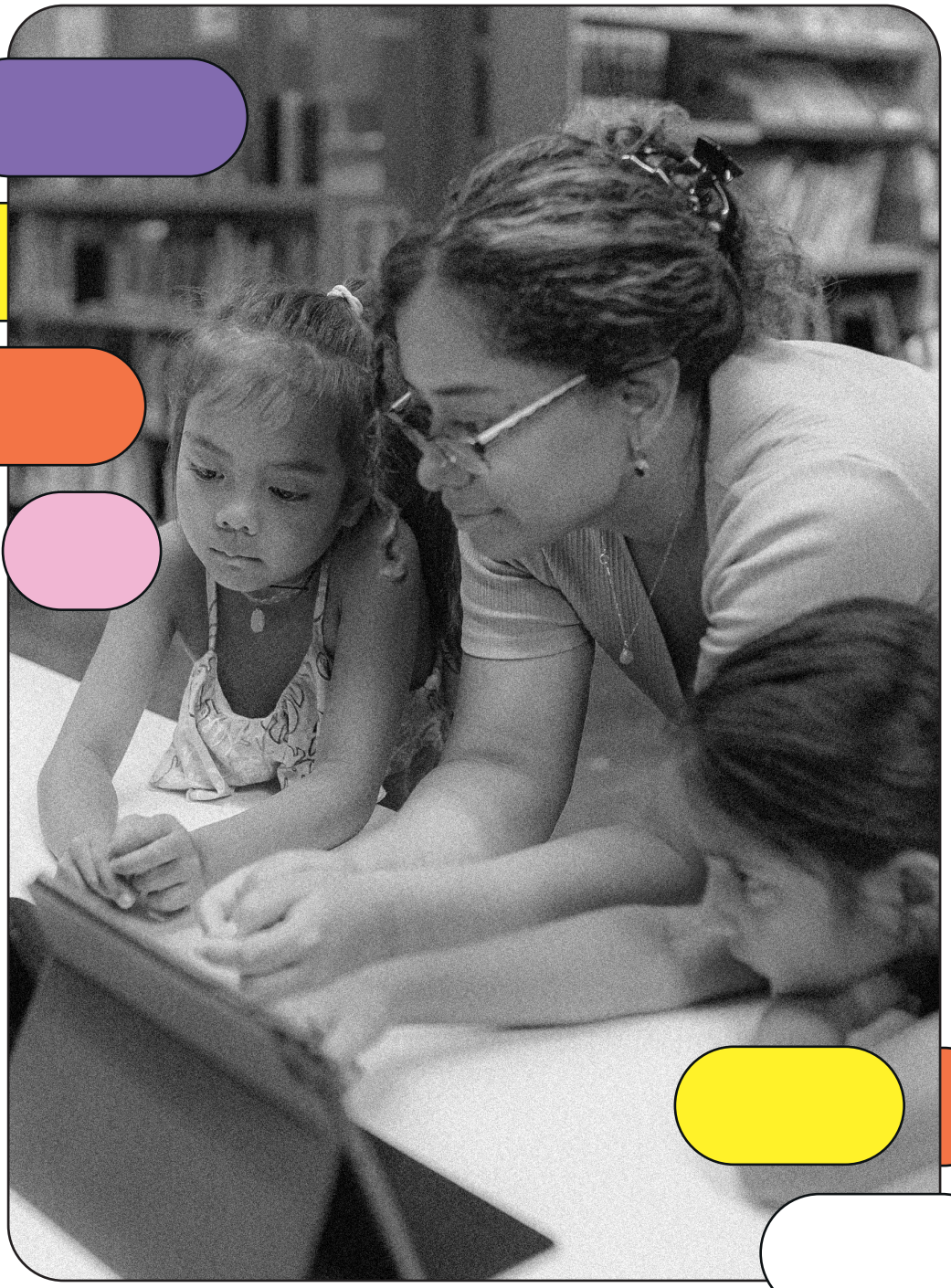
EVALUATION 4.0

Algorithms put to the test: **Why AI in education?**



Algorithms put to the test:
Why AI in education?

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Girona, 34
08010 Barcelona
fbofill@fbofill.cat
fundaciobofill.cat

Content writing / Alfredo Hernando Calvo, Ana Municio Zúñiga, Azucena Vázquez Gutiérrez, Héctor Gardó Huerta, Héctor Martínez Romero
Content coordination / Héctor Martínez
Content management / Héctor Gardó Huerta
Photography / Uncle Jun
Additional images / Unsplash.com
Graphic design and layout / Sonia Fernández
Editing coordinator / Anna Sadurní
Publishing / Fundació Bofill
List of contributors to this guide / Marià Cano, Jordi Corominas, Karina Gibert, Neus Lorenzo, Marc Oliveras, Carles Sierra, F. Javier Álvarez Jiménez, Rosanna Cabau Pomar, Pablo Dúo Terrón, Jorge Lobo Martínez, Carme López Casanova, Álvaro Martín De Ocampo, Alicia Morales Hermoso, Andreu Pons Prat

A project of

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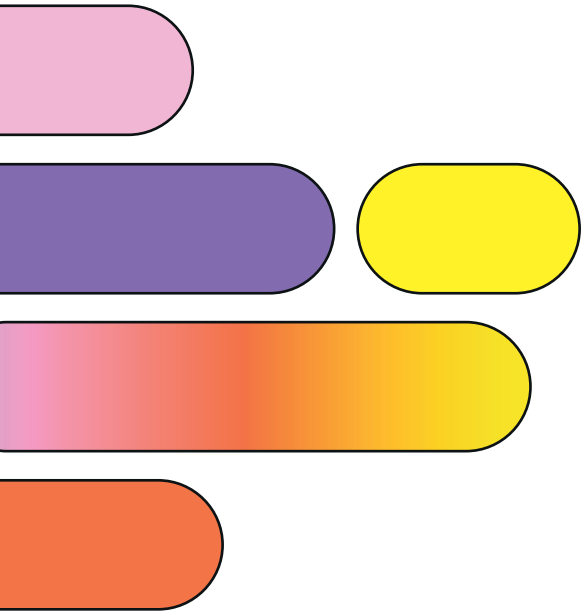
EVALUATION 4.0

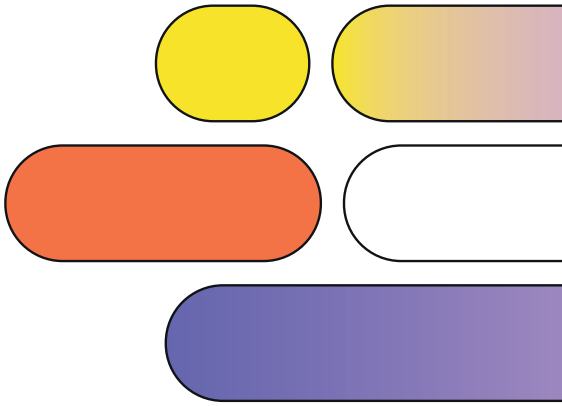
Algorithms put to the test: **Why AI in education?**



Héctor Gardó and Carles Sierra

The guide you are holding or are reading on your screen **is the result of the speedy collaboration** between two people, Héctor and Carles. The former explores the ways in which education might become more critical with digitisation. The latter creates and investigates solutions for digitising education. We are, to some extent, **two sides of the same coin:** improving education by incorporating educational and ethical technologies. **Our entities and people** joined our crazy partnership, and believed that experimenting on how **artificial intelligence** (hereinafter, AI) can improve educational assessment processes was well worth the effort. And so the **Evaluation 4.0** project to which this publication belongs was born.

Given that one of the **main goals of education is to train critical citizens**, it is clear to us that **pupils must be informed, educated and trained on the possibilities that technologies have to offer**, either to use them as a **source of opportunities** to improve their lives or to **question and hack them.** One technology that is advancing most quickly and that will have the greatest impact on education is **artificial intelligence**.



This process of mutual discovery and connection between AI and education results in challenges that involve us all. **Opportunities and risks** that we must detect and tackle, also as a group. For this desire to come true, teachers and pupils must take part as informed co-creators of these solutions. Only then will we be in touch with their real **needs**, their **doubts**, and their **expectations**. We will also be cultivating **communities that are more critical, empowered and prepared** to face the difficulties arising from the intensive digitisation to which they are exposed.

Gaining knowledge on **the intentions of the political and economic elite regarding the implementation of these technologies** is essential to be able to demand respect for human rights and shared social values from governments. In 2019, 100 Member States of UNESCO signed what was called the **'Beijing Declaration'**, in which a consensus was adopted for the **integration of AI into education**. It reinforces the idea that AI must focus on benefiting humans while guaranteeing their rights. This declaration emphasises the use of AI as an **opportunity to support education, and especially assessment**. It also warns that we must promote the equal and inclusive use of AI, guaranteeing ethics and transparency in the processing of education data. As educators, we must therefore play an active, leading role in these transformations.

As citizens, **pupils must be aware of the fact that they have digital rights that must be respected**, as acknowledged, for example, in the recent publication by the European Commission. **Teachers play an essential role in this process of exploration, education and support for pupils. Digital rights are increasingly becoming social rights**, and educational organisations are key to ensuring technology is not just another factor of inequality and social fragmentation.
We have set two challenges with this guide.
On one hand, **to provide the entire education community with a thorough** yet digestible study on the intersection between AI and education. We would encourage you to read it line by line if you are starting from scratch. If not, you can skip directly to the section that most interests you if you are familiar with the basics. Furthermore, **we would urge our nearest authorities to regulate** the potentially harmful impact of this technology on our pupils.

Finally, we would like to **thank** all the organisations that have made this possible, the experts who have contributed, and the ground-breaking teachers who have shared their classroom experiences.

We are taking the first steps, which are the most uncertain and important. Let's take them together.
Will you join us?

INSTRUCTIONS FOR USE OF YOUR GUIDE TO ARTIFICIAL INTELLIGENCE

This guide invites you to reflect on the use of artificial intelligence in education. When writing it, we wanted **to cover the most general concepts of artificial intelligence** before discussing more specific ones that focus on its actual application in the classroom.

Within this, **we also include the ethical and legal considerations required for its responsible use**.

Its contents offer support so that:

- you acquire **basic knowledge of what artificial intelligence is and which technologies are included in its definition** and you have access to materials to expand on this knowledge;
- you understand its **historical development to put into context the current point in time of this technology**;
- you consider the **ethical considerations required for its implementation in the classroom**, so that you can use it responsibly and support your pupils in this knowledge and its conscious application in their private lives;
- you discover **how artificial intelligence is being developed for application in education** and which laws govern this implementation;
- you find out **which advantages, opportunities and risks the application of AI offers in educational assessment**.

How can this guide be read? We would like to offer some shortcuts when reading it:

1/ If you know nothing about AI, congratulations, this guide is for you and you should read it in full.

2/ If you already know what AI is but want to find out about its potential in education, you can go directly to the **What can AI provide for education and assessment?** section on Page 23.

3/ If you know a lot about AI and are familiar with its educational potential, you can go directly to the **How is AI being introduced into education in Spain?** section on Page 38, where you will find cases of its application and can connect with people who love the subject as much as you do.

> Any sufficiently advanced technology is indistinguishable from magic".
>
> Arthur C Clarke,
> Profiles of the Future, 1962

We finished dinner and tapped our card on the terminal to pay: "Don't worry, we'll settle up. I'll send you my part by phone later". As we were finishing the conversation and saying our farewells, I ordered a car to take me home. With the app installed on my mobile phone, they charge it directly to my account and I can then download the receipt. On the way I unlocked my phone with facial recognition, "it even works when you're wearing a face mask, that's impressive", and I checked out my social media , "not that advert again that tries to make me buy the trainers I've been after for a while? How do they know what I want? It makes me feel a bit uneasy, they say that technology is listening to us". I've had so much fun this evening that I bet I can't sleep when I get home. Oh well, I'll listen to one of the playlists or a podcasts that my preferred content platform recommends, that's bound to make me relax.
I suddenly check my train of thought and realise that everything I've just done or planned is based on technology…

Technology is designed to be user friendly and, therefore, forms part of our everyday lives so effectively that it becomes "invisible". It's a kind of everyday magic that no longer surprises us. It's available to perform mechanical work, to make some transactions simple and instant, to inform us of things, to ensure we remain in touch remotely, and to fill our leisure time. The technology we use in our everyday lives triggers a series of operations that occur in seconds, which are so coordinated and fast that we don't even notice the complexity behind them.

We're living in the era of the implementation of artificial intelligence (AI), a technology that reveals its possibilities while forcing us to assess risks and new ethical frontiers. Everything you say, write, photograph, search for on the internet, and even the places you visit, generate information. All the data on our everyday lives can be captured, digitised and transferred anywhere on the planet. This data is used to generate digital footprints to anticipate our movements and influence our lives.

Is technology also "invisible" in educational environments? How can we assess its degree of "invisibility"? Digital integration is what happens when technology enables us to replace or redefine certain ways of considering the teaching and learning process. **Are we close to automating some of the more mechanical actions of our teaching work? What role is AI beginning to have in education? What do teachers need to know in order to integrate AI while ensuring the safety of their pupils? How should we prepare our pupils to live in a world in which technology is capable of making decisions and of influencing us?**[1]

We hope this guide will help you answer some of the questions posed or to ask new ones, but above all that it will awaken your curiosity to learn a bit more about artificial intelligence, encourage you to experiment with it in the classroom, and understand the necessary cautionary measures to use it responsibly.

[1] The goal of this guide is to answer these questions and to open you mind to new ones. The "Conclusions and looking to the future" section includes some answers in line with the contents of the guide.

WHAT IS AI?

Images generated by AI at https://this-person-does-not-exist.com/en

WHAT IS AI?

My name is Lupe, I've just been awarded a place at a state-funded school in Tarragona and I've been working in year 1 primary for two months. I couldn't be more inspired and surprised by these kids, and I learn something from them every day. I've only just started, and they've already shown me that I need to be up to date on a lot of things in order to fill the bill. They even told me that they use devices based on artificial intelligence in their everyday lives. Let me tell you how I arrived at the conclusion that I'll also have to use it in the classroom.

I had been asked this question every morning for several days: "Miss, did you
remember to bring that photo you promised?" A few days ago I promised my class that I would show them the sequaro cacti that live near my home town, Punta Chueca in Mexico, but I'm so busy what with all the changes and learning new things that I never remember it when I get home.

I forgot the photo, but they didn't forget to remind me. Insistence is one of the most powerful weapons of childhood. I apologised again, and asked them what I could do to not forget next time. "That's easy", a girl said so resolute that we all looked at her to find out what was coming next: "Talk with your mobile phone, tell it to remind you at a time you're at home. Mobile phones never forget to do what you ask them to do".

Her strategy worked, of course, and I was able to keep my promise. However, I also learned something very important: artificial intelligence forms part of my pupil's lives, and we cannot ignore it in the classroom and act as if it doesn't exist. From then on, I decided on two things: to always consider their ideas, and to learn how artificial intelligence can help us on an everyday basis in the classroom. But before planning anything, I need to fully understand what artificial intelligence is.

1.1 CAN MACHINES THINK?

The history of artificial intelligence wasn't full of machines right from scratch. It was the ideas regarding mechanisms of reasoning and the inventions to apply these ideas to machines that marked the start of artificial intelligence.

To place these first steps on a time line, experts go back to the syllogisms of Aristotle and inventions such as the *ars magna* by **Ramon Llull** (Majorcan philosopher, 1315)[2], which is considered the first creation capable of applying artificial reasoning to mechanical artefacts. It isn't so much the invention but the approach of Ramon Llull that established a line of scientific research that was to continue over the following centuries, leading mathematicians from times gone by to continue considering models to ascertain how to structure logical reasoning.

Victorian algorithms

Ada Lovelace (1815 - 1852) wasn't a conventional Victorian woman. Although she attended the parties of high society like any other aristocrat of her time, her true passion lay in mathematics. At one of these parties, Ada Lovelace met mathematician Charles Babbage and this friendship marked the course of Ada's short life. In 1842, Ada Lovelace published an article in the journal *Scientific Memoirs* in which she translated a document that described the analytical machine invented by her friend Babbage. But Ada Lovelace did not resign herself to translating the document, and the article contained many different notes in which she provided her own theories on how Babbage's machine worked. In these notes, Ada Lovelace described the algorithm to calculate the values of Bernoulli's numbers using two loops, she described how to perform trigonometric operations that used variables in Babbage's analytical machine, and she defined the use of perforated cards to programme the machine. The contributions by Ada Lovelace[3] weren't published under her real name until 1953; however, she has since been recognised as the first programmer in history.

In actual fact, the birth of the machines that will make artificial intelligence possible did not occur until the 20th century, when the keys for the technological innovation that would change society started to arise.

By the mid-20th century, technology had advanced enough for Alan Turing to try to answer the rhetorical question **"Is it not possible that machines do something that could be described as thinking, but that is very different to that of a human?"** (Turing, 1950). To do so, he designed a relatively simple test known as the **Turing Test**[4]: to place a human in front of a machine so that it could try to discover whether the replies to certain questions were given by a human or by a machine.

In his study, Turing concluded that when machines were able to pass this test, they would have reached the point at which it could be said they knew how to "think" in an operational sense.

Application of the binary system

The **Turing machine**[5] is the system that led to computing and the operating model on which any computer is now based.

It was at this time that Marvin Minsky, John McCarthy and Claude Shanon proposed a meeting of all those who were starting to work in the field of cybernetics, automata theory, and the processing of complex information.

At the Dartmouth workshop (1956), the term *artificial intelligence* was used for the first time as **"the science and engineering of making intelligent machines, especially intelligent computer programs"**.

Artificial intelligence did not take the form we know today until the 90s, when the *hardware* offered sufficiently high processing speed and the possibilities of the internet came into the equation. In 1997, Garry Kasparov **accused the IBM's computer equipped with AI, Deep Blue, of cheating**[6]. When Deep Blue won the match, the entire world - including Kasparov - realised that AI had reached a whole new level of development.

According to Kelley (2017), in the mid-2000s three factors converged that led to a great boost in the development of AI: the increased possibility of AI learning, the accumulation of data, and the development of effective deep learning codes.

