IMPACT OF THE ARTIFICIAL INTELLIGENCE ON SOCIETY

Curriculum for primary school children

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This chapter introduces some ideas about teaching primary school children about artificial intelligence (AI) and its impact on society. You will learn some general approaches, as well as practical activities to address these concepts in the classroom.

Unlike learning to code, the topic covered in this chapter relies primarily on unplugged activities and group discussions. It's best to interweave them with computer-based assignments to maintain interest, and also to provide a wider context of application for coding skills.

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AI IN SOCIETY

Artificial intelligence, or AI, is steadily growing in use in many areas of life. We often use this technology without even realizing it: recommendations and suggestions from video-streaming services (like YouTube or Netflix), user authentication on smartphones (fingerprints or face recognition), conversations with virtual assistants (Siri, Alexa, Google Assistant and various chatbots). We rely on weather forecasts, navigation tools, predictive typing on a phone or Google search, all of which rely on AI technologies to provide best services.

So many of our decisions are influenced – and even dictated – by algorithms[1] that it's important to understand how this technology works, and to make sure that we're not misguided by it.

AI has significant potential to help solve challenging problems by replicating the processes happening in the human mind. To put it simply, machines learn from provided examples to recognize patterns, distinguish objects, categorize them, and create predictions based on observed trends.

Artificial intelligence (AI) is a simulation of human intelligence demonstrated by machines.

AI technology requires data – it's like fuel to bring life to complicated algorithms, which work through the data and provide solutions, such as predictions, suggestions, or evaluations. The data can be gathered in different ways. Some data come from environmental sensors, while others can come from human actions, registered by digital devices.

Practically every action in the digital world generates a trackable data packet, which can be used for further analysis and AI-based decision-making. That's why we need to be aware of the consequences of our actions and their potential to influence suggestions provided by algorithms.

[1] *Algorithm is a procedure used for solving a problem.*

Students need to understand the possibilities AI opens up, as well as the challenges it presents.

While praising the benefits of AI-based tools, it's important to be aware of the risks and challenges they might bring. At the same time, while presenting this topic to kids, teachers should find the delicate balance between awareness-raising and unnecessary detail or implications that are too complex to be understood by a pre-teen.

When talking with students about modern technology, and AI in particular, we may often find that they already have some ideas about these tools. It's important to set up an engaging conversation, opening the floor to all participants and letting all voices be heard.

This can be done by means of enquiry-based learning, when students are encouraged to explore ideas, ask questions and learn through discussion.

The following questions could serve as starting points for further discussion:

"Artificial intelligence around you"

- [ ] Have you ever recommended anything to another person? For example, have you ever picked a present for someone? Why did you make that choice? Perhaps you took into account the likes and habits of that person?
- [ ] Have you ever been advised by someone (parents, teachers, friends) about anything? A movie, a book, a toy, some food? Have the recommendations always matched your likes?
- [ ] Have you ever had anything recommended by computer? Perhaps a YouTube video, maybe a book or a toy in an online store? Have you noticed Google's autocomplete feature? Are the suggestions always useful?
- [ ] Have you heard about self-driving cars? How do you imagine they work?
- [ ] Have you ever talked to a chatbot? Did you like the experience? Are there situations when a chatbot is more suitable than a real person?
- [ ] Have you ever interacted with Alexa or Siri? Did they answer your questions? Did you manage to ask a question they were not able to answer?
- [ ] How does a smartphone recognize its owner? Can we always rely on this technology? Are there any other ways of identification and authorization?
- [ ] Have you ever played a game against a computer? Did you win?

In all these cases, and many more, you've dealt with AI systems and algorithms. AI covers a huge range of technologies and can have many different applications in numerous areas.

Extension activity

AI for Oceans (1) is a wholesome multi-step activity, which can be used as an introduction to the topic of AI. Its cartoon graphics and environmental focus appeals to young students. At the same time, the learner gets an illustrative explanation of the process and mechanics of AI algorithms of object recognition.

Personalized Shopping. After getting to know a particular customer's needs and preferences, the AI system provides personalized selection of goods or services. The same principle applies to increasing engagement with targeted advertisements, when users are provided with customized offers based on their previous web history and purchases.

Virtual Assistants. An application, usually capable of voice and speech recognition, assists with daily tasks, such as managing calendar, ordering food delivery, getting a taxi, checking the weather or performing internet search. Sometimes these assistants work as chatbots, trained to have human-like conversations using a process known as natural language processing (NLP).

Autonomous Vehicles. A self-driving car (sometimes called an autonomous or driverless car) is a vehicle that is equipped with a combination of sensors, cameras, radar, cloud services, GPS, and control signals, as well as AI that enables it to travel between destinations without a human operator. AI is also used to predict traffic and calculate routes in Maps apps.

Spam Filters. Programs are used to identify malicious or unsolicited emails and prevent those messages from reaching a user's inbox. These programs work by recognizing patterns that spam emails tend to follow. Filtering junk email is an important cybersecurity measure to guard against phishing attacks, viruses, scams, and malware.

Facial Recognition. Facial recognition system is a technology capable of matching a human face against a database of faces by pinpointing and measuring facial features from a given image. Such systems have been used for user identification, authorization, and video surveillance by governments and private companies. There are concerns regarding privacy violations, incorrect identifications, and safety of sensitive personal data.

Medicine. AI in medicine is used in diagnosing patients and providing guidance in treatment decisions. Nowadays we can spot early signs of many illnesses with the aid of advanced medical data-based models. Modern smart technology can predict the spread of infectious disease by analyzing data from hospitals, laboratories, and even surveillance cameras.

