although some have been found in primary school, but none in infant education.

We are already coming across manuals and recommendations on the educational use of AI, such as that of the UNAM (2023) or that of the Vice-rectorate for Educational Innovation of the UNED (2023). All of them highlight the usability of these new tools, which follow the line initiated by web 2.0 tools, designed for users without technical knowledge. Many of them are also free to use or have simpler free versions and more complete or powerful paid versions. We are going to give an example of some of the tools, without pretending to make an exhaustive catalogue, which is impossible and would be out of date before we finish writing these lines, given the speed of change. We only intend to offer an overview that

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[10] https://unesdoc.unesco.org/ark:/48223/pf0000377897
[11] https://library.educause.edu/-/media/files/library/2022/4/2022hrteachinglearning.pdf?la=en&hash=6F6B51DFF485A06DF6BDA8F88A0894EF9938D50B

shows the multitude of possibilities of AI, as it is not only *ChatGPT* or *Bing*, the best known among teachers (Sánchez-Vera, n.d.).

4.1. Some recommended tools for academic use

There are tools that have a general character and can be used in any context and situation, such as *ChatGPT*, *You.com* or *Google*'s *Bard*. Some tools we have been using on a regular basis for a long time and it is easy to see that they now incorporate AI, such as *Microsoft*'s office suite (*Copilot* is integrated), *Google Chrome* extensions (e.g. *ScribeHow* to record tutorials or *Print Friendly* to remove ads before printing) or AI assistants for browsers such as *Monica*, which can be installed in *Chrome* and *Edge.*

There are tools that have utilities that make them especially recommendable for an academic context, such as *Perplexity* and *Consensus*. I encourage all readers of this article to try them out and experiment with them, because unlike the more well-known *chatbots*, these tools lead us to the original sources of information.

Other useful tools in our context are those that can help us to improve our meetings, such as *Fireflies*, *Audionotes* or *Otter AI*. And others can even help us to improve our presence in social networks, such as *Tweet Hunter* (to improve our use of the social network now called *X*), *Fliki* to create videos from texts in *X* or *Taplio* to use with *Linkedin*.

4.2. Specific applications for teachers

Any AI tool can obviously be used in education. For example, in the guide produced by the Chilean Government's Innovation Centre (2023) we find numerous examples of educational use of *ChatGPT*. But there are AI tools that have been specifically developed to support teachers in their professional work and we have collected in this section some that we find particularly interesting.

For pre-university levels we liked to experiment with *MagicSchool* and also *Machine Learning for Kids*. For use at any stage, including at university, we recommend trying *Schemely* and *Eduaide.ai* (Figure 4), both of which are very versatile and usable. And lastly in this selection we suggest *ChatDOC*, which allows us to learn from a document by generating questions about its content, and similarly *Humata*.

Figure 4.
Eduaide as an example of an AI application to support instructional design
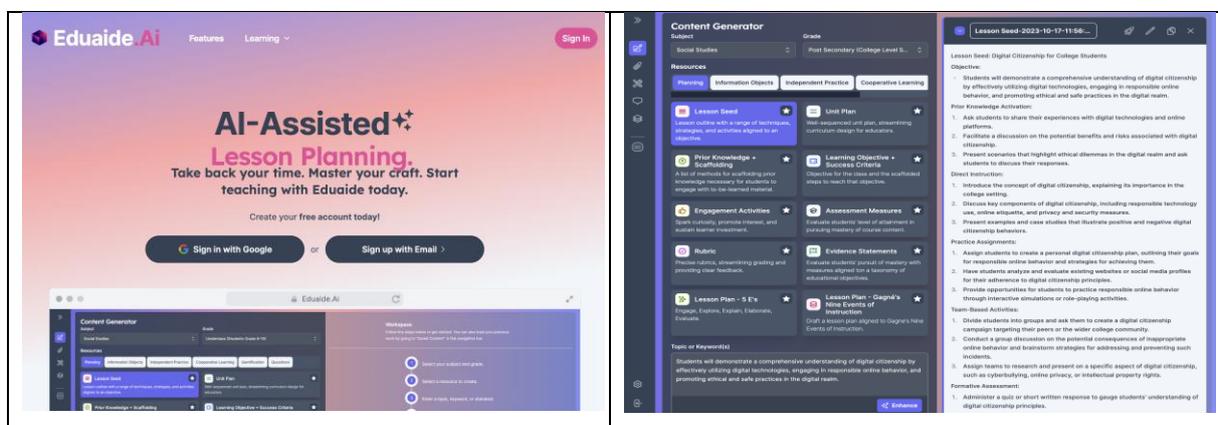
4.3. Generative AI applications to create digital materials

Here the catalogue is very extensive and we have not even been able to test them all, but they are tools recommended in social networks, forums or AI news. We have categorised them according to the type of digital content they help to create.