It could be said that we are now in "the era of the implementation" of AI, and it is becoming so commonplace in our everyday lives that the process towards its "invisibilisation" is beginning. We cannot, however, avoid the impact that the current technological revolution has had and the social changes it is making, in which AI supports technologies such as robotics, nanotechnology, the Internet of Things, 3D printing, quantum computing, and autonomous vehicles, so much so that it has been called the 4th industrial revolution.

So, what is artificial intelligence today?

The UNESCO World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) describes (2019) AI as something that involves machines capable of imitating certain functionalities of human intelligence, including such features as perception, learning, reasoning, problem solving, language interaction, and even producing creative work.

[2] Find further information in the article **Ramón Llull y el Ars Magna: los orígenes de las máquinas pensantes** from the eldiario.es technology section.

[3] Read Ada Lovelace's bibliography in the National Geographic History Blog , with the article by J.M. Sadurní (2020) **Ada Lovelace, la visionaria hija de Lord Byron.**

[4] To increase your knowledge of the Turing Test, we recommend watching the video **¿Puede pensar una máquina?** by Javier Velasco, philosophy teacher at the Colegio Marista Casilla school in Palencia.

[5] Derivando video on Youtube (2018) **¿Qué es una máquina de Turing?**

[6] Further information on the story of **Deep Blue and Kasparov** in the article by Darlington (2016) in BBVA OpenMind.

1.2 IS TECHNOLOGY ACTUALLY INTELLIGENT?

What is and what is not artificial intelligence

Most of the population interacts with artificial intelligence on a daily basis, but do we understand what it really is?[7]

AI is the field of information technology that involves the creation of intelligent machines. In it, a group of technologies is developed to which certain human capabilities are attributed to **become competent in extracting knowledge by analysing different data** through the application of algorithms that generate patterns, their identification and, based on these, the production of new information.

TO SATISFY YOUR CURIOSITY

Do you want to know how Google Translate[8] learns languages to help you translate texts? This is a good example to understand how artificial intelligence learns.

AI is not capable of replacing human experts, but it is able to enhance human capabilities when performing certain tasks that neither machines nor humans would be capable of performing by themselves. AI never rests, it learns exponentially, handles huge amounts of data with a smaller margin of error than that of a person. But it must be remembered that **AI is designed for a specific task and is not capable of doing different ones**, and **it is unable to perform activities that involve an ethical or empathic assessment**.

The group of technologies known as artificial intelligence is described and classified in different ways, depending on their range or application. There is narrow AI (weak) or general AI (strong), depending on the scope of its use. **Narrow AI** is made up of very powerful systems in terms of the amount of data they handle, yet with a specific field of action. The AI we use in our lives is narrow AI, given that **general AI** is still hypothetical, although some AI programs are already capable of passing the Turing Test. Strong AI refers to the ambition to produce technology that is capable of successfully performing human intellectual tasks considering qualities such as conscience, sensitivity or self-knowledge.

It is not possible at present to talk of one AI but instead many technologies with shared characteristics.

Let's define them according to the way in which they work:

MACHINE LEARNING

The technology based on machine learning requires three components: macrodata, mathematical algorithms, and powerful computers. **The AI system analyses huge amounts of information to identify patterns and build models that it then uses to predict future values. This is why it is said that the algorithms "learn"**.

TO SATISFY YOUR CURIOSITY

Practice and try a machine learning model on one of these sites: Learning ML, Machine Learning for kids, AI and Machine Learning #7 with Scratch. If you're interested in finding out how to use it in your classroom, go to Page 40 where you'll find a practical experience.

[7] See the explanation in audiovisual format with the HubSpot video on Youtube (2017): **What is Artificial Intelligence (or Machine Learning)?**

[8] Find out how Google Translate learns, Youtube (2010). **Inside Google Translate.**

There are several techniques in making the machine learn:

Supervised learning
This relates the data with labels created by humans so that it builds models applicable to similar data. An example: Did you know that the applications that organise your photos by locating faces use artificial intelligence? Digikam.org is open-source freeware capable of differentiating people's and pet's faces for the localisation and classification of photos. Try it to understand how supervised learning works.

Unsupervised learning
The AI has a large amount of data that has not been classified or labelled. The search focuses on identifying patterns to group together data that will help classify new data. An example: Have you every tried OCR software to convert your written text into digital text? The recognition of handwritten words works by automatically identifying numbers and letters with patterns created based on thousands of examples.

Reinforcement learning
AI evaluates the models generated based on the initial data. It obtains information from this assessment on the degree of accuracy of the model and, based on this feedback, is capable of implementing continuous improvement.

An example: If an autonomous vehicle avoids a crash, the model achieving this receives reinforcement so that its capacity to avoid crashes in the future is improved.

DEEP LEARNING

The concept of deep learning comes from using a large number of hidden layers in neuronal networks (RNA). It is used to solve very complex problems, which require a huge amount of data and a powerful processing capacity.

TO SATISFY YOUR CURIOSITY
A neuronal network[9] is a computer system that provides machines with the capacity to "learn" based on connections inspired by the human brain. The network is formed by a large number of interconnected processing units that act simultaneously. These units are organised in layers of different levels: one input layer for data into the system, one or several hidden layers where the information is processed, and one output layer where the system decides how to proceed according to the data.

This technology has led to many of the more recent and surprising AI, as well as that which is already in everyday use, such as voice assistants like Google Assistant, Cortana, Alexa and Siri. The social media platforms also apply this technology to analyse user behaviour and interactions in order to detect trends, risky movements at personal or social level, and to improve the offers and contents suggested to each user.

An example: Through the project STOP (Suicide Prevention in Social Platforms)[10], the Pompeu Fabra University and the Ajuda i Esperança Foundation use artificial intelligence to detect metal illness over the social media, particularly depression, eating disorders, and suicidal tendencies. Based on this analysis, campaigns can be established to increase the number of calls made to the Helpline.

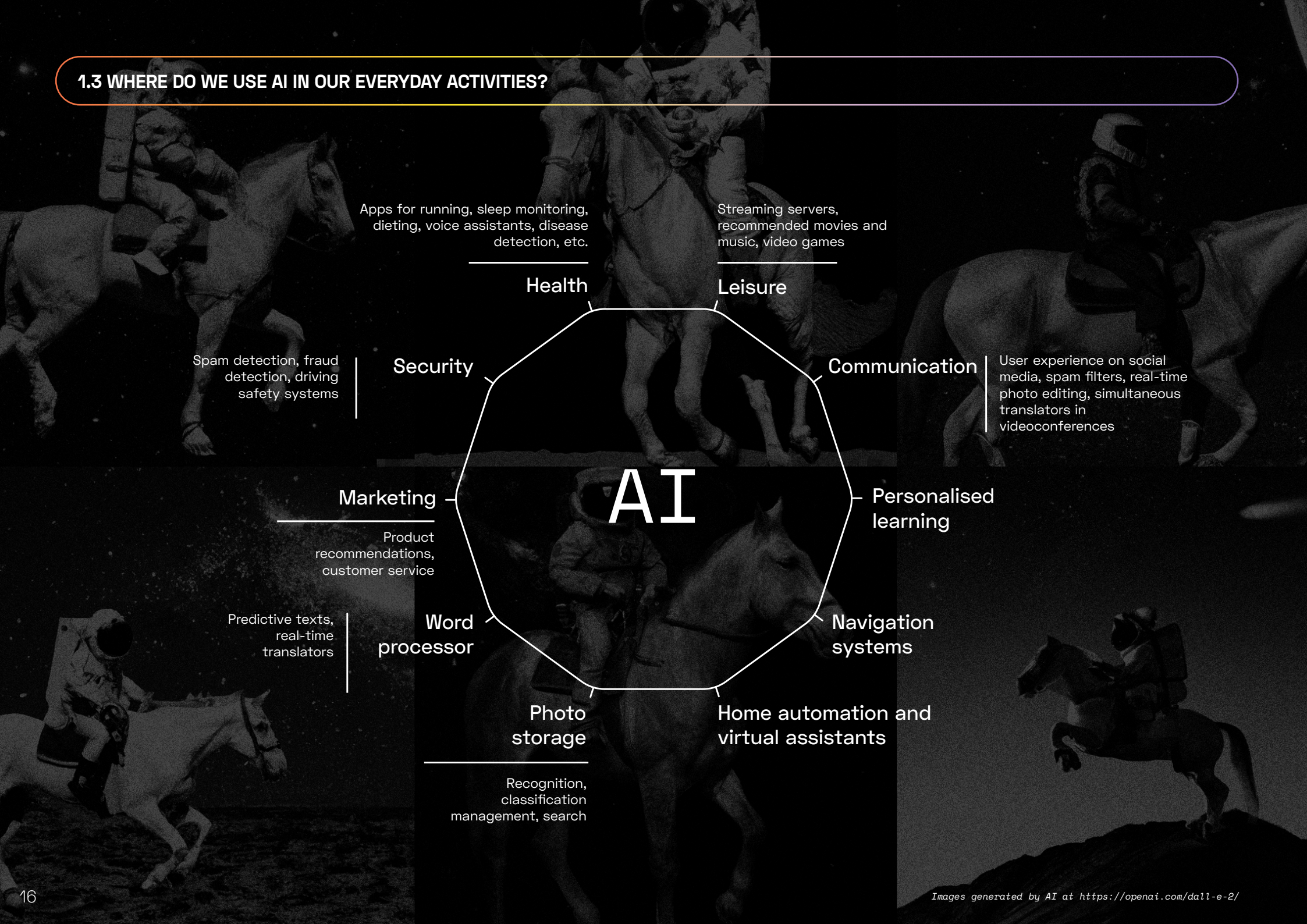
TO SATISFY YOUR CURIOSITY
Could you now explain what the difference is between *machine learning* and *deep learning*?[11]

[9] Expand on this information at BBVA OpenMind with the article **¿Qué es el aprendizaje profundo?** By Ahmed Banafa, an AI expert.

[10] Find out more about the **STOP Project.**

[11] The AprendeInnovando video **¿Qué son el MACHINE LEARNING y el DEEP LEARNING? - DIFERENCIAS** can help you organise your ideas on these concepts and understand them more fully.

1.3 WHERE DO WE USE AI IN OUR EVERYDAY ACTIVITIES?



Images generated by AI at https://openai.com/dall-e-2/

Increasingly present in our lives for years now, artificial intelligence has become part of everyday life to such an extent that we no longer ask ourselves how the software is able to do what it does. We are used to using our digital fingerprint on our mobile phone or unblocking it using facial recognition, to listening to music or watching series according to the personal recommendations given by the platform to which we are subscribed, to receiving advertising adapted to our needs, or to translating a text from any language, even from a sign in a photograph. **AI is increasingly cheap, powerful and ubiquitous** (Kelley, 2017).

Most of the software that we use with AI is classified into one of these services:

Natural language processing (NLP)
Software that enables us to interpret texts automatically, translate them, analyse them semantically or generate texts.

An example: **Otter.ai**, **DeepL**.

Speech recognition
AI personal assistants capable of interpreting our words, *chatbots* that hold a conversation to solve our doubts, processors that write dictated texts.

An example: **Alibaba Cloud**.

Image recognition and processing
Facial recognition, handwriting recognition, image processing, autonomous vehicles, early detection of diseases or early detection of abnormalities in foetal scans.

Examples: **Siemens NX Solution**.

Automated agents
Virtual assistants, intelligent robots, gaming avatars, **malware** bots. Examples: **Woebothealth**, **Hello Baby** (Family support project by UNICEF).

Emotion detection
Use of AI in different environments to detect and analyse behaviour and facial expressions.

An example: **Affectiva**.

Data mining for predictions
Application of AI in medical diagnostics, weather forecasting, business forecasts, fraud detection, user recommendations on leisure platforms, search engines, information spaces, managed trade.

Examples: *streaming* platforms, music platforms or **Suggin**.

Artificial creativity
Use of AI for the artistic creation of music, photographs, works of art, narrations.

Examples: **Random face generator (This person does not exist)**, Gpt3(text generation with AI), **Neuroflash**, **NVIDIA GauGAN2**, **Verse by Verse** (poetry creation with AI), **Ai-Da el robot artista**, **DALL-E-2**

Source: **UNESCO, 2021.**

Luce is ready to use AI in her classroom as yet another technology that could make some processes easier. She has understood how AI came about and which types of technology are classified as artificial intelligence, but this has led to a series of questions to which she can find no easy answers. If she has learned anything about AI, it is that it's already in our lives and that we all need to know how it works in order to use it responsibly. She has realised that not only is it another tool for the classroom but is also knowledge that forms part of the digital skills we must all develop as citizens. Pupils must understand that AI decisions are not always the most appropriate for humans, for many reasons or circumstances (as AI doesn't know what's best, worse or suitable in each circumstance), and that many of the AI-based apps they use collect data that is stored and used. Using technology from a critical viewpoint forms of the literacy required today.

At present, alongside its technological development, work is being performed worldwide towards responsible artificial intelligence. This need is clear to international institutions and governments, and to technology companies, and involves both the research budget to minimise the risks inherent to technology and the drafting of laws to govern its use.

Implementing responsible AI consists of ensuring AI systems are ethical, legal, beneficial and solid; that these requirements are auditable, and that the organisations implementing or using these systems are held accountable (UNICEF, 2021).

The main concerns regarding AI systems are:

1/ That the **source of the data** used is the result of its ethical, transparent collection and pathway based on respect for personal privacy.

2/ That the **bias resulting from the data** can influence the results, making the human errors of those programming or planning data collection chronic.

3/ That equality and non-discrimination is guaranteed throughout the process: analysis planning, data collection, and results obtained.

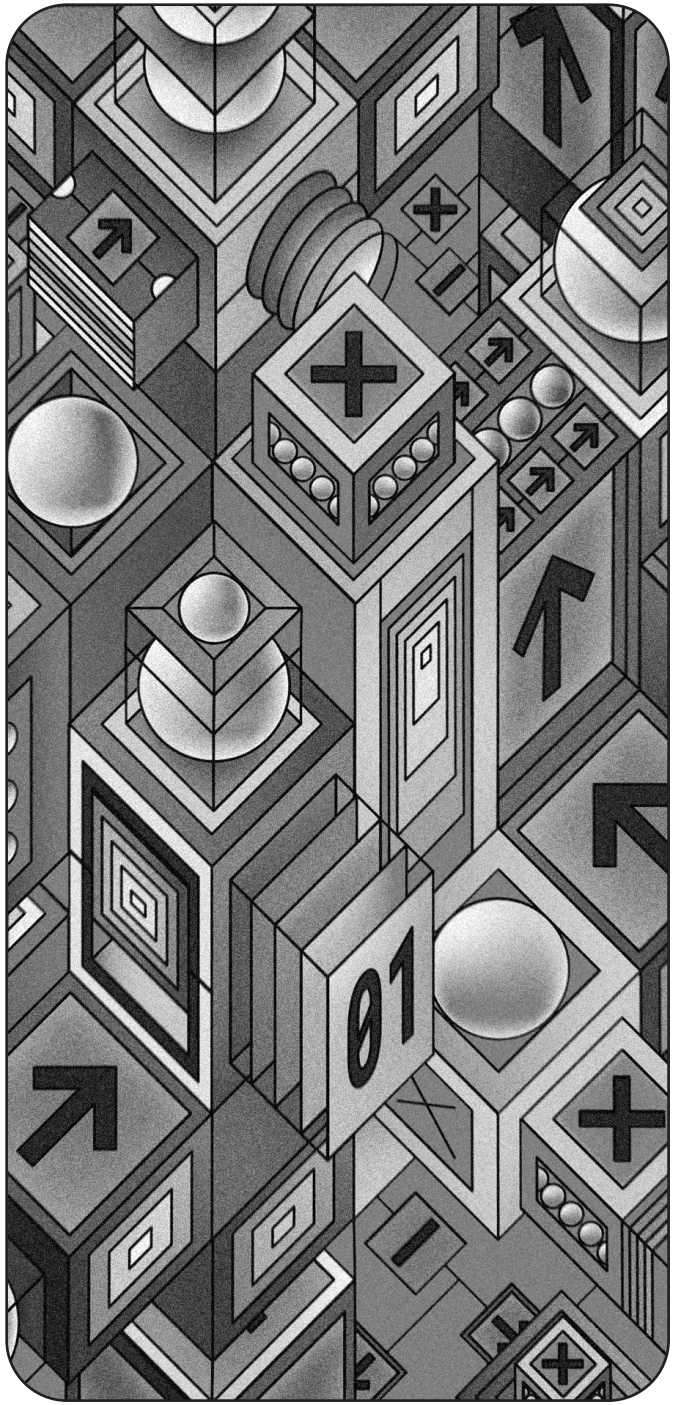
4/ That **the ethical parameters** based on which the technology is designed and artificial intelligence is supervised and audited over time are consensually defined.

5/ That the **traceability of the solutions** are known, as the complexity of complex processes in hidden layers of artificial neuronal networks sometimes makes knowing how the results have been obtained difficult.

As was seen in the previous section, artificial intelligence must be trained using a large amount of data to improve its predictions and decisions. One of the main precautions of using AI is **the bias that this data may have on the results**; this bias **is a reflection of real discrimination that exists in society**. Not all the population is represented in the same way in the data used and, therefore, **the results of artificial intelligence might lead to discrimination by gender, race, age or origins.**

TO SATISFY YOUR CURIOSITY

The algorithms that use historical data to make predictions can increase gender, social or ethnic gaps. For example, translators of text reproduce gender bias when translating texts that include certain professionals: they often translate into masculine in the case of doctors and into feminine in the case of nursing professionals. If the use of AI involves the risk of reproducing bias, **what can we do regarding bias?**[12]

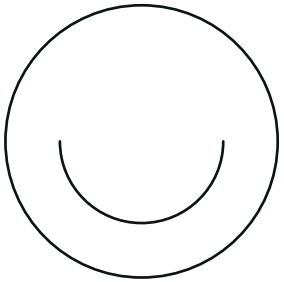


[12] James Manyika, Jake Silberg and Brittany Presten from the Harvard Business Review in the article **What do we do about the biases in AI?** analyse the source of biases in AI, and how to implement this technology responsibly to ensure equality.