Table 1.

IAG Tools

PURPOSE	TOOL
Writing Assistants	*Jasper, Writesonic, Hemingway, Rytr, AdCopy, Copy AI*
Book publishing	*Bookwiz*
Image creation/editing	*Midjourney, Bing, LeiaPix, Dreamstudio, Leap AI, Magician Design, PicWish, Getimg ai, StockimgAI, Removebg*
Video creation/editing	*Runway, inVideo, Vidnoz, Kaiber, Heygen, Klap, Eightify, HeyGen*
Audio creation/editing	*Boomy, Voicemod, Lovo AI, Eleven labs, Songburst AI, Adobe Podcast, Buzz IA*
Designing visual presentation	*Tome, Decktopus, Canva, Flair AI, Gamma*
To translate audio from videos	*Rask, Camb ai*
Web design	*Framer AI, 10Web, Style AI, Durable*

4.4. General catalogues of AI tools and news

On the Future IA Lab website (Figure 5)[12] we find an extensive and interesting catalogue of more than a thousand tools classified by category and which also allows us to search for them. The portal also includes a newsletter to which anyone interested can subscribe. Another extensive catalogue that is continuously updated is Futurepedia[13]. And an equally highly recommended specialised portal is AI Generation[14], in which we find five categories (text, image, programming, audio and video) and a very interesting news portal.

In addition to these portals, we recommend the Telegram group created by Juanjo de Haro under the name ChatGPT-IA-edu[15], which currently has more than a thousand followers. And my collection of pins[16] on Pinterest, where I also collect infographics and information about AI and IAG.

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[12] http://futureailab.com
[13] https://www.futurepedia.io
[14] https://generacionia.com
[15] To subscribe: https://t.me/ChatGPTedu
[16] https://www.pinterest.es/pazprendes/inteligencia-artificial/

Figure 5.

Future IA Lab´s AI Tools Catalogue

4.5. The ethics of using AI

It is essential that these tools are used ethically and with academic honesty, but this is not new, it is as old as the technologies themselves. Those of us who are getting older remember projects such as Ted Nelson's Xanadu, which arose from the concern to protect the authorship of information that unlabelled wine of which Barlow spoke. Or the importance acquired over the years by Creative Commons licences, also generated to try to protect authorship while promoting collaboration and the exchange of information and digital content.

Now it is no longer just that we must pursue plagiarism, but that the information generated by IAG tools is not authored, it is the product of a machine. A valid strategy is to introduce an express reference to the IAG tool with which this information has been produced, like someone who incorporates a URL as the source of an image. In this sense, we recommend the Universidad Politécnica de Valencia's guide[17], which, in addition to explaining how to cite these sources, does so by adapting it to the different citation standards, including APA. In the specific case of the APA standards, which are the most common in the field of education and the social sciences in general, we have specific indications and examples that can help us (McAdoo, 2023).

There are other problems associated with the good use of AI and in this case we are talking about biases and hallucinations. Biases[18] arise from the information with which the machines are trained. Hallucinations[19] are responses invented by the AI. Both make it necessary to promote the critical use of information generated by intelligent machines, as the information we obtain is not completely reliable.

It is also interesting to see how easy it is to spread hoaxes and defame using the IAG, but again we have to remember that defamation has not just been invented, it is as old as human history. What we do have to recognise is that it is now very easy to construct hoaxes, for example to spread a false image, but with such an appearance of reality that it is really difficult to discover whether or not it is real. The

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[17] https://biblioguias.webs.upv.es/bg/index.php/es/citaria
[18] https://www.iic.uam.es/innovacion/inteligencia-artificial-responsable-sesgos-y-explicabilidad/
[19] https://www.bbvaopenmind.com/tecnologia/inteligencia-artificial/alucinaciones-de-la-inteligencia-artificial/

examples of the images of Donal Trump[20] being arrested or of the Pope wearing branded clothes[21], both created with AI and which went viral on social networks, are well known.

With human rights in mind, UNESCO (2022) lists the following basic principles for an ethical approach to AI. In summary they are:

1. A risk assessment to ensure necessity and to ensure that no harm is caused.
2. Secure use, avoiding vulnerability of systems.
3. The right to privacy and data protection, aspects that are undoubtedly of particular importance in the European context.
4. Develop regulations in an international context - while respecting the national sovereignty of states - that emerge from collaboration with actors involved in AI development.
5. Impact assessment and providing mechanisms that contribute to solving problems and ensuring well-being.
6. Transparency and that it is a technology that can be explained in every context of use, guaranteeing the above principles of security, privacy and protection.
7. They should be supervised practices for which there are responsible and accountable persons.
8. Sustainability guarantees in relation to the SDGs defined by the UN.
9. Awareness and literacy. This aspect is of particular importance from an educational perspective, as it advocates the need to promote AI literacy by promoting open and accessible education, as well as civic engagement and adequate training in digital skills, including specifically, of course, ethics in the use of AI.
10. Promote social justice, equity and non-discrimination, adopting an inclusive approach to ensure that the benefits of AI are made available to the whole of society without distinction.

5. IN CONCLUSION

In the work of Sánchez-Vera (n.d.) it is observed that for the teachers surveyed, the most useful use of AI is as support in planning tasks, for example, asking for ideas to work with students. And in classroom work, the most common use of AI is to search for and contrast information. Whatever its use at the moment, it is clear that it is already being used in education, which shows how quickly some of us teachers have already incorporated it into our practices. "Every teacher should question whether some of the management, teaching, learning or assessment tasks they perform can be improved by incorporating text, image or multimedia content generation tools" (Generative Artificial Intelligence Working Group, 2023, p. 7). The authors make the following basic recommendations:

- To use it critically and on the basis of reflection processes that help us to assess the possibilities, but also the risks and limitations.

- Use it safely and being aware of biases

- Use information responsibly and transparently, with professionalism, as AI brings with it the emergence of new forms of plagiarism and dishonest behaviour for academics.

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[20] https://www.bbc.com/mundo/noticias-65071726
[21] https://cnnespanol.cnn.com/video/papa-francisco-imagenes-falsas-inteligencia-artificial-redaccion-buenos-aires/

- Use it creatively (see the repository of examples in Nerantzi et al., 2023).

- Rethink teaching and learning, especially in terms of assessment strategies and tools, and also their uses for lifelong learning or community development.

It is precisely the assessment of students that is one of the critical aspects that we must be alert to with the advent of AI and IAG. We recently addressed this issue (Prendes et al., 2023) and proposed a serious reflection on the need, at last, to change our assessment strategies and move towards more personalised models in which the process has value in itself, beyond the product, as well as assessment tests based on interaction, student collaboration or even creative strategies that allow students to demonstrate the acquisition of competences and not just knowledge. We need to think about proposals original, in which we ask students to show us what they have really learned to do and not just what they have memorised.

As stated in the guide produced by the UNED (Vice-rectorate for Educational Innovation, 2023), "AI is here to stay" and what is relevant is to think about "how educational institutions can promote its effective, responsible and ethical use; in other words, how these tools can be integrated so that they add and do not subtract" (p. 4). In short, AI must be understood as a new catalogue of tools at our disposal, but tools so powerful that they will be the catalyst for that fourth educational revolution with which we began these reflections. We cannot remain passive spectators who watch the show from their armchair, because AI technology is so disruptive that it forces us out of our comfort zone.

And to get out of the comfort zone, the articles in this special issue allow us to learn a little more about its possibilities and potential.

From the University of Granada comes the work of Óscar Cordón, who reflects on the impact of AI from a broad perspective that allows him to contemplate not only the teacher, but AI in institutions and the impact that can be contemplated from technical, legislative, ethical and organisational perspectives, thus complementing the pedagogical.

The following article contains an interesting reflection on AI. Marcelo Ubal Camacho and his collaborators allow us to delve into these two sides of the coin: the risks and opportunities of AI, especially *chatbots*. This analysis is necessary from the point of view of rigour and critical thinking in order to be able to assess the transcendence of this technology.

Beyond the necessary reflections, in the work of Montiel-Ruiz and López-Ruiz we find the real experience of using AI in a rural cluster school and we see how AI has been used in this case for planning, resource creation, classroom implementation and evaluation, a whole range of real educational possibilities for AI applications.

The article by Dúo-Terrón et al. shows how training in AI and *machine-learning* can have important repercussions not only on the knowledge acquired, but also on attitudes and willingness to incorporate these innovative tools into our educational work.

So that's it: the fourth revolution of technology in education. It is here and it has come to change our institutions and our roles. We have to assume the need to redefine our teaching role and understand how it has changed the learning ecology of our students, our way of teaching and their strategies for learning. This is a challenge for 21st century education.

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