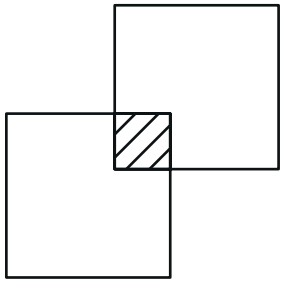
VALUES THAT SUPPORT, ENDORSE AND ENCOURAGE RESPONSIBLE INNOVATION

The ethics of AI must be considered as of the very design of the technology, ensuring it respects the following values:

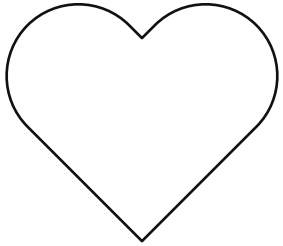
1/
RESPECT
the dignity of individual persons.



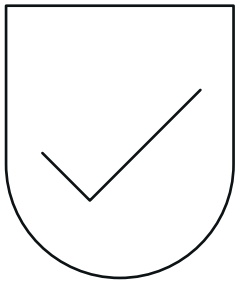
2/
CONNECT
with each other sincerely, openly, and inclusively.



3/
CARE
or the well-being of each and all.



4/
PROTECT
the priorities of social values, justice, and the public interest.



The use of AI-based technology must consider these values so as not to produce negative or harmful effects.

Source: The Alan Turing Institute[13], 2022.

[13] These 4 points summarise the recommendations of the guide **Engaging children with AI ethics** presented by The Alan Turing Institute in 2022 to responsibly and ethically engage children in the use of AI.

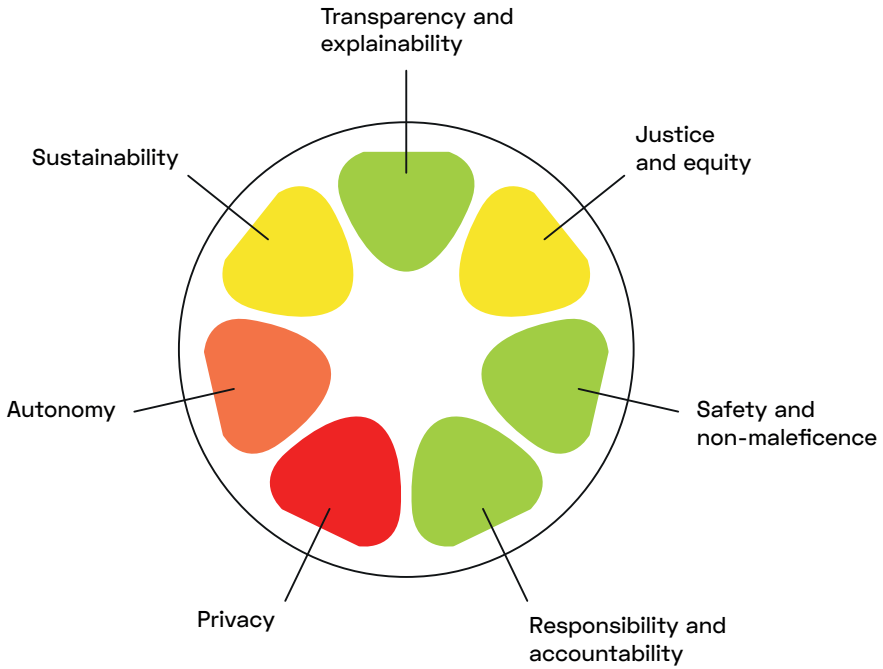
The impartiality of AI must be ensured through high quality, reliable, fair, transparent, solvent, compatible and safe data. Considering the global nature of the companies developing these technology systems, international agreements and the commitment of developers in ensuring AI ethics is implicit to technical development are essential.

TO SATISFY YOUR CURIOSITY

Following the polemic sparked by **Google employees due to their involvement in the military project known as Project Maven**[14], the company has taken steps to improve its image, presenting **ethical principles for the long-term development of AI**[15]. Furthermore, the European Union has established **7 rules for ethics in AI**[16], in order to gain the trust of citizens and to be used as a basis for regulating its use.

An example closer to home of the ethical use of AI can be seen in the work produced by El Observatori de l'Ètica en Intel·ligència Artificial de Catalunya (The Observatory of Ethics in Artificial Intelligence of Catalonia) in collaboration with the University of Girona. Published in June 2022, the **PIO Model (Principles, Indicators and Observables**[17]) is a proposal for organisational self-assessment on the ethical use of data and artificial intelligence systems, based on the *White Paper on AI* by the European Commission.

This model consists of 7 indicators to assess the degree of responsibility in the use of AI in any organisation:



Transparency and explainability: **100%**
Fairness and non-discrimination: **80%**
Safety and security: **100%**
Responsibility and accountability: **100%**
Privacy: **0%**
Autonomy: **20%**
Sustainability: **60%**

Source: **PIO Model (Principles, Indicators and Observables)**.

[14] The BigDatamagazine article describes the effects of the **Project Maven** following the protests by its employees on learning that the company was supporting the US army with AI.

[15] Read the **7 principles announced by Google for work with AI.**

[15] Ethical AI is included in the article **The 7 rules of the European Union** so that the technological development benefits individuals.

[17] Read the document on the **PIO Model**, where you will find further details on the 7 indicators for the responsible use of AI defined by El Observatori de L'Ètica en Intel·ligència Artificial de Catalunya in collaboration with the University of Girona.

UNICEF and the European Union have sought to highlight the importance of focusing research for technological development on the user and, therefore, have also considered the points of view of children and youngsters as important users of AI-applied technology. The report by the European Union **"Artificial intelligence and the rights of the child: towards an integrated agenda for research and policy"**[18] considered what children and youngsters think of the use of AI through participative research that included their viewpoint and their values, interests and needs.

The study considered, for example, how AI can work differently with the speech of a small child (given their tone of voice and lack of grammatical proficiency) or how it can affect their rights by providing access to services that are unsuitable for their age.

The **report indicates that youngsters are concerned about the risks of using AI**: privacy and data protection, violating the rights of the child, reduced freedom of expression, the possibility of attacks affecting cybersecurity, reduced autonomy of children due to excess supervision, and increased prejudice and discrimination. But the youngsters do not only mention the risks, **they also highlight the opportunities: encouraging learning and entertainment.** The children perceive robots positively and trust them, which can lead to a great many possibilities insofar as support for their learning; AI provides possibilities of personalisation and adaptation to individual differences, increasing the inclusive potential with regard to diagnosing and enhancing opportunities.

This study also brought together external experts from different entities, policymakers and researchers to review political initiatives and scientific trials to consider the viewpoint of youngsters, resulting in the **detection of several gaps in research and policies regarding the rights of the child when applying AI**, which pave the way to continue researching and developing the law. **Five requirements were identified:**

1/ Sustainability in the use of the technology, in terms of environmental impact,

2/ Transparency, explainability and accountability,

3/ Non-discrimination and inclusion,

4/ Privacy and data protection for security,

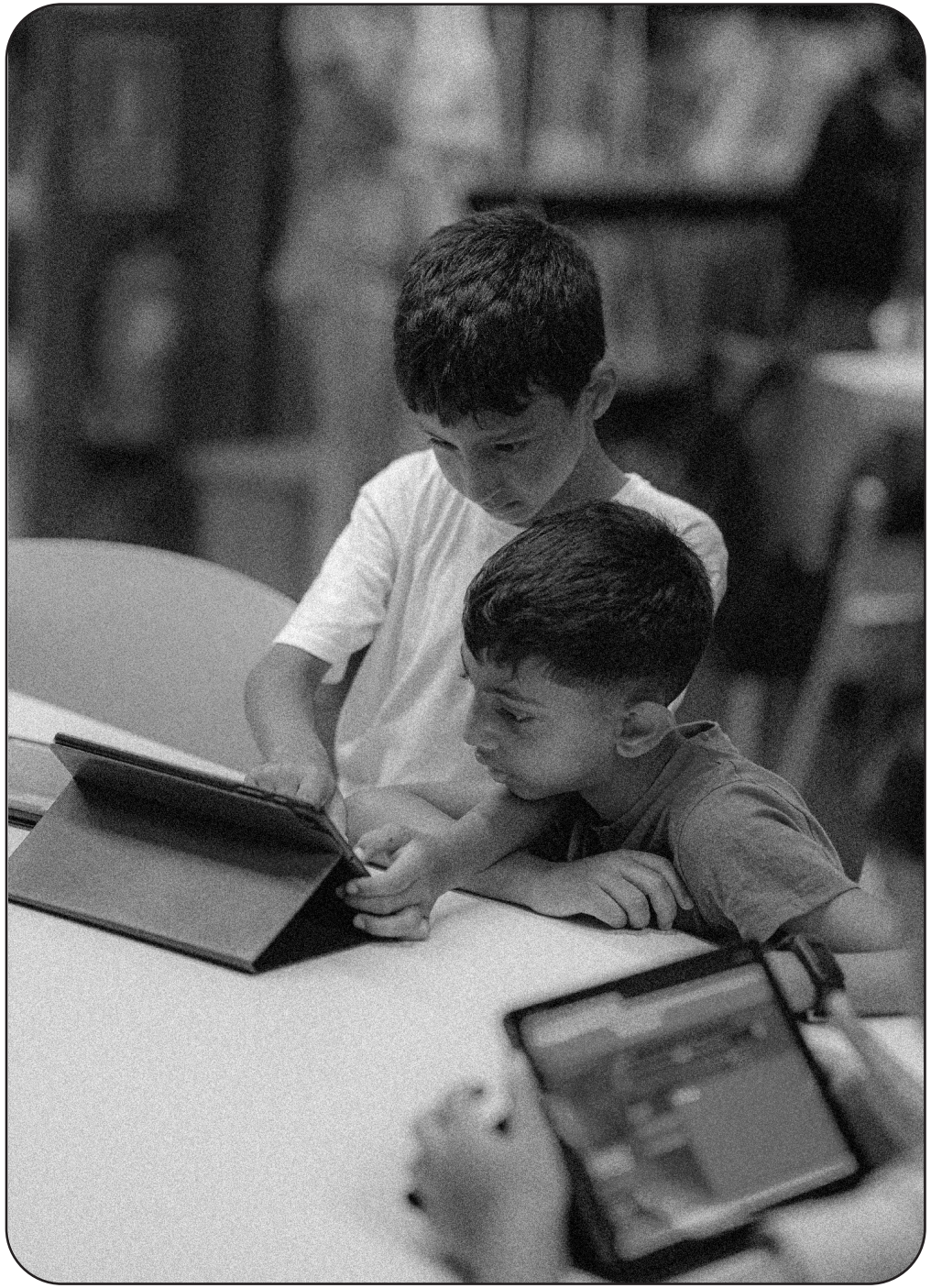
5/ Integration and respect for children's rights.

It also highlighted **four methods required to successfully develop and define AI technology adapted to children**:

- Anticipation, assessment and monitoring,
- Multi-stakeholder collaboration,
- Children's participation, and
- Balancing conflicting rights.

[18] Read the full European Union report (2022) **"Artificial intelligence and the rights of the child: towards an integrated agenda for research and policy".**

WHAT CAN AI PROVIDE FOR EDUCATION AND ASSESSMENT?

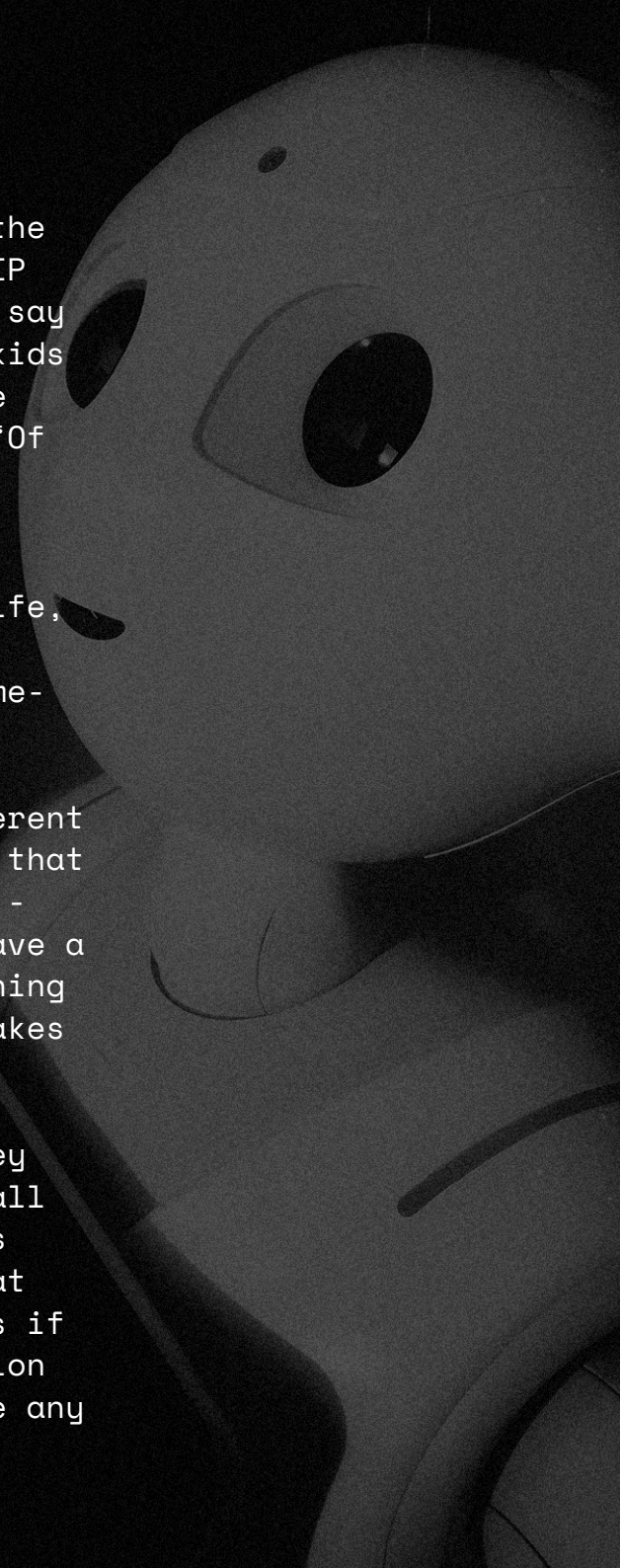


Checklists, checkllists and more checklists. Measurements, indicators and percentages. Initialling, binders and notes in the margin. Giving a grade at the end of each term isn't as easy as it seems! My name's Amparo and I work at CEIP Los Ángeles primary school. My school is in a small village near Malaga. They say it's a dormitory town but there's not much sleep to be had, especially by my kids who spend the evenings running around, as the heat forces them to stay at home during the daytime. "There's no way we can study like this, miss!" they say. "Of course you can!" I always say, "That's why we study bit by bit right from day one".

There is no place for learning in the grade of an exam. Learning comes from life, and lessons and experiences must be gained in order to reach a fuller, more comprehensive experience in the way our pupils learn. But this process is "time-consuming".

I like to integrate the final grade of my pupils right from day one using different tools and different moments throughout the year. However, although this means that everyday work is fairer and more equal, and I make sure - as much as possible - that each one of them is monitored, I do collect a huge amount of paper and have a lot of correction work to do. It's at times like those that I would give anything for some different kind of help, either by magic or technology, whatever it takes to help me through those endless hours of correcting.

How could all this be improved? Is there no way of making it easier or, as they say these days, of automating it? I suppose a robot-teacher that helps me do all these calculations and leaves me time to find out how each one of my pupils has come to school, whether they have had enough sleep, whether everything is OK at home... That would help me a lot with my checklists and initialling, almost as if they corrected themselves. Why not? It would be great if they gave their opinion of the total grade I give each pupil. With all the data I provide, isn't there any way of organising it so that technology can help me, from robot to teacher?



2.1 AI APPLIED TO EDUCATION

Interaction between AI and education goes back a long way. Overcoming the debate over the certainty that no technology can replace the social and emotional potential of humans, the application of AI in educational environments makes sense based on the statement that "if artificial intelligence and human intelligence work together they are stronger than either of the two working separately" (UNESCO, 2021).

Nowadays, AI is applied in education for different purposes and in different educational environments. The possible potential of applications that allow for greater **personalised learning** or that support it by providing educational *feedback*,
that streamline communication, and that reduce mechanical tasks, such as the classification of messages in an asynchronous forum, must be highlighted.

Ai-based applications that are already regularly used are involved in **education management**, simplifying certain tasks that were very complex, such as preparing timetables, distributing exams or using spaces.

Furthermore, many different AI-driven applications are used on a personal level for **lifelong learning**.

An app that enables you to expand your knowledge at your own pace

Brilliant Learn Interactively is a mobile app that allows for skills to be developed in different areas, such as mathematics, physics, and computational science. It is based on interactive problems that provide instant *feedback* so that the activity and the achievements reached can be fully tracked.

Within education, a lot of research has been done on AI applied to **the assessment of learning**. However, use of this technology is not generalised. Its potentiality has led to it being called the "fourth education revolution" (Seldon and Abiyode, 2018), and it seeks to provide access to **quality, personalised and ubiquitous learning** by anyone in the world and throughout their life. Although this application of AI still raises concerns, the solutions to which depend on the **creation of suitable laws**, all the institutions seeking the quality of education highlight its potential in inclusivity, equality, personalised learning, and how it might be key to help meet **Sustainable Development Goal No. 4**[19].

TO SATISFY YOUR CURIOSITY

Lay Teacher is an on-line platform of the Erasmus+ project that teaches languages to immigrants and refugees. The platform organises open educational resource contents and, in these environments, helps unqualified people take the place of teachers, as the platform itself personalises the learning of each pupil depending on their needs and level.

From international dialogue for the application of AI in education, agreements are being reached regarding its ethical considerations. There is wide consensus in these conversations as to how the platforms can lead a **change of role for teachers**, where it is increasingly necessary for teachers to develop a series of skills so that they can work efficiently and responsibly with AI.

[19] **Sustainable Development Goal No. 4** focuses on guaranteeing inclusive, equitable and quality education and promoting lifelong learning opportunities for all.

Furthermore, these considerations regarding the use of AI are extremely important in **"educational data mining"** and **"learning analytics"**, which focus on analysing macrodata generated by learning management systems (LMS) that can be used to guide teachers, managers, and the pupils themselves. This macrodata might also contribute towards guidance in the formulating of education policies.

The fact that a lot of this data comes from commercial learning platforms involves an inherent risk regarding its use. According to Shenone (2021), there are several risks in the use of information from learning platforms:

1/ The possible dishonest use of the data and algorithms, which can be manipulated for certain financial profits.

2/ The reduction to data from a complex reality such as education.

3/ The possibility of fabricating information through *fake news*.

4/ The homogenisation of criteria in response to a business model.

5/ The gaps that this might cause.

TO REFLECT

Have we considered which corporations are involved in data mining?[20]

A plan is important for the collection of data in education to ensure digitisation is democratic in terms of privacy and data and information sovereignty, but also in terms of applying the law, transparency, and freedom of expression and access to information.

To provide guidance on the development of education policies related with the **application of AI in education**, UNESCO (2021) classifies the emerging applications into four categories based on the needs they meet: for education management, for learning and assessment for the empowerment of teachers, and for lifelong learning. **SEE ANNEX 1,** Page 68.

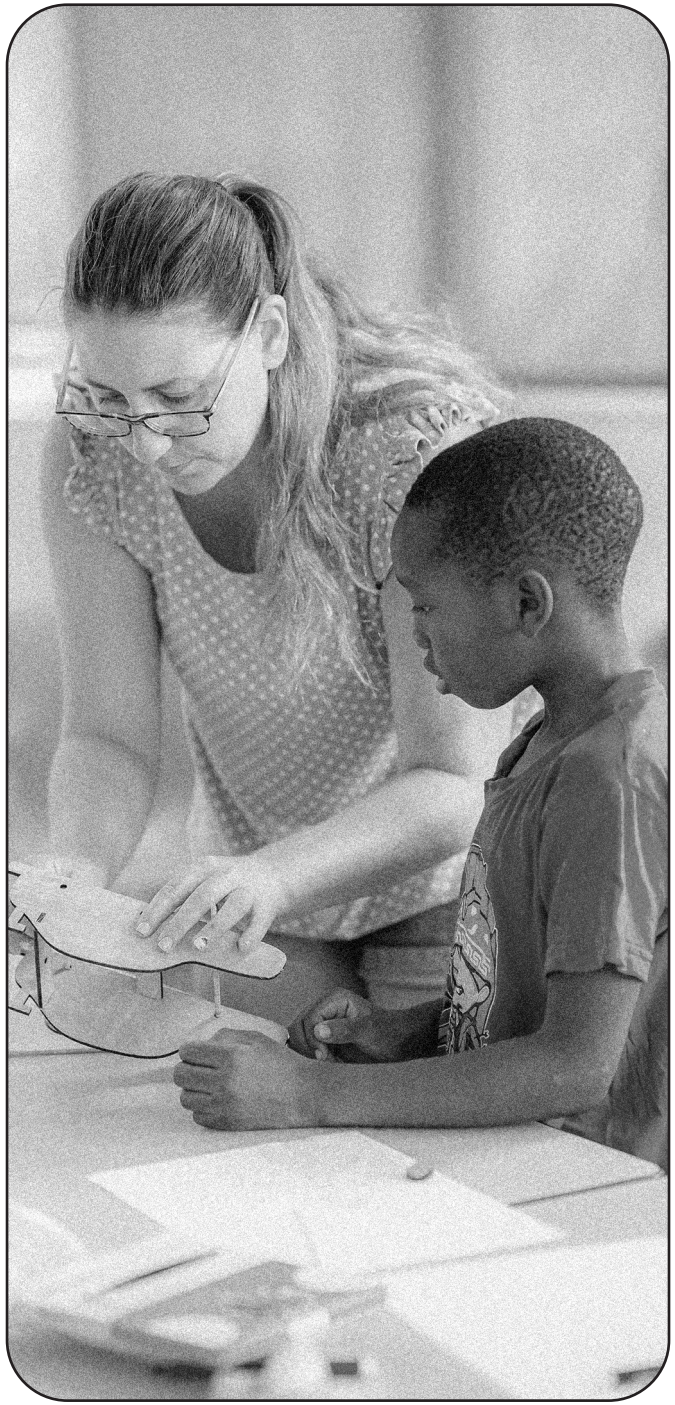
[20] See the **Plan for Data Privacy and the Democratic Digitisation of Education** presented by xnet-x.net t the Generalitat de Catalunya Education Department in 2019.

SO, AM I USING ARTIFICIAL INTELLIGENCE AT SOME TIME AS A TEACHER?

You're using artificial intelligence if you are implementing the use of applications with any of these functions:

	Chatbots	Recommender systems	Robots	Automated decision-making
Natural language processing	✓	✗	✓	✓
Computer vision	✗	✗	✓	✗
Rule-based models	✓	✓	✓	✓
Learning by example	✓	✓	✓	✓
Planning techniques	✓	✗	✓	✗
Predictive analytics	✓	✓	✗	✓
Reinforcement learning	✗	✓	✓	✗

Source: UNICEF, 2021.



DIGITAL SKILLS TO EMPOWER PUPILS

In education, AI is considered essential knowledge that must be acquired in an era in which every individual must prepare themselves to live and work with it based on an approach of developing free and critical thinking, in an increasingly technological society in which data is the main bargaining chip for the use of many services.

To help promote this education, open materials and digital spaces have been developed to streamline AI learning in the classroom, which are available to teachers or anyone interested in this technology (you can find some of these materials in Section 5).

Worth noting are the teaching materials created by **ISTE (International Society for Technology in Education)**[21] on AI in compulsory education. These materials are created using the guidelines developed by the **AI4K12** Initiative[22] as reference, which indicate what K-12 pupils should learn about 5 major ideas on AI:

1/ Perception: Computers perceive the world using sensors.

2/ Representation and reasoning: Agents maintain representations of the world and use them for reasoning.

3/ Learning: Computers can learn from data.

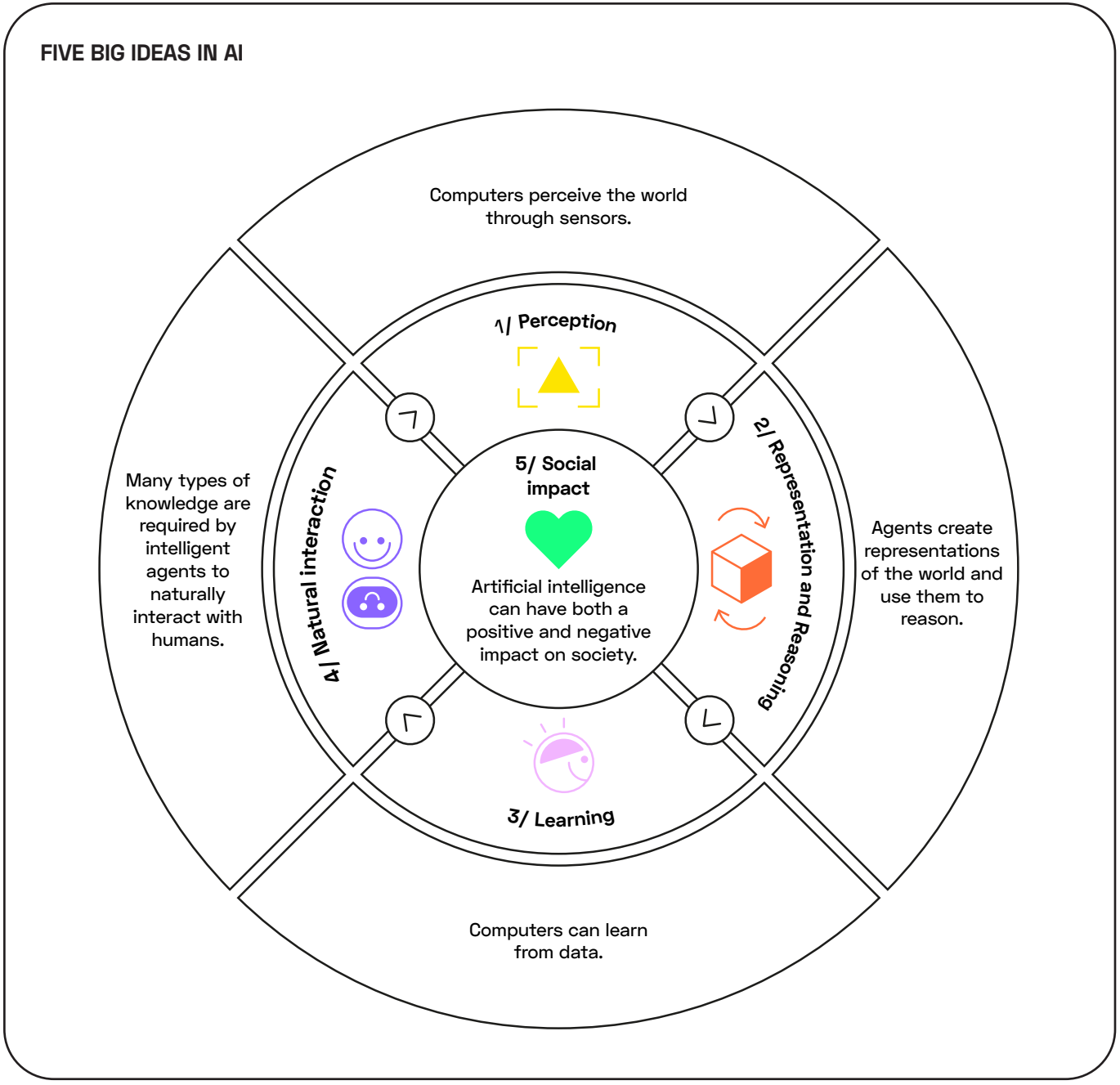
4/ Natural interaction: Intelligent agents require many kinds of knowledge to interact naturally with humans.

5/ Societal impact: Artificial intelligence can impact society in both positive and negative ways.

These free, open materials for download are available on the ISTE website and in the reference section of this report, Page 64**.**

[21] **The ISTE blog** aims to help educators around the world to use technology to transform education.

[22] International committee that develops the **guidelines for AI education for pupils up to the age of 12** in the USA.



Source: Five big ideas of AI. Credit: AI14K12 Initiative.

In Europe, we have the **European Commission Digital Education Action Plan (2021-2027)**[23], which includes two strategic priorities:

- → Fostering the development of a high-performing digital education ecosystem.
- → Enhancing digital skills and competences for the digital transformation.

In this second strategic priority, the importance of developing advanced digital skills among teachers and pupils, including Ai-related skills, is highlighted.

In Spanish law, the digital skills that teachers and pupils must develop is regulated based on the **digital competence framework for teachers**[24], updated in May 2022, which is the reference for the drafting of digital competence development plans by the education departments of the Autonomous Regions.

[23] The **Digital Education Action Plan (2021-2027)** is a renewed political initiative of the European Union (EU) to support the sustainable and effective adaptation of education and training systems in EU Member States to the digital era.

[24] Resolution of 4 May 2022 of the Directorate General for Territorial Assessment and Cooperation, publishing the Agreement of the Education Sector Conference on the updating of the **digital competence framework for teachers**.

> **“The development of artificial intelligence should be human-controlled and centred on people; that the deployment of artificial intelligence should be in the service of people to enhance human capacities; that artificial intelligence should be designed in an ethical, non-discriminatory, equitable, transparent and auditable manner; and that the impact of artificial intelligence on people and society should be monitored and evaluated throughout the value chains”.**
>
> **UNESCO, Beijing consensus on AI in education[25], 2019.**

In 2019, UNESCO brought together 50 education ministers, 105 states, and 100 representatives from UN agencies to assess the importance of using AI in education and the necessary recommendations for it to become a regulated reality. Following this meeting, the *Beijing consensus on artificial intelligence and education* was published, the first document to propose advice and recommendations on how to make the most of AI technologies with a view to meeting the goals of the Education 2030 Agenda.

The consensus is based on the premise that the deployment of AI in education will make it possible to tackle its most significant challenges today and to meet the goals of SDG 4 more quickly. It also declares that AI applied to education is a medium for improving human capabilities and protecting human rights, with the purpose of effective collaboration between people and technology that favours learning and sustainable development (see Point 5 for more).

Based on the considerations of UNESCO, on 19 May 2021 the European Union presented a **Resolution of the European Parliament on artificial intelligence in education, culture and the audiovisual sectors**[26]. This resolution defines the objectives of technological deployment, analyses the risks to be overcome, and offers a series of measures to create regulatory frameworks for this sector, which is considered high risk and priority for the deployment of AI in an adequate, effective manner that generates quality education.

The acquisition of digital skills across all parts of society in the Union is a precondition for using AI and necessary for a digital transformation beneficial to all. The EU has therefore updated the **common European digital competence framework for citizens, DigComp 2.2**[27], in which Annex A2 is added on citizens interacting with AI.

Training for the digital competence of teachers is also considered a priority in the 2019 Resolution, which states that their media, digital and computer literacy is essential for knowing what AI consists of, how it is used, and how the fundamental rights of people and children are favoured. This digital training must always go hand in hand with ongoing teacher training, as “the benefit that AI provides to education does not solely depend on the technology to be deployed, but also on how it is used by the teacher to meet the needs of their pupils”.

Along with teacher training, paying special attention to children in precarious situations, launching initiatives on AI and robots in the coming educational statutes, investing in the digital equipment of schools, and closing the digital gap for the elderly are considered priority.

The European Union (2022) recommends that, when drafting new statutes and when applying technology with AI in the classroom, the **4 basic principles** of the rights of the child must be taken into account: **non-discrimination, ensuring their best interests, right to care for their well-being and development, and respect and consideration for the opinions of children.**

[25] The **Beijing Consensus**, UNESCO 2019, establishes the international agreement on the use of AI in education.

[26] European Union Resolution, 2021, which underlines the importance of the development of technology from an approach focused on humans and their rights, considering education, culture and the audiovisual sector as sensitive areas regarding the use of AI, while highlighting the importance of its deployment for quality education.

[27] **DigComp2.2** provides more than 250 new examples of knowledge, skills and attitudes that help citizens engage confidently, critically and safely with digital technologies, and new and emerging ones such as systems driven by artificial intelligence (IA).

In accordance with the report **"Artificial intelligence and education. A critical view through the lens of human rights, democracy and the rule of law"**[28] of the European Council, October 2022, children's rights regarding AI might be contemplated in the following points:

1/ RIGHT TO EDUCATION
AI may be an opportunity to improve certain specific educational processes, such as meeting individual needs or helping develop the skills of teachers through the more efficient use of available resources.

2/ RIGHT TO HUMAN DIGNITY
The aspects related with the teaching and learning processes must not be delegated to an AI system unless it can be guaranteed that doing so does not risk violating the dignity of the participating children.

3/ RIGHT TO AUTONOMY
Children cannot be subject to decisions made solely by AI systems, while they are entitled to challenge the decisions made by these system and decide on being excluded from them.

4/ RIGHT TO BE HEARD
Children and their families are entitled to express themselves and reject any participation in AI systems that affects them negatively.

5/ RIGHT NOT TO SUFFER DISCRIMINATION (FAIRNESS AND BIAS)
In both their design and their deployment, AI systems must be fair and inclusive for children, avoiding any biases that may harm them.

6/ RIGHT TO PRIVACY AND TO DATA PROTECTION
Privacy must be considered in terms of personal protection and with regard to freedom of expression. The storage and use of data must be extremely rigorous, particularly when children are involved.

7/ RIGHT TO TRANSPARENCY AND EXPLAINABILITY
Teachers and families are entitled to receive precise information to understand the decisions made by children with AI mediation, and to know which parameters they have been based on and to cancel them if need be.

8/RIGHT TO WITHHOLD OR WITHDRAW CONSENT
This right guarantees that children and their families provide genuine and comprehensive consent to the collecting and use of their data, and their freedom to withdraw said consent at any time.

9/ RIGHT TO BE PROTECTED FROM ECONOMIC EXPLOITATION
It is necessary to cover the storage and use of children's data to ensure they are not unsuitably exploited by trading companies.

10/ RIGHTS OF PARENTS
When collecting or using children's data, consent must be given by the children and their relatives, and must not be assumed by the school.

[28] The recent **EU report, October 2022**, examines the impact of using AI in education with regard to the rights of the child.

AS A TEACHER, WHAT SHOULD I CONSIDER WHEN USING AI-INTEGRATED TECHNOLOGY?

UNICEF offers 9 questions that you must ask yourself when you are going to use AI with your pupils in order to ensure their fundamental rights.[29]

Do the technological solutions fulfil these 9 points?

1/ Support children's development and well-being.

2/ Ensure inclusion of and for children.

3/ Prioritise fairness and non-discrimination for children.

4/ Protect children's data and privacy.

5/ Ensure safety for children.

6/ Provide transparency, explainability, and accountability for children.

7/ Empower governments and businesses [their community and institution] with knowledge of AI and children's rights.

8/ Prepare children for present and future developments in AI.

9/ Create an enabling environment: ensure everyone can contribute towards child-centred AI.

Source: **UNICEF, 2021.**

In Spain, the update issued in May 2022 of the **digital competence framework for teachers**[30] regulates the development of digital skills by teachers in the use of AI in order to empower pupils (Area 5): knowledge of how AI works, knowledge of the applicable regulations and the ethical and educational risks involved in its use, and appropriate use to achieve personalised learning. Also considered is computational thinking and the use of AI in relation to the development of the digital competence of pupils for its use in the creation of digital content (Area 6).

[29] In this video, you can see the stance of UNICEF on the use of AI with children: UNICEF (2021) **Artificial intelligence for children.**

[30] Resolution of 4 May 2022 of the Directorate General for Territorial Assessment and Cooperation, publishing the Agreement of the Education Sector Conference on the updating of the **digital competence framework for teachers.**

2.2 AI APPLIED TO ASSESSMENT

How many literary commentaries can a teacher read in their life? I've lost count. It could be ten thousand or half a million. Whenever the EBAU (University Entrance Exam) comes around, it feels like I read half a million every year. It's probably a lot less, but it seems like a lot more.

My name's Mercè, I teach A-level history at IES Ramón Llull secondary school and I'm taking part in a project to study the potential of artificial intelligence in correcting literary commentaries.

At first I wasn't overly clear about the potential of all this. Artificial intelligence is a concept that sounds too futurist and technological, and education is, above all, human and present. But as we've progressed in the trial, its never ceased to surprise me.

Evaluating pupils with AI is one of its applications in education where greatest results are expected. Rose Luckin (2017) states that AI is a "powerful tool to open up the 'black box of learning' by providing a deep, fine-grained understanding of when and how learning actually happens"

This is precisely the main advantage of applying AI in assessment processes, especially in the case of diagnostic or formative assessment where the information that teachers will obtain can positively influence the support for learning provided to pupils.

Point 16 of the Beijing consensus encourages research and educational systems to "apply or develop artificial intelligence tools to support adaptive learning processes; to leverage the potential of data to enable the assessment of the multiple dimensions of pupils' competencies; and to support large-scale and remote assessment".

The challenge not only lies in technological development but also in the design of the pedagogical production function of the assessment. It is here where AI will reach its greatest potential by encouraging inclusive education based on the content of pupils' individual study in terms of their motivation, performance and development of skills, enabling teachers to provide the answers adapted to the needs of each individual.

2.2.1 RISKS AND OPPORTUNITIES

The advances in technology and the 30-plus years spent on research in this field confirm that the application of AI for assessment can be of great help for teachers and pupils. AI can help ensure formative assessment is more closely integrated into the learning process and is more invisible to pupils, and can help make sure the feedback they receive is much more appropriate and efficient, as it is provided in sufficient time for it to be applied and, therefore, to continue learning and improving in their personal learning process.

However, the application of AI for assessment purposes is still far from being an everyday reality, given the investment in research and the development of tests required to make it a large-scale project, and considering the extremely careful management it requires. According to Rose Luckin (2017), an AI-based assessment system would make it fairer, richer and more inclusive, as it would evaluate pupils across a longer period of time and from an evidence-based, value-added perspective, with a lower emotional cost and reducing the evaluative oversaturation that pupils currently experience.

The assessment model promoted by AI should provide a different pedagogical approach in which the assessment is not exclusively implemented to obtain summative pupil grades. The evolution of the technologies applied to assessment must provide data so that teachers are able to offer an educational environment in which personalised learning is possible.

The objectives of the Evaluation 4.0 project, of which this guide forms a part, include validating the advantages that the use of AI may provide in assessment processes:

ADVANTAGES OF THE AI-BASED ASSESSMENT

1/ Reduction in paperwork and time spent correcting by teachers.

2/ Possibility of improving access and diversifying the forms of evaluating to ensure inclusive, personalised assessment.

3/ Possibility of it occurring in the background, forcing assessment tests out of the spotlight and ensuring authentic, infused assessment that cuts back on the saturation of assessment tests.

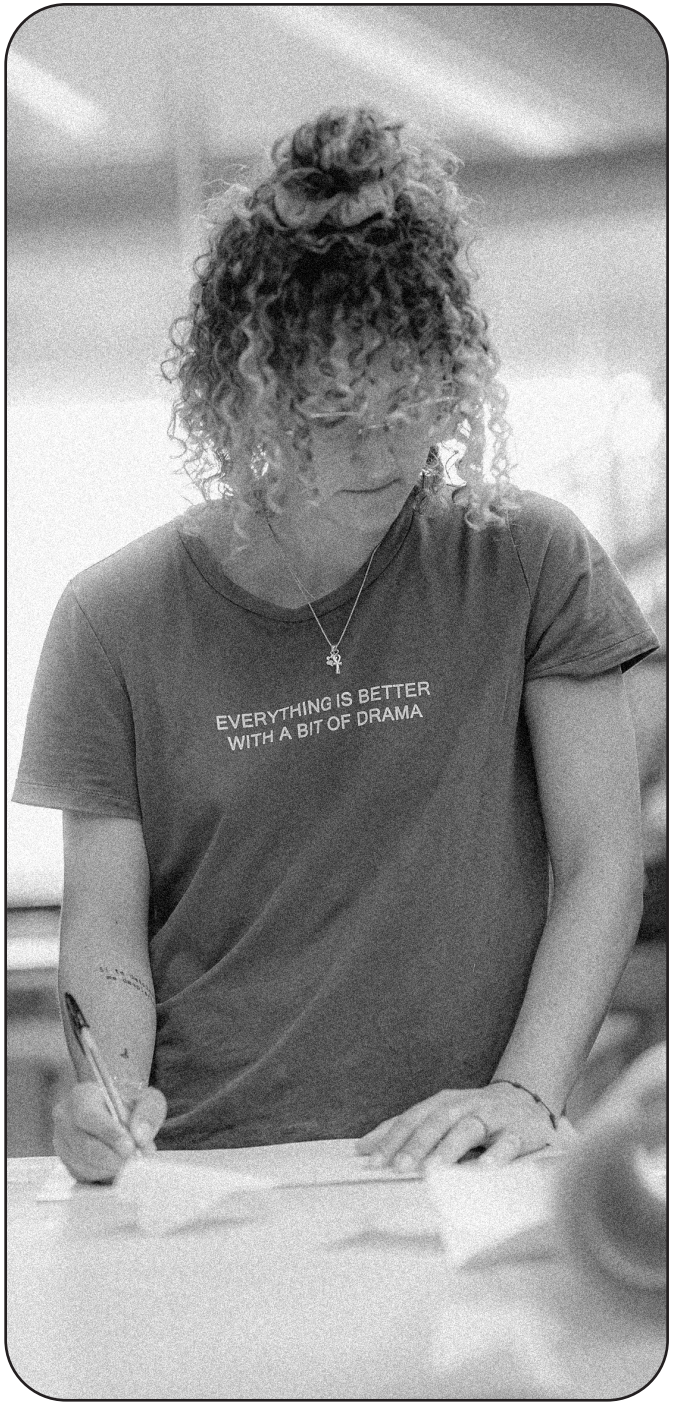
4/ Reduction of the “test preparation” effect in teaching processes.

5/ Provision of individualised feedback, making the assessment more formative.

6/ Possibility of providing instant and appropriate feedback, in sufficient time to be applied by the pupil to improve their learning process

7/ Long-term assessment and monitoring to help teachers learn learning styles, identify difficulties, and arrange the necessary support.

Soure: **Evaluación Inteligente** (Municio, 2022).



However, when applying these technologies, one must not lose sight of the ethical matters regarding the privacy of personal data and of intellectual property. To this end, in its resolution on AI and education, the European Union highlights the need to collect reliable data and guarantee pupil safety, as well as the systematisation and transferability of data without harming individual privacy. It highlights the fact that the application of AI in education can create stereotypes and discrimination from biases inherent to the data and, therefore, underlines the fact that the datasets used to train AI should be as broad as possible and that, in educational environments, any automated decision made must be revised by professionals to detect and correct discriminatory practice.

DIFFICULTIES OF AI IN RELATION WITH THE ASSESSMENT

1/ Input data may contain incorporated biases that affect general or particular results.

2/ The use of AI generates a lack of trust in the fairness of the results by those being evaluated or their families.

3/ The use of AI could perpetuate past inequalities and increase the gaps in access to opportunities to obtain high-level achievements, given that it is programmed by people.

4/ Data collection could affect individual privacy and, therefore, it is important for users to be informed transparently and directly when their data is used as input for any learning algorithm.

5/ There is a possibility of degradation if the teaching-learning processes are automated. It is therefore necessary to implement a critical evaluation of the use of technology and its impact on the process.

Soure: **Future of Testing in Education: Artificial Intelligence.**

For example: *The problem of the reproduction of biases in input data does not effect all the algorithms equally nor is it shown in the same way. On all accounts, when using predictive algorithms in education, the risk of generating predictions that end up coming true because a low performance by pupils who performed poorly in the past is expected must be avoided.*

The **major organisations**[31] ensuring the development and deployment of technologies to obtain reliable, explainable and transparent artificial intelligence in sensitive areas such as education support the use of AI in collaboration with the human agent, the criterion of whom must always take priority. **The concept sought is that of augmented human intelligence *vs.* purely artificial intelligence.** When AI is used in an educational process, families and pupils must be informed of this important aspect. (See the **decalogue** of indications by the European Union for the deployment of AI in education, Page 57).

[31] **Horizon Europe** is the European cluster focused on the development of key and emerging digital technologies as part of the European Framework Programme for Research and Development for the period 2021- 2027.

2.2.2 THE APPLICATION OF AI TO ASSESSMENT IN PRIMARY AND SECONDARY SCHOOLS

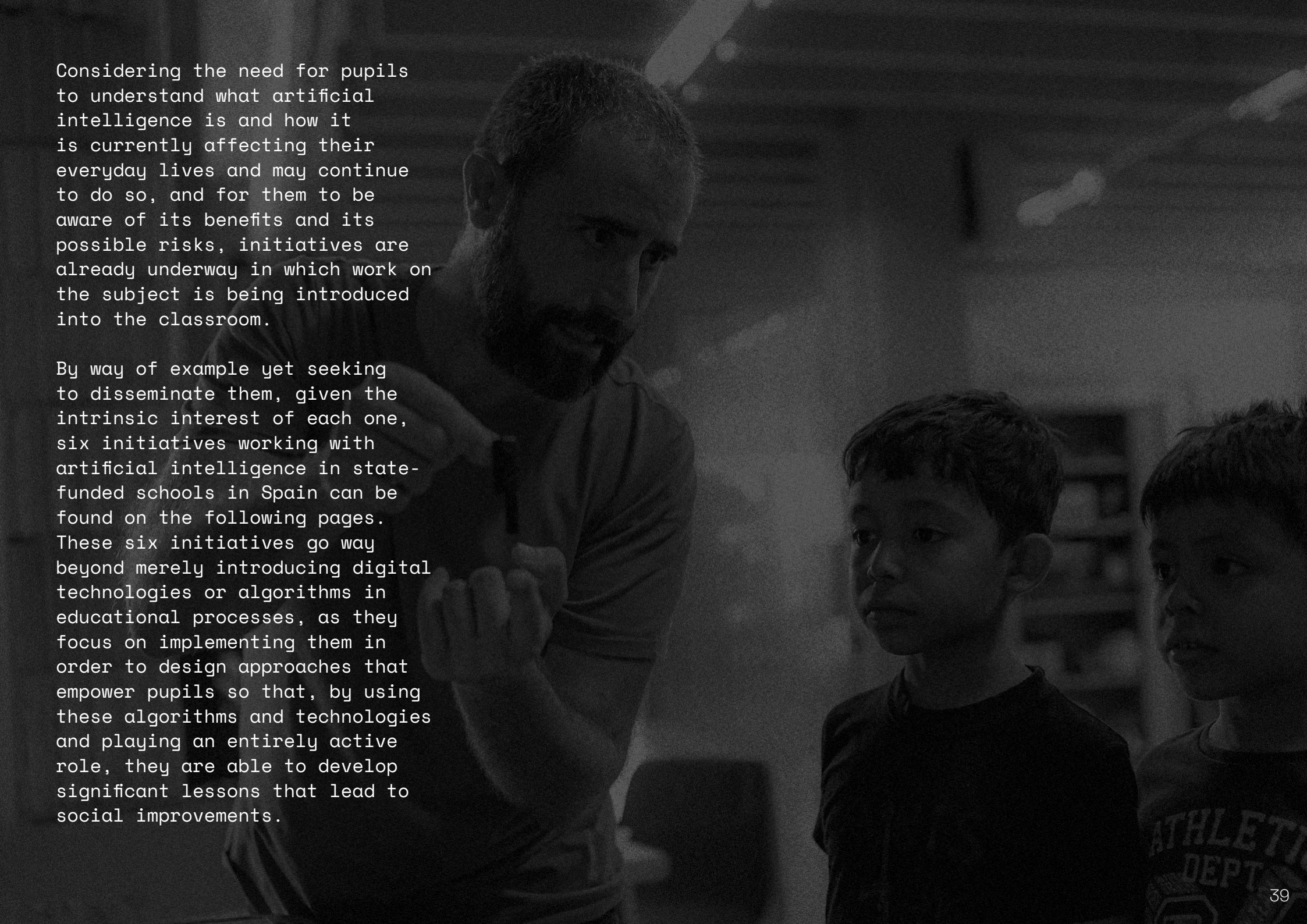
The different types of artificial intelligence technologies are applied to educational assessment for different purposes:

- AI based on rules and automatic learning is used in intelligent tutoring systems (ITS), offering specific comments to pupils in relation with particular activities.
- AI based on automatic learning that interacts with large datasets with several layers could be capable of supervising a wide variety of tasks, monitor pupils, and forecast their results.
- Technologies based on natural language processing provide applications to supervise and grade written work, to correct pronunciation in language learning or to improve reading skills.
- AI based on image recognition that uses optical systems capable of grading or providing recommendations depending on the pupils' work is also being deployed.
- AI is also being applied to generate early warning systems in predicting early school leavers by tracking grades, attendance and other factors to predict academic performance, thus allowing for timely intervention.

One example of assessment efficiency by applying AI

Gradescope makes assessments much faster for teachers of secondary and higher education. Pupils upload their exams to the platform and its AI capacity sorts and groups the answers to verify them. According to Gradescope, the use of AI decreases the amount of time spent grading by 70 percent or more.

HOW IS ARTIFICIAL INTELLIGENCE BEING INTRODUCED INTO EDUCATION IN SPAIN?



Considering the need for pupils to understand what artificial intelligence is and how it is currently affecting their everyday lives and may continue to do so, and for them to be aware of its benefits and its possible risks, initiatives are already underway in which work on the subject is being introduced into the classroom.

By way of example yet seeking to disseminate them, given the intrinsic interest of each one, six initiatives working with artificial intelligence in state-funded schools in Spain can be found on the following pages. These six initiatives go way beyond merely introducing digital technologies or algorithms in educational processes, as they focus on implementing them in order to design approaches that empower pupils so that, by using these algorithms and technologies and playing an entirely active role, they are able to develop significant lessons that lead to social improvements.

3.1 THE 20TH CENTURY MONUMENTS OF THE CITY OF CEUTA

> “The key to everything lies in empowering pupils”.
>
> Pablo Dúo Terrón, 2022.

A BRIEF INTRODUCTION OF THE TEACHER

This experience was designed and implemented by **Pablo Dúo Terrón**, a primary school teacher in Ceuta and professor in the ITC and TDC Master’s Degree at UNIR, specialising in digital technologies. He is also a PhD student in STEAM methodology, coordinator of the mixed courses of the Future Classroom, and associate professor in teacher training on advance digital competence, computational thinking and artificial intelligence at INTEF.

@esparaTIC

All the pictures of the teachers have been edited using Pixlr, an on-line AI-powered photo editing tool. https://pixlr.com/es/photomash/

CONTEXT OF THE EXPERIENCE

Pupils in year six of primary school (aged 11-12) at the Príncipe Felipe Pre-School and Primary School in Ceuta. This is an extremely complex state-funded school in which all the children are from families with a low socioeconomic status and a high percentage of pupils are late entries. Spanish is predominantly a second language.

WHAT WAS THE PURPOSE OF THE ACTIVITY?

There were three purposes to this project:

- To encourage pupils to learn about the history of their city through **significant and skill-based learning**.
- To encourage the use of **invisible technology for children who do not have devices in their family and personal environment**.
- To encourage **digital equality and breach the digital gap** in the skill-based use of devices by **empowering pupils** through the creation of an AI experience.

HOW WAS THE EXPERIENCE CONDUCTED?

The historic buildings in Plaza de los Reyes square were studied to analyse the traces that the passage of time has left on them, observing the contrast between what was there and what still remains from 20th century Ceuta.

The steps followed to develop the experience were:

- Proposal of a question-challenge by the teacher: Will we be capable of creating a resource that, by focusing on any monument or building in Plaza de los Reyes square with the camera of a device, is able to display its history in the screen?
- Internet search by pupils for old images of Plaza de los Reyes from the 20th century and of its monuments, statues and its history.
- Taking of photographs by the children of the different monuments and statues still standing.
- Entry of the pictures taken into **LearningML** and subsequent automatic learning. LearningML is an educational platform for learning content about artificial intelligence and the promotion of computational thinking that is being developed by **Juan David Rodríguez** in collaboration with the research group **KGBL3**[32]. This is a *machine learning*-based platform in which, using correctly classified data (the current pictures taken by the pupils), the algorithm adjusts a series of parameters in a model. Therefore, in addition to classifying the input data, it is able to classify new data whose classification is not known in advance (i.e. of recognising any other picture in which the same statute or the same monument appears) Later on, the use of **Scratch**, a project by the **Lifelong Kindergarten Group at the MIT Media Lab**[33], which is distributed with a free licence to which the necessary blocks have been added to use the *machine learning* models built using the editor.

The pupils programmed an algorithm so that, when the current image of one of the buildings in Plaza de los Reyes is received via the camera, the old photograph of the same place is superimposed on the screen along with a short informative text created by the pupils. Anyone walking through the square who points their camera at the different buildings and monuments can find out about their history; all they need is a browser and a connected device. It is possible to watch a video summary of the experience at this **link**.

WHAT DIFFICULTIES AROSE AND HOW WERE THEY SOLVED?

- Obtaining permission to conduct an activity in the city centre during the pandemic. The teacher had to guarantee that it was being conducted outdoors (the entire group had to walk) and that the children remained at a distance of 1.5 m from each other.
- The tablets were set by default for Scratch to use the front camera and not the rear, and the photos and the AI recognition samples had to be taken with the front camera.
- The lack of connection for the tablets. The Provincial Department of Education of Ceuta, with the provincial director, the head of the Education programmes unit, and two ITC consultants simplified the collaboration with Orange, which provided the connection so that the pupils could develop the experience, and were also present during the activity.

[32] **KGB-L3** is a research group at Rey Juan Carlos University (Madrid, Spain) formed by several researchers, PhD pupils, and undergraduates. The main goal of KGB-L3 is the research and promotion of computational thinking skills.

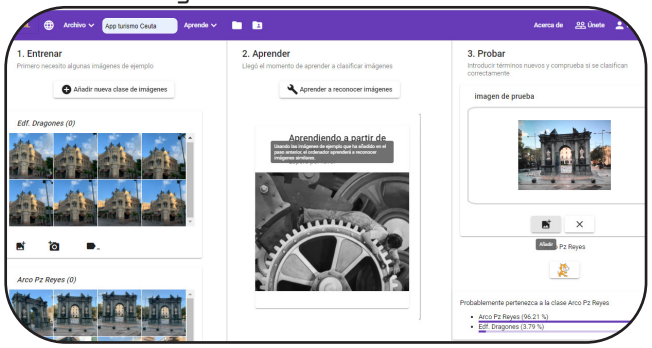
[33] The **Lifelong Kindergarten Group at the MIT Lab** develops technologies, activities and communities to involve youngsters of all origins in creative learning experiences so that they can develop their thinking, their voices, and their identities.

WHAT DID WE LEARN FROM THIS CASE?

- To use AI to work on curricular content contextualised into teaching units, while the pupils become familiar with it and learn how to use it in a critical manner, exploring possible real-life applications.
- To link the past with the future. To use new advances to value history and heritage.
- The richness of integrating the environment into the lessons to be built, going beyond the classroom.
- The interest in seeking alliances and using external and local resources to increase or adapt the technological provision when enhancing educational experiences.

WHAT ARE THE NEXT INITIATIVES YOU WOULD LIKE TO IMPLEMENT?

- The design of new activities so that the pupils can develop other options for the applicability of *machine learning*. For example, in terms of voice classification, its application to syntactic analysis or programming by voice.
- To study the biases of artificial intelligence.
- For pupils to learn how to identify *fake news*.
- To explore the ethical dilemmas associated with the development of *machine learning*.



3.2 FOSTERING THE CRITICAL VIEWPOINT OF PUPILS THROUGH AI

> **If we ignore the need for our pupils to learn about AI, we will have children who consume but do not reflect".**
>
> Alicia Morales Hermoso, 2022.

A BRIEF INTRODUCTION OF THE TEACHER

Alicia Morales Hermoso, music and primary school teacher. Interested in the world of technology, music, and everything related to them.

instagram.com/alismusica/

CONTEXT OF THE EXPERIENCE

The experience was developed with year 4 primary school pupils from the state-funded primary school in Mataró, **Escola Maria Mèrce-Marçal**. Insofar as the profile of the pupils, the vast majority are local and their families had an average disposable income.

WHAT WAS THE PURPOSE OF THE ACTIVITY?

There were three purposes to the activity:

1/ To make pupils aware that digital technologies are **useful resources for learning in any area, field or subject**.

2/ To develop **digital literacy**. The pupils come from homes where technology is widely present, and some of them even have their own mobile phone. We wanted to focus on their digital competence so that they are capable of using technology beyond leisure and consumption. In turn, it is important for them to understand how it works. For example, why certain things happen when you press a button on your phone.

3/ To encourage a **critical viewpoint**. It is important for pupils to be sensible when using digital technologies. The first step might involve making them aware of the fact that, behind a machine, there is someone who programmes it. This is one of the main lessons that the pupils learned when they started working with AI.

HOW WAS THE EXPERIENCE CONDUCTED?

Given that the teaching unit responsible in the media area was that of knowledge of the districts, the process was designed to learn about them with the integration of AI, the development of which involved interrelating other areas (for example, languages or maths).

The challenge given by the teacher was to create a search engine with which users could find the most noteworthy about each village or city in their district. The class was organised into small work groups, each one being assigned three of four towns. Each group had to search for the most noteworthy aspects of their towns: the best hotel, the first railway station or the tastiest strawberries, for example. Once they had the information, they entered it into Scratch, but they realised that, to get answers, they always had to enter the same question: any difference in the way it was written prevented them from obtaining the expected answer. By introducing *machine learning*, the questions could be open because the system detected the keywords and gave the answer.

In terms of the de metacognition process, the activities carried out were shared at the end of each session and proposed improvements were suggested. Every two sessions, a reflection on what the pupils had learned was videoed to create a compilation for the families as the end product, which is **available on the school's website**.

WHAT DIFFICULTIES AROSE AND HOW WERE THEY SOLVED?

The main difficulties were that some of the pupils had less digital competence than expected, and the technical incidents that arose when entering data into the AI software. To solve this, the number of sessions scheduled was increased (from 6 to 10), and the goals of the proposal were simplified.

WHAT DID WE LEARN FROM THIS CASE?

The pupils learned a lot of different things while developing this experience:

- They became more critical in the use of digital technologies. **They developed critical thinking**, aware of the fact that the machine required programming, followed processes, and analysed data, but that **the intelligence was provided by the pupils, as they generated the information and the instructions**.
- They reflected on the importance of performing good **information search and selection processes**, as not all data on the internet is valid.
- They learned how to **work as a team** through activities such as debates and sharing, or the need to reach agreements.
- They became aware of the **need for precision** when working with technologies: AI requires the creation and management of specific information for a particular fact.

WHAT WOULD BE THE NEXT STEPS?

To establish a plan in the school through which pupils sequentially enter the world of AI: working with **Scratch** in music at the age of 9, starting with *machine learning* at the age of 10, and beginning written programming in HTML at the age of 11 using **Sonic Pi**, which has a long track record in English in introducing children to programming.

3.3 ARTIFICIAL INTELLIGENCE FOR SOCIAL IMPROVEMENT

> “Technology is only useful when it’s used for something. Particularly if it can be applied to improve familiar and social situations”.
>
> Álvaro Martín De Ocampo, 2022.

A BRIEF INTRODUCTION OF THE TEACHER

Álvaro Martín De Ocampo, an inquisitive technology teacher who likes methodological change.

@tecuribarri

CONTEXT OF THE EXPERIENCE

Instituto Martínez Uribarri, a state-funded school located in the centre of Salamanca where the academic results are positive and there is an excellent relationship within the education community. The experience was conducted as part of the Technology, Information and Communication course for year 1 A-level students. Students are middle class and have their own devices, usually mid-range mobile phones.

WHAT WAS THE PURPOSE OF THE ACTIVITY?

There was a dual purpose. On one hand, for the students to understand what AI is, as understanding this will enable them to be better prepared for life in current society. On the other, for them to understand why it is used and to be aware of how it can be applied in any job and its potential to develop social improvements.

HOW WAS THE EXPERIENCE CONDUCTED?

The steps below were followed to develop the experience:

- Viewing in the classroom of videos that showed the usefulness of AI applied to different contexts. The following is an example of a video proposed by the teacher: "**La inteligencia artificial creará 58 millones de puestos de trabajo**", with Núria Oliver.
- Viewing of videos to understand how AI works in relation with **driving autonomous cars**. Its opportunities and also its risks were discussed at this point.
- Introduction to programming using App Inventor, learning the procedure to create *apps*.
- Exploring social apps created by other students. One example is "**Hello Navi!**", created by students to help a blind classmate move around.
- Creation of a simple *app* with **Machine Learning** and **App Inventor** that responded to a need of the immediate surroundings. One example of an *app* created by the students is **Orientai**, which helps year 4 GCSE students make decisions as to which subjects to enrol in for their A levels.

The project can be followed on the *posts* of the **course blog**. You can also listen to the **radio programme that the students made on artificial intelligence**.

WHAT WERE THE MAIN DIFFICULTIES AND HOW WERE THEY SOLVED?

- The time limits to the duration of the project. Further sessions would have enabled them to study in greater depth.
- The lack of ideas for the creation of their own product. To support the students in their creation, brainstorming sessions were organised and strategies for self-assessment, joint assessment and hetero-assessment were developed, valuing the lessons arising from the *feedback* among equals very positively.

WHAT LESSONS COULD BE LEARNED?

- The skill-based learning of the students built through a process using active methodologies: learning about AI by creating AI.
- The wealth of feedback between classmates.
- The development of their own projects, completing each stage of their construction.
- The importance of ethics and a critical outlook in AI.
- The real opportunity to make improvements to our environment based on our ideas.

WHAT ARE THE NEXT STEPS YOU WOULD LIKE TO TAKE?

Taking the leap into introducing **Python** into the classroom.

3.4 CREATING A VIRTUAL ASSISTANT WITH ECHIDNA + LEARNINGML

A BRIEF INTRODUCTION OF THE TEACHER

Jorge Lobo Martínez, a primary school teacher and teacher trainer in robotics, programming and artificial intelligence. He takes part in the development of open source educational robotics projects.
@lobotic / blog: lobotic.es

CONTEXT OF THE EXPERIENCE

The project was developed by year 4 primary school pupils from Lope de Vega Pre-School and Primary School in Madrid, **as part of the plastics subject**. The school provides two lines of pre-school and primary school education, **classified as a school for learning difficulties that accommodates a wide range of pupils**. It includes lower class families and those with more resources in an environment marked by a good atmosphere among pupils, which is why it is classified as a healthy school. They have been working with robotics and programming since 2013.

> **“Programming makes pupils realise that sometimes there is not just one right answer but multiple possibilities.** This helps empower them, and enables them to find their own paths, see what others are doing, and learn from them. **Copying is approved in this class”.**
>
> **Jorge Lobo Martínez, 2022.**

WHAT WAS THE PURPOSE OF THE ACTIVITY?

- To develop a STEAM project by introducing programming, robotics and artificial intelligence into the subject of plastics in order to discuss these contents in a cross-cutting manner.
- To introduce the pupils to artificial intelligence. Because **our lives are surrounded by algorithms, pupils must have a notion of how they work**. This knowledge might be extremely useful in different areas, such as in **understanding which data is given to companies and how these companies find solutions using this data**.

HOW WAS THE EXPERIENCE CONDUCTED?

The initiative was developed during the time of the plastics subject. It was possible to implement it in six sessions, as the pupils already had certain prior knowledge of programming and robotics.

The experience was divided into four parts:

- Creation of a model that represents a room, directly related with artistic skills. The teacher made the previous model as an example of the end product to be created. All the rooms had to have light and a fan.
- Design of a *machine learning* text model related with digital and communication skills.
- Programming of the assistant using Scratch, once again linked to digital skills and mathematical competence.
- Introduction of domotics in the model, which involved skills relating with knowledge of and interaction with the physical world, among others. The actions to be configured were light and a fan, and switching them on and off. An Echidna microcontroller board was used to manage the model from the computer.

Sufficient data was entered on the model to ensure it was capable of interpreting new phrases and acting in line with the information received. For example, the fan switched off following phrases such as "I'm freezing".

WHAT WERE THE MAIN DIFFICULTIES AND HOW WERE THEY SOLVED?

The main **difficulty was the development of the experience with new pupils who had no prior knowledge** of programming. **This was solved through the mentoring of their classmates who paired up with them**, and who took on their new role very positively.

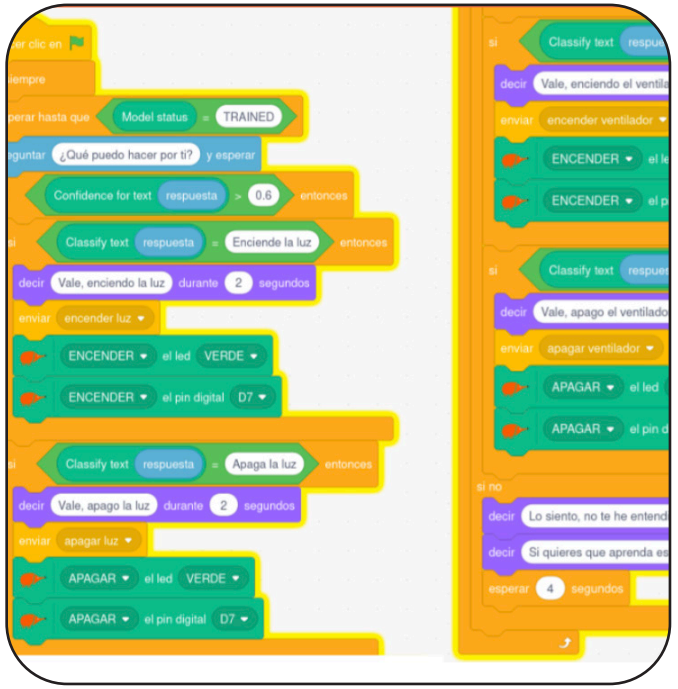
WHAT LESSONS COULD BE LEARNED?

- **The richness of mentoring among equals**.
- The joint creation of knowledge, visualising sharing as something that is fair and desirable.
- **Developing overall skills associated to programming and robots**, based on different areas and subjects.
- Applicability of the lessons in artificial intelligence. Not only is it motivating and can spark the interest of the pupils but it is also a useful and applicable tool for building real improvements that are applicable to everyday life.

WHAT WOULD BE THE NEXT STEPS?

To continue working along these lines, developing more activities that include programming, robotics and artificial intelligence in other areas. To foster an extensive approach to work on overall skills so that pupils can see their real-life utility.

The project can be seen in further detail at this link.



> “Violence begins with language. With the excuse of introducing artificial intelligence, I wanted my pupils to learn how to detect it and act consequently”.
>
> F. Javier Álvarez Jiménez, 2022.

A BRIEF INTRODUCTION OF THE TEACHER

F. Javier Álvarez Jiménez, a primary school teacher by vocation, and always learning. A technical teaching consultant. Coordinator of the computational thinking project at CEIP Carlos V.

@fjavier_aj

CONTEXT OF THE EXPERIENCE

The experience took place during the 2019-2020 school year in the year 6 primary school classroom at **CEIP Carlos V**, a state-funding pre-school and primary school in Seville. The school has a wide diversity of pupils, with families who have average-low disposable income.

WHAT WAS THE PURPOSE OF THE ACTIVITY?

To support the pupils in **detecting possible violent behaviour in language** to be able to identify it.

HOW WAS THE EXPERIENCE CONDUCTED?

- The learning experience was designed through a motivating challenge contextualised by an increasingly significant day for the pupils, which is 25th November, the International Day for the Elimination of Violence Against Women. **Its challenge involved building *software* that used artificial intelligence to recognise violence in language.**
- It was based on a **reflection of what was considered violence and gender-based violence** to connect with the initial knowledge of the pupils, trigger their previous ideas regarding violence and the types of violence that might exist and, with this in mind, produce a list of concepts that they themselves established. Terms such as *gender-based violence*, *sexist violence*, *school violence*, *bullying* and *cyberbullying* came up. They used all this to produce a dictionary of terms that was added to as the project progressed.
- They were **guided through an examination of artificial intelligence** based on questions they had in order to encourage motivation for the project, such as: "Do you know what artificial intelligence is?" "Do you know any device that uses it?" "Have you ever used it?" "How do you think it works?" "If it's intelligent in some way, perhaps it has to learn. How do you think it can learn?" or "What do you think it is useful for?"
- The next activity consisted of building a table with columns to establish two categories. One included ideas, phrases, individual words that were considered positive (phrases that they liked to hear, that made them feel good, etc.) and the other included the opposite. Two initial **lists were therefore compiled of simple phrases** such as "I don't like what you're wearing" or "You're such a great person!"
- The next step consisted of them becoming familiar with the **Machine Learning for Kids** tool, which is software that combines machine learning with block programming environments such as **Scratch**. The tool was presented and its classes were created (positive behaviour and negative behaviour), and they started to complete them with the examples previously compiled. They **learned by themselves that data plays a key role in artificial intelligence and that they had to create a larger database and improve the instructions.**
- During this phase, different strategies were used for the pupils to learn the **importance and relationship that the different types of phrases might have** depending on the intention of the speaker in terms of the loaded words and empathy of the dialogue. Based on these investigations, they found out that the use of question marks denotes a certain interest in learning about others, that people who use exclamation marks are often arrogant and have little respect for those they are addressing, or that the use of hesitant phrases sometimes suggests that they are not in possession of the whole truth. They also saw how different verbal forms, such as the imperative, are often more violent than use of the conditional. They also discovered that some rhetoric, such as hyperbole, intonation or animalisation, also denoted a certain level of manipulation or ridicule. In addition to this, the pupils learned that descriptive adjectives could clearly be classified into categories of positive or negative behaviour. These considerations were taken into account when building the different examples used to train the new model.
- All these lessons were used in the next phase of model debugging. The **model was retrained** and worked much better afterwards, even with more complex phrases.
- Finally, an **interface** was created through the **Scratch** programme in which the phrases were entered and a percentage obtained that referred to the possibility of the person saying it hiding some kind of violent behaviour.

WHAT WERE THE MAIN DIFFICULTIES AND HOW WERE THEY SOLVED?

The fact that the first model didn't work, given the lack of data that made it inaccurate. Although this was actually a premeditated difficulty that the pupils had to detect and turn into an opportunity to continue learning.

Because it was considered more accessible to teachers and pupils, the tool used was LearningML in the two years after the first time this experience was conducted.

WHAT LESSONS COULD BE LEARNED?

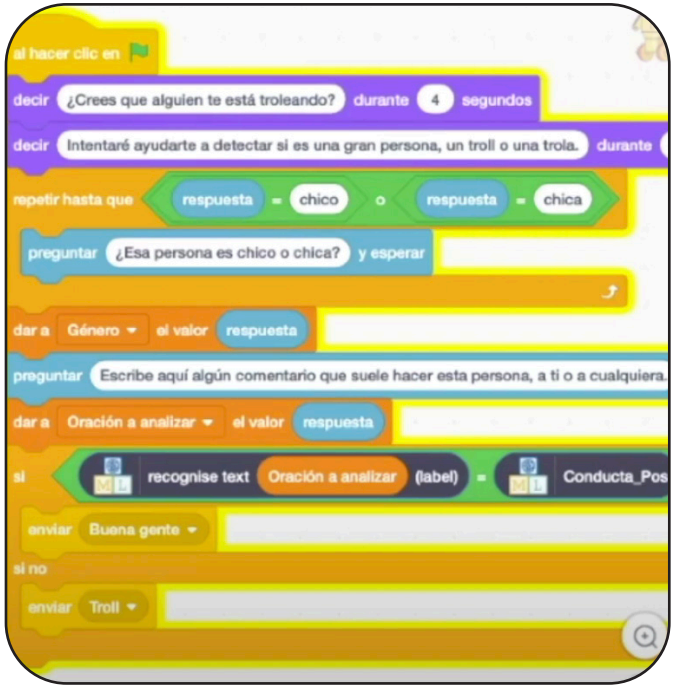
- The approach to computational thinking and artificial intelligence not as a limit but **as an instrument to delve further into learning from any area by applying motivating methodology.**
- The richness of **computational thinking in the development of the skill of learning how to learn**. To be able to train a system or train *software*, it is first necessary to go deeper and structure the information, which involves processes of examination and investigation.
- **The importance of learning from one's mistakes.**

WHAT WOULD BE THE NEXT STEPS?

- To delve deeper into the elements behind artificial intelligence and explore with the pupils the algorithms used to provide safety and understanding to today's world.
- To create teaching material to share with other teachers on artificial intelligence and computational thinking.

You can find out more about the project and its phases at this link. The end product that the pupils created in video format can be viewed here.

This experience forms part of the model practical work selected and published by the National Institute of Educational Technologies and Teacher Training (INTEF).



3.6 LIVING LIFE AND COEXISTING AT SCHOOL: FROM ARTIFICIAL INTELLIGENCE TO THE RESTORATIVE OUTLOOK

TEACHERS WHO CONDUCTED THE EXPERIENCE

Rosanna Cabau Pomar, a special education teacher and school secretary. Head of the plan for coexistence and care of pupils with specific needs.

Carme López Casanova, a special education teacher. She supports pupils with specific needs and is responsible for implementing the restorative approach in the school.

Andreu Pons Prat, a physical education teacher. Technological coordinator at the school, he heads its integration of digital technologies.

> “Technology in itself is not innovation. This only occurs when it is used to humanise the school”.
>
> Rosanna Cabau, Carme López and Andreu Pons, 2022.

CONTEXT OF THE EXPERIENCE

A state-funded two-form entry pre-school and primary school in Castelldefels, Catalonia (@escolaelspins). They have launched a methodological renewal that involves technological and teaching aspects linked to the well-being of the pupils. The experience was carried out with year 4, 5 and 6 primary school pupils.

WHAT WAS THE PURPOSE OF THE ACTIVITY?

Improved coexistence as the path to strengthening positive relationships in the educational community and better academic results through social cohesion and cross-gender relationships.

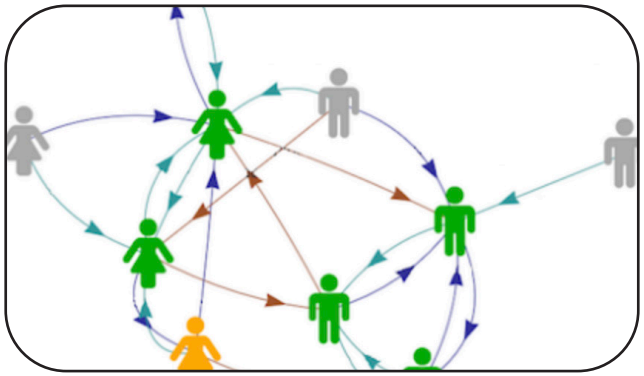
HOW WAS THE EXPERIENCE CONDUCTED?

The project started as a pilot test with **WatsomApp**, an artificial intelligence-based system developed by IBM and KIOAI. The company wanted to implement the system in a school to see its real benefit and develop it in a school environment. The school was also interested in exploring its potential and seeing how it could favour coexistence at the school.

The project was implemented in two phases:

→ **Data collection**

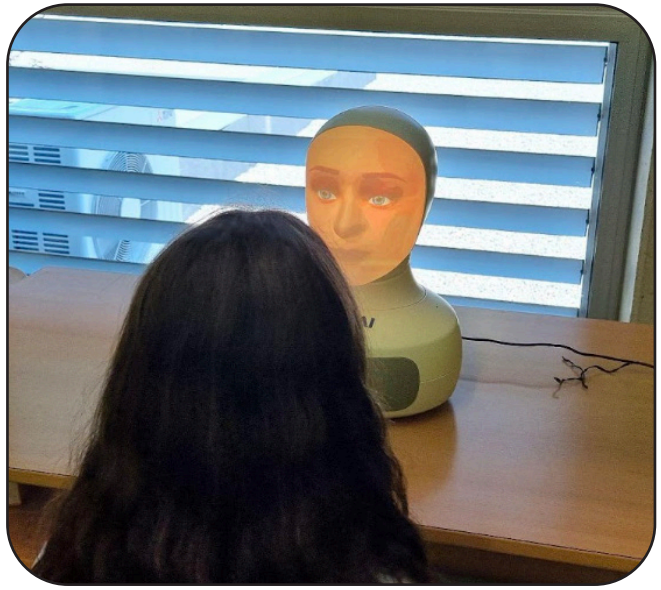
Once a term, the pupils use their username and password (which enables them to create a log) to enter an application all at the same time. This application poses a series of questions on relationships in the classroom and how they would react to specific situations. **The test lasts around 40 minutes** and is alternated with games. As it is being carried out, the teachers see that the pupils are relaxed and having fun. **The programme generates two sociograms, a group report on different profiles, and an individual report** on the relationships that each pupil establishes.



→ **Decision making**

Once the sociograms have been analysed and the reports generated, **the teacher must manage this information in order to make decisions at both group and individual level**:

- **In relation with the group**, each teacher already knows what is happening in the classroom, but Watsom shows them the data very clearly, as a snapshot of what is occurring in their group. **The teacher often uses the data obtained to manage assessment meetings to better respond to the needs of the pupils and to design activities for tutorial spaces.**
- In terms of the individual treatment of each pupil, the teachers decide which children should take a step further, analysing the information they already have along with new evidence. This is done, for example, if they see that different “no friendship” arrows are pointing towards a pupil, if the percentage of their risk of bullying is high or if there is information that they are bothering a classmate. The robot performs an interview with these children. The results of the surveys held on these children show that they feel they can open up more in the conversation with the robot, as it is not bias, makes no value judgements, and it does not take into account non-verbal aspects. Using the information that the robot collects during the interview, a report is generated along with the transcription.



The implementation of this project was the driving force for change to ensure the school applied a restorative outlook. Throughout the 21-22 school year, **all the teachers in the school were trained in this area and restorative circles are now applied to find solutions to conflicts and facilitate intra-group knowledge**, both among the teachers and with the families and among the pupils. This experience also fostered a change in outlook of the pupils, valuing the quality of the relationships and active listening towards classmates.

WHAT WERE THE MAIN DIFFICULTIES AND HOW WERE THEY SOLVED?

- Because it was a pilot test, the school had to spend a considerable amount of time managing the application. It was initially necessary to provide the school's knowledge to be able to adapt the content of the software to the corresponding ages and to ensure the usability of the resource. Communications between the school and the technicians remained flowing, with the school forming part of the work groups and conversations to improve the application.
- **The school showed concern for the management of the pupils' data. To guarantee their privacy, they received the support of the Generalitat de Catalunya Centre of Telecommunications and Information Technologies (CTTI).**

WHAT LESSONS COULD BE LEARNED FROM THIS EXPERIENCE?

- Enhancing the relationship between pupils to improve coexistence and learning.
- **Placing the pupils in the school, as technology in itself involves no kind of improvement.**
- **In terms of the group tutorial work, the implementation of artificial intelligence has favoured support, advice, help and empathy strategies.** More specifically, it has helped redirect behaviour and relationships, restorative conversation, the role of the leader as mediator, group listening, individual and group empowerment of (especially) girls, shared responsibility, inclusion, and the obtaining of criteria to form cooperative groups.
- With regard to the assessment sessions, implementing the experience has structured the information, teamwork through active listening, and proposing aspects of improvement and agreement.

WHAT WOULD BE THE NEXT STEPS?

To encourage carrying out the project outside the school, as the data collected shows that this is very positively valued by the teachers and the pupils.

To have more evolved robots, with the capacity to hold more specific conversations, for example.

To continue to move forwards on the path towards a more restorative school through different elements; training, the presence of facilitators, time to perform restorative circles (to discuss issues such as knowledge among equals, the feeling of belonging or responsibility for one's own actions), the encouraging of restorative meetings in primary education and of word of mouth in children's education (strategy to encourage active listening).

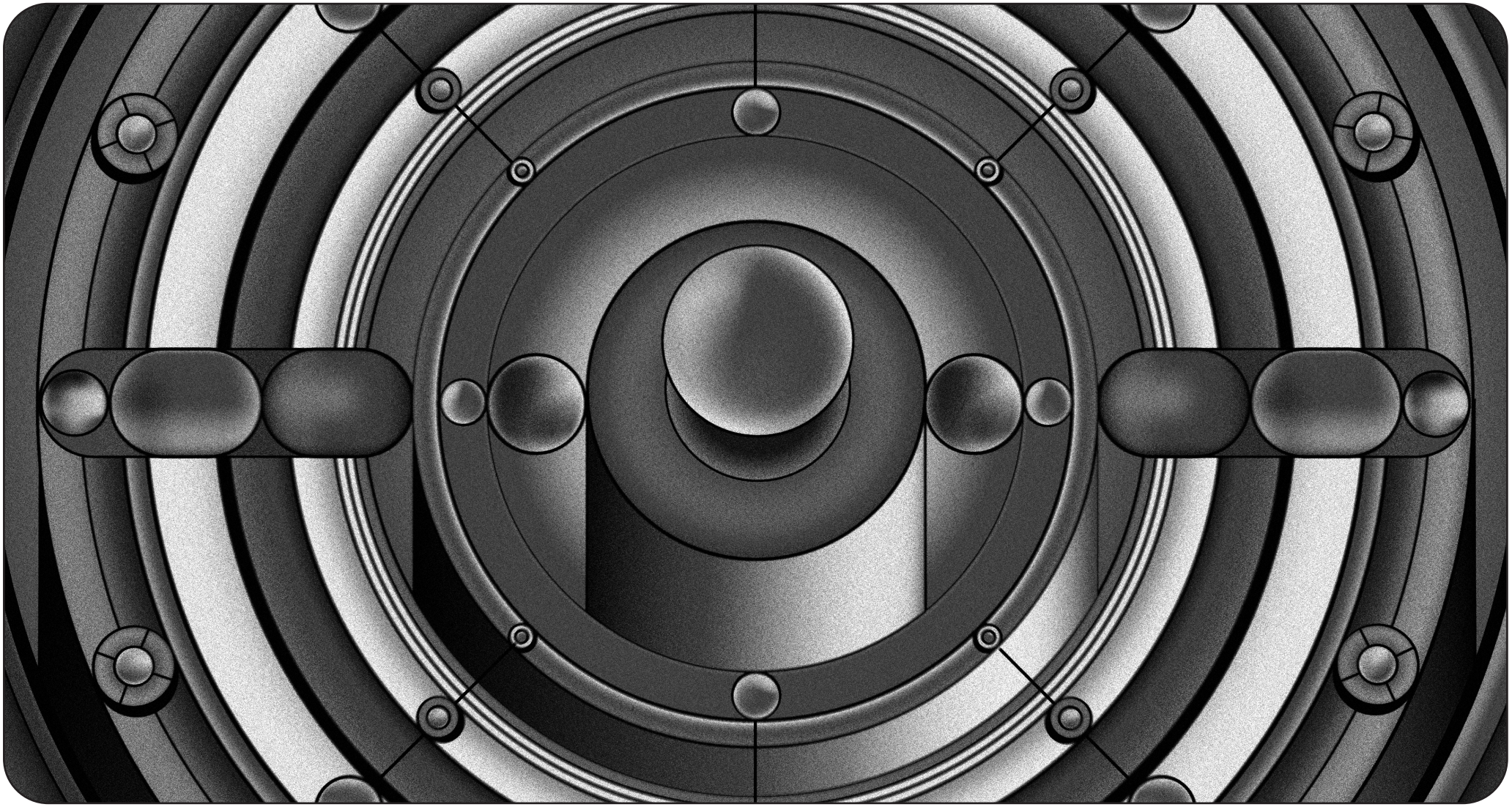
You can find out more about how this project was conducted at the following links:

• En Línia, TV2 Escola Els Pins Castelldefels: **https://www.youtube.com/watch?v=S7eK7-_90Ic**

• Projecte IA-WATSOM. Intel·ligència Artificial per la millora de l'èxit educatiu: **https://projectes.xtec.cat/claustreobert/projecte-ia_watsom/**

• IA-WATSOM i les mesures reparadores a l'Escola Els Pins: **https://www.youtube.com/watch?v=SsEUkCMvMKs**

PUBLIC POLICY RECOMMENDATIONS



The Beijing Consensus recommends that governments and other stakeholders of UNESCO Member States:

- **Plan for AI in education policies** to capitalise on the potential and address the challenges that AI technologies bring, while adopting whole-of-government, cross-sectoral and multi-stakeholder approaches, thereby also setting local strategic priorities in order to achieve the goals of SDG 4;
- **Support the development of new models** made possible by AI technologies with a view to providing educational and training services, where benefits outweigh risks, and use AI tools to **suggest lifelong learning systems that enable personalised learning** anytime, anywhere and for everyone;
- Provide, where appropriate, for the use of relevant data, with a view to **boosting evidence-based policy planning**;
- Ensure that AI technologies **empower teachers** rather than replacing them and create appropriate programmes with the aim of **building abilities for teachers to work alongside AI systems**;
- **Prepare the next generation of workers**, providing them with the values and skills needed for the more relevant life and work of the AI era;
- **Promote the equitable and inclusive use of AI,** regardless of any disability, social or financial status, ethnic or cultural background, or geographic location, with an emphasis on **gender equality and ensuring ethical, transparent and verifiable use** of educational data.

Based on these recommendations, in 2021 UNESCO published **a guide for education policy-makers**[34] that provides an understanding of what AI is, how it is being used and in which fields it has the greatest potential for development, and summarises the recommendations of the Beijing Consensus. Moreover, it is interesting to consider the guidance offered by UNICEF (2021) to **ensure the protection of children from the use of AI**[35].

In turn, the **European Union**, in its 2021 Resolution on artificial intelligence and education, sets out a series of considerations and **recommendations for the implementation of AI** in education, which we summarise in this Decalogue:

34 UNESCO (2021) **Artificial Intelligence and Education. A guide for policy makers**.

35 UNICEF (2021) **Policy Guidance on the Use of Artificial Intelligence for Children.**

1/ AI is a tool aimed at people as a general interest service.
It offers opportunities to respond to the main challenges of education: individualisation of learning, monitoring of difficulties, offering solutions for accessibility and responding to special learning needs, automation of knowledge in specific fields, reduction of teachers' administrative work to free up their time for tutoring students, the possibility of getting to know students better and continuously assessing their progress or needs, while increasing student motivation and reducing their dropout rate.

2/ The educational framework is considered to be a particularly sensitive sector, due to its great importance in establishing the rights and values of a society. The opportunities of AI must therefore be exploited based on an implementation perspective that guarantees fundamental rights.

3/ Algorithms and AI must integrate ethical principles from the design process, while especially reviewing built-in biases and for the protection of individual rights.

4/ AI can and should promote quality, comprehensive, inclusive deep learning that respects and protects gender equality, multilingualism and intercultural dialogue.

5/ It is necessary to collect reliable data with security, systematisation and transferability, without detriment to privacy. Thus, the European AI Ethics Agency has been launched and proposes the creation of a single European data space. The regulations laid down by the GDPR are binding for the implementation of AI.

6/ The acquisition of digital skills by all is a prerequisite for digital transformation that benefits everyone. Citizen education from an early age is considered essential to be prepared for the safe use of AI and take advantage of the opportunities it offers.

7/ The benefits of using AI do not depend exclusively on the technology, but also on the pedagogical use that teachers are able to implement. Ongoing digital competence and pedagogical training for teachers is key to prepare them in order to address individual needs, to detect and correct discriminatory situations in the use of AI, to pay special attention to students in vulnerable situations and to take advantage of the opportunities for pedagogical transformation that AI can bring about.

8/ AI should not be used to the detriment of face-to-face education to enhance learners' social development and cooperative skills.

9/ Member States should **invest in digitally equipping schools to ensure equal opportunities** for the implementation of AI in education.

10/ Steps taken to eliminate bias and discrimination in the education sector must not jeopardise technological progress.

CONCLUSIONS AND FUTURE OUTLOOK

IS TECHNOLOGY ALSO ”INVISIBLE” IN EDUCATIONAL SETTINGS, AND HOW CAN WE ASSESS ITS DEGREE OF ”INVISIBILITY”?

At present, technology integration is a fact in any work environment. The educational world is characterised by incorporating practices from other fields for pedagogical purposes, so teachers may be using AI-based applications with students without being aware of it. We can talk about technological ”invisibility” when technology becomes a tool that transforms educational practice through its application. What we do by applying technology could not be done without it; however, the use of the tool is not an end in itself, but an element that fosters or enhances better teaching.

ARE WE CLOSE TO AUTOMATING SOME OF THE MOST MECHANICAL ACTIONS IN OUR TEACHING?

The experts interviewed for this report believe that there is still a long way to go in terms of the application of AI-supported technologies to efficiently and responsibly automate some educational mechanics, both as to the development of technology and the legislation needed for its application. On the other hand, they warn of the fact that the application of AI can introduce discriminatory biases or promote inequalities, so they call for caution when applying it and the need for appropriate legislation.

WHAT ROLE IS AI BEGINNING TO PLAY IN THE WORLD OF EDUCATION?

In the world of education, there are great fields of action as to the use of AI. Some applications are more developed, such as the application to simplify educational management (creation of timetables, distribution of spaces or final assessment tests) or learning analytics, with the inherent risks that these analytics are being developed from commercial business platforms.

Other fields, which are considered to have great educational potential, are still in the process of research or development. For example, the application of AI for student assessment is still little implemented, but the great potential it can have for educational improvement towards greater personalisation of learning through the implementation of an AI-supported educational assessment is acknowledged, which will promote students’ actual knowledge, to support them in their educational process.

The different institutions in charge of ensuring the ethical and responsibility considerations involved in the application of AI-supported technology encourage the educational sector to take into account the field of application as a field of special sensitivity and care, without slowing down technological progress and the advantages it can bring. AI applied based on the requirements set by these institutions is key to meeting Sustainable Development Goal 4, due to its potential to achieve a more inclusive and equitable quality education.

WHAT DO TEACHERS NEED TO KNOW IN ORDER TO INTEGRATE AI WHILE ENSURING STUDENT SAFETY?

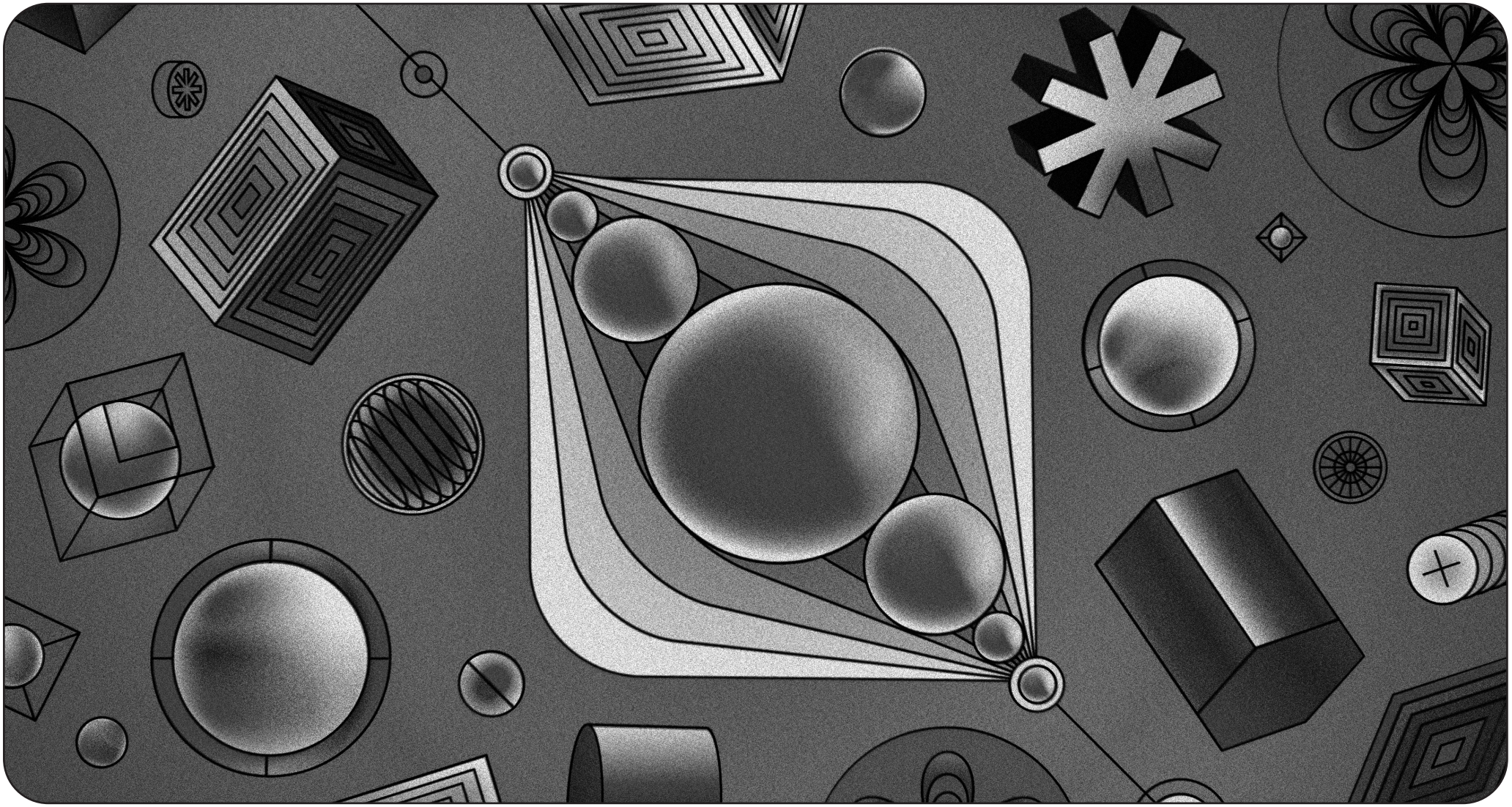
Teacher training is considered by UNESCO and the European Union to be an essential step for the responsible application of AI in educational settings, while favouring a change in the role of teachers and with the aim of preparing students to develop freely and with a critical attitude in an increasingly technological society.

Teachers need to know what technology is applied in AI is and what technology is available to them to improve the teaching and learning process. However, it is also important that they are clear about the risks and opportunities that this technology has in their field of application, not only so that they use it ethically and responsibly, but also so that they are able to support their students in the development of the necessary skills to manage their daily lives safely and critically.

HOW SHOULD WE PREPARE THEM TO LIVE IN A WORLD WHERE TECHNOLOGY IS CAPABLE OF MAKING DECISIONS AND INFLUENCING US?

ISTE's AI4K12 initiative identifies five major learning strands to be developed by students for the use of AI in their daily lives: understanding how computers work and how they perceive the world through sensors; understand how computers reason and represent the world; understanding how AI uses data, how it influences their daily lives and what risks in terms of biases they have; knowing what the interaction between technology and humans can be like; and last but not least, knowing the impact that AI-supported technology can have on society and the environment.

GLOSSARY OF KEY CONCEPTS WHEN DEALING WITH AI



GLOSSARY OF KEY CONCEPTS WHEN DEALING WITH AI

ADAPTABILITY
Ability to improve task execution by learning from experience.

AI-ASSISTED ROBOTS
Robots equipped with sensors that allow them to collect information, based on which they can make autonomous decisions.

ALGORITHMIC BIAS
Systemic under- or over-prediction of probabilities for a given population. Causes include the use of unrepresentative, flawed or biased training data, context blindness and uninformed application of results without human control.

ALGORITHMS
Algorithms are step-by-step instructions that help a computer complete a computation. AI uses algorithms to create machines that, as they gain more data, are able to learn from their own experience, reconfigure themselves to new situations and perform tasks in a similar way to humans.

ARTIFICIAL INTELLIGENCE
Engineering of technologies applied to the solving of complex problems in order to provide answers similar to those of human intelligence.

AUTONOMY
Ability to execute tasks in complex situations without constant user guidance.

BIASES
Preferences for or against an idea or thing. Some biases are based on unconscious biases. When using AI for decision-making, we must be aware that biases may arise from the biases contained in the data from humans, based on which the technology operates.

BIG DATA
Process that analyses and interprets large volumes of both structured and unstructured data. Big data works on the basis of the so-called "5 Vs": volume, variety, velocity, veracity and value.

CHATBOT
A programme that simulates or processes a human conversation. It allows users to interact with digital devices as if they were a person, i.e. offering automated but accurate answers to the questions raised.

COMPUTATIONAL THINKING
Thinking about a problem in such a way that a data-processing system can calculate the solution. Computational thinking is something people do, not machines. It includes logical thinking, abstraction, pattern recognition, algorithms, problem decomposition and debugging (Jeannette Wing, 2006).

COMPUTER VISION OR IMAGE RECOGNITION

DATA MINING
A set of techniques and technologies that allow large databases to be explored automatically in order to find repetitive patterns, trends or rules that explain data behaviour.

DATA SCIENCE
A recent umbrella term (a term covering several sub-disciplines) that includes machine learning and statistics, certain aspects of computing and, in particular, algorithms, data warehousing and web application development.

DEEP LEARNING
A programming technique in which thousands of examples of a given concept are provided to a software system that searches for patterns on its own.

ETHICAL SEMANTICS
Consensus definitions of ethical terms to consider in the responsible use of big data and for the application of artificial intelligence.

INFORMATION ECHO CHAMBERS
The echo chamber is a metaphorical concept linked to mass media. This term is mainly based on the fact that a set of ideas of the same information or ideology segment is amplified and conveyed in a hermetic system, where what is different is limited or not shown.

KNOWLEDGE ENGINEERING
Research, design and development of knowledge-based "expert systems", based on advanced logic in computer systems that simulate human decisions to support AI capabilities.

MACHINE LEARNING
Systems that improve the way they perform a given task as they gain experience or data.

NATURAL LANGUAGE PROCESSING (NLP)
AI technologies used to understand, interpret and interact with human language.

OCR
Optical Character Recognition is text recognition software that extracts text from an image and transforms it into character strings to be saved in a format that can be used in text-editing programmes.

PASSIVE DATA COLLECTION
Data that applications collect or track about users, as they are used.

PATTERN RECOGNITION
The automated identification of regularities in data used, for instance, for image processing or computer vision.

PREDICTIVE ANALYTICS
A set of statistical techniques that analyse data to forecast unknown events or outcomes.

ROBOT
A machine with sensors (that detect the environment) and actuators (that act on the environment) that can be programmed to carry out sequences of actions.

ROBOTICS
Construction and programming of robots that can operate in complex real-world situations.

SYMBOLIC REPRESENTATION
Representation of data or models that humans can understand.

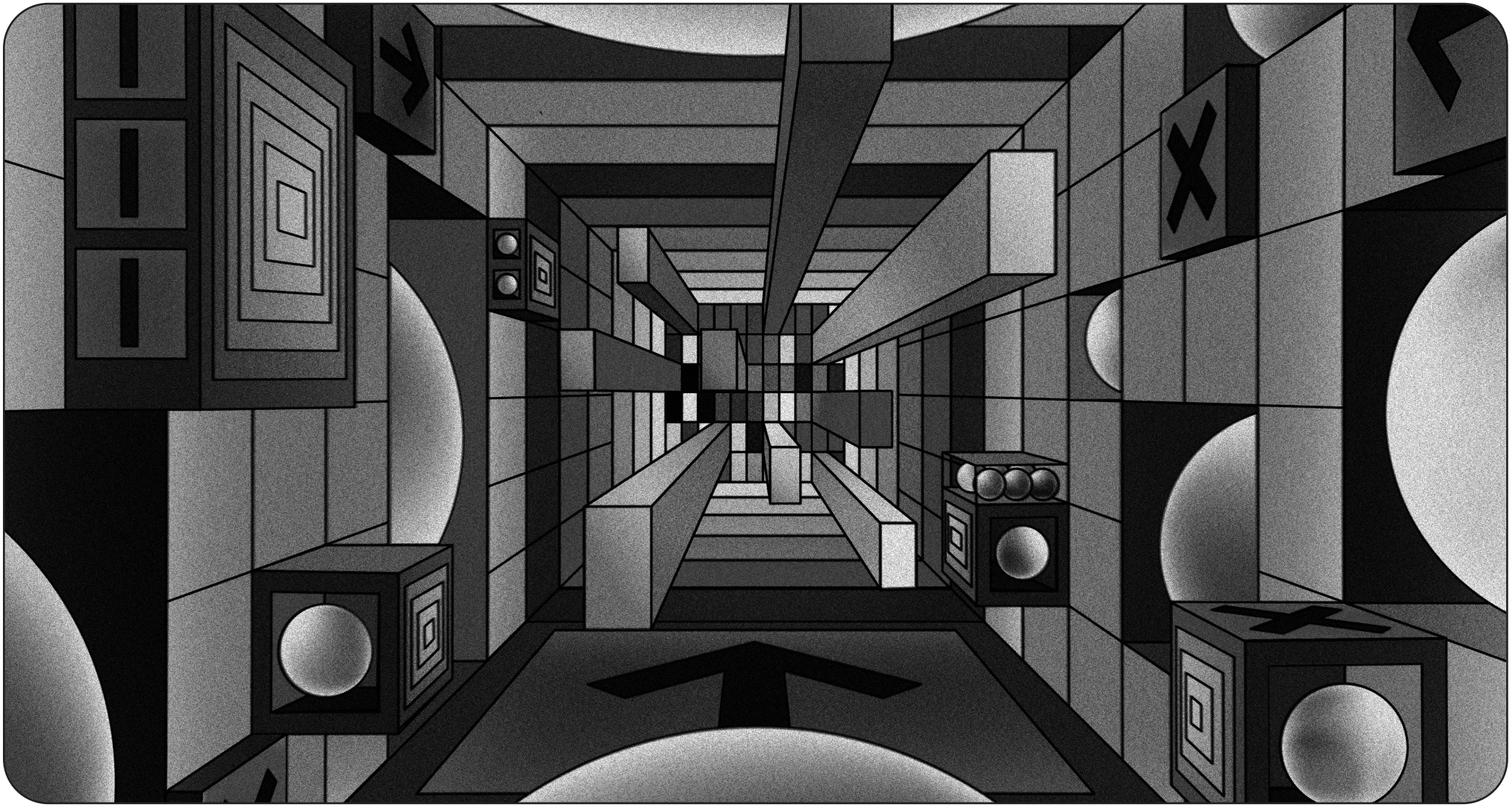
TARGETED MARKETING
The process of identifying individuals who are most likely to respond positively to certain advertising, information or recommendations.

TECHNIQUES
Techniques that allow computers to interpret digital images or videos, as in the case of facial recognition.

TRAINING DATA
Using AI systems using data models to train a machine learning model.

CLICKABLE REFERENCES TO OPEN AI RESOURCES ORGANISED BY PROFILE

(e.g. for teachers or education policy makers)



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ANNEX 1
USING AI FOR EDUCATION MANAGEMENT AND DELIVERY

UNESCO (2021), in order to guide education policy development in relation to the application of AI in education, classifies emerging applications, based on the needs they meet, into four categories: for education management, for learning and assessment, for teacher empowerment and for lifelong learning.

TO SATISFY YOUR CURIOSITY

The TEC de Monterrey Observatory and the UOC invite you to learn more **about what an educational chatbot is and why you might consider one as a teacher**.

Try **Snatchbot** if you dare to create a chatbot.

THE USE OF AI TO MANAGE AND TEACH EDUCATION

Need met	*Usefulness*	*Examples*
Facilitating communication with students	*Educational chatbots*: frequently asked questions, student admission, 24/7 information, automated feedback, dialogic learning.	**Snatchbot**
Support management	Predictive systems for anticipating possible difficulties and distribution of appropriate support for each case.	**OU Analyse**, from the UK's Open University.
Personalised training designs	Generation of personalised training pathways.	**Swift eLearning** in India.
Creation of psychometric profiling of students	Creation of profiles to predict the performance and progress of any digital learning product.	**ALP** in the United States.
Comprehensive systems for educational programming	Creation of course and exam schedules, management of time and room changes and information to students about their individual schedules.	**UniTime**

USING AI FOR LEARNING AND ASSESSMENT

Need met	*Usefulness*	*Examples*
ITS or intelligent tutoring systems	Individualised tutoring for students in specific subjects, such as mathematics or physics. The system responds to each student's successes and misconceptions by determining an optimal learning path.	ITSs are used by platforms such as *Moodle* and *Open edX*, they are also used by Coursera and **Khan Academy**. **ITalk2Learn**, **Knewton**, **Thinkster Math**.
Collaborative and dialogue-based learning systems (CDBL)	Simulation of tutorial dialogue while working on online activities in order to guide students in their development through questions that invite them to discover solutions by themselves.	AutoTutor and **Watson Tutor**. **Norilla**.
Exploratory learning environments (ELE)	Accompanying students by guiding them through feedback for active exploration and construction of their own knowledge.	**Betty´s Brain**. Fractions Lab.
Automated writing evaluation (AWE)	Automatic feedback on students' writing from an educational approach, to improve performance, or from a summative approach, for grading.	**WriteToLearn** and **e-Rater**.
AI-supported language and reading learning	Feedback on pronunciation or reading skills from comparative expert recordings.	**AI Teacher**, **Babbel** and **Duolingo**.
Support for students with learning difficulties or disabilities	**Intelligent robots:** provide alternative systems for accessing information, for communication and even for telepresence. **Humanoid robots:** used for communication with autistic people or in early childhood classrooms.	**Nao** or **Pepper** **Smart Learning Partner**
AI-supported virtual reality or augmented reality	Creation of immersive environments that facilitate learning, as if the user were present or close to the environment to be studied.	**WR Monkey**, **EonReality**.
Learning Network Orchestrators (LNOs)	Learning environments that connect students and teachers to create learning networks based on their needs, subject mastery, time availability and experience.	**Third Space Learning**.
Crowdsourced Learning	Applications that create communities of learners to help each other, learn about areas of common interest and connect with others.	**Brainly**.
AI-supported assessment	Tracking student performance and engagement, automating assignment marking and personalising the curriculum needs of individual students.	**Riid Labs**.

CAN YOU IMAGINE A ROBOT HELPING YOUR STUDENTS TO STUDY?

The robot designed to be a Smart Learning Partner provides an enjoyable learning experience and seeks to motivate students to study. Can you imagine a large-scale deployment of SLP in schools and families? You can see the robot at work here: **https://youtu.be/m8zfSZG-ySo**.

USING AI TO SUPPORT TEACHERS AND IMPROVE TEACHING

Need met	*Usefulness*	*Examples*
Monitoring of AI-based forums and discussions	Classification of messages with overlapping issues and automatic response to some simple messages in asynchronous forums. Useful for finding out students' collective opinions or concerns.	**Jill Watson**, based on IBM's Watson platform, answered some of the students' questions and sent emails about their assignments.
Human and AI "dual-teacher" training	Collaboration between a less experienced local teacher and an expert remote teacher. It is considered that AI can support one of these two roles in terms of providing specialised resources, monitoring student performance and tracking student progress.	LeWaijaia's AI classroom.
Teaching assistants powered by AI	Assistants for easily automatable tasks: correction, answering routine questions, monitoring attendance, distributing students in cooperative groups.	**Watsomapp**, sociogram creation and bullying detection. **Eduteams.iiia.csic** for cooperative team building


EVALUATION 4.0