Agriculture. AI technologies like computer vision, robotics, and machine learning applications can identify weeds and target them with herbicide or remove them mechanically. It is also possible to analyze soil composition, detect nutrient deficiencies and balance them with high-precision interventions. This way we can obtain a higher crop yield of better quality while using fewer resources, contributing to solving the hunger problem with sustainable farming.

Climate change. In order to create models and predict impact on climate and ecosystems, it's important to have quality data. The sources of the data can be drone images or underwater audio recordings, which contribute to wildlife monitoring. Automatically gathered data from different kinds of sensors can be used for forecasting floods, wildfires and other devastating natural disasters.

Art. Despite what many people think, AI is not limited to scientific applications. It can be used to generate art. Of course, it's nothing like human creativity. Still, AI can use algorithms to spot patterns and restore damaged pictures, remove unwanted items from the background, and even generate new images, based on provided text or other images.

Education. In education AI can be used to deliver individualized learning experiences, based on the learner's test results and activity tracking on learning management systems. This way, every student in a classroom can receive a personalized selection of learning materials, as well as a set of activities matching their strengths, needs, skills, and interests.

After the students learn about the sheer scope of AI technologies application, they can try to formulate their own understanding of it.

"What is artificial intelligence?"

After introducing the topic of AI, the teacher asks the students to share their understanding of the concept. There might be some versions of the following answers:

- It's the way robots think.
- It's what's inside a robot's brain.
- It's when a machine knows about emotions but doesn't really feel them.
- It's when a machine gives you a suggestion.

It might be useful to create a simple concept map, and refer to it later, highlighting the aspects covered in different lessons during the course.

Extension activity

Teachers can use the **A-to-Z of AI guide (5)** to reference some AI terminology, or even create such a guide with their students themselves. This activity may span the whole course, adding a term or two at every lesson.

When teaching young students about complex and abstract topics, it's important to make these topics tangible and provide many opportunities for group work and discussions. Below you will find a set of activities on AI topics and aspects, suitable for young students.

"Drawing a robot"

Students learn that it's important to provide clear instructions to a computing system.

1) Each student draws a robot consisting of geometric shapes.

2) Each student writes a short description of their drawing on a separate piece of paper.

3) Students exchange the descriptions in pairs, without sharing their drawings.

4) Each student draws a robot according to the description received.

5) Students share and compare their drawings in pairs.

It's important to highlight the need to provide clear and precise instructions if we want someone else to do it effectively. Making good instructions for robots is even harder, because we need to use special languages.

This activity introduces students to the idea of an algorithm – a list of exact instructions that should be unequivocally understood and performed by the executor of this algorithm. To avoid confusion and enable effective communication and collaboration, it's extremely important to share a common language when describing the algorithm. In fact, this applies to any group problem solving activity.

Reference Framework of Competences for Democratic Culture[2] focuses on promotion of human rights, democracy and the rule of law, effective participation in a culture of democracy, and peaceful living together with others in culturally diverse societies. The proposed activity is linked to the following RFCDC descriptors:

- Skills of listening and observing
- Linguistic, communicative and plurilingual skills
- Co-operation skills
- Tolerance of ambiguity

DATA AND SENSORS

Data are information that is ready for processing or storage. Humans perceive information from the outside world by using five senses. For example, when we register something with our sight, we can say it's red, yellow, green or any other color. The color we're perceiving is data.

Computer systems receive data from input devices of different kinds: mouse, keyboard, microphone, camera, as well as specialized sensors for color, light, temperature, humidity, touch, proximity, smoke, and countless others.

"How do you learn about the world?"

What senses do you use when exploring everyday objects?🌼🍋🔥🌈

Would you be able to explore them if one or more senses were missing? How do you think people with disabilities explore the world?👂🕶️🦯

What tools do we use to get more data? 🔬🧭🔭🔬🩺🌡️

Can you provide examples of animal senses that are superior to humans?🐶🐬🦅🦅

How would you describe and compare humans, animals and computers at gathering data from the outside world?

Interestingly, AI technologies can assist people with disabilities and compensate for sensory challenges. For example, technologies of computer vision can help visually impaired people, speech recognition and automated translation apps can be used by people with hearing difficulties, robotic systems can support the daily functioning for those with mobility issues.

This would not have been possible without including people with disabilities when designing and developing AI technologies. It's important to keep an open conversation about possible applications of modern technologies, to find the best fit for their potential.

Extension activity

To learn more about application of artificial intelligence to the needs of people with disabilities, refer to **Seeing AI (4)**, where you will find videos and cases that portray AI as an intelligent assistant.

We can collect data by asking questions: What color is it? How big is it? How does it smell? How does it feel to touch? Answers to these questions create data. Some questions are pretty straightforward to answer, while others can be trickier. For example, if we ask people about their favorite fruit, the answers will vary due to different tastes. A question about dogs might be even more interesting, because each of us has a different idea about what a dog looks like: some will imagine a Labrador while others will think about a Chihuahua.

To account for all the different viewpoints and ideas, as well as to make sure that the common understanding reflects every voice, it is important to gather diverse data.

"Quick Draw"

The teacher asks the students to draw something simple, like a table, an apple or a dog. Students compare their drawings and find similarities or patterns. The common features are shared in our understanding of these objects. AI works by comparing a lot of data, like drawings, and looking for similarities, patterns and trends.

This activity is even more fun with AI-tool Quick Draw (3): ***https://quickdraw.withgoogle.com/***. A user is tasked with drawing an item in 20 seconds, while the computer is tries to guess what is being drawn. After a session you can see the doodles that were not recognized.

What do 50 million drawings look like? Check out the drawings from millions of users: ***https://quickdraw.withgoogle.com/data*** – select an item and see how different people were drawing it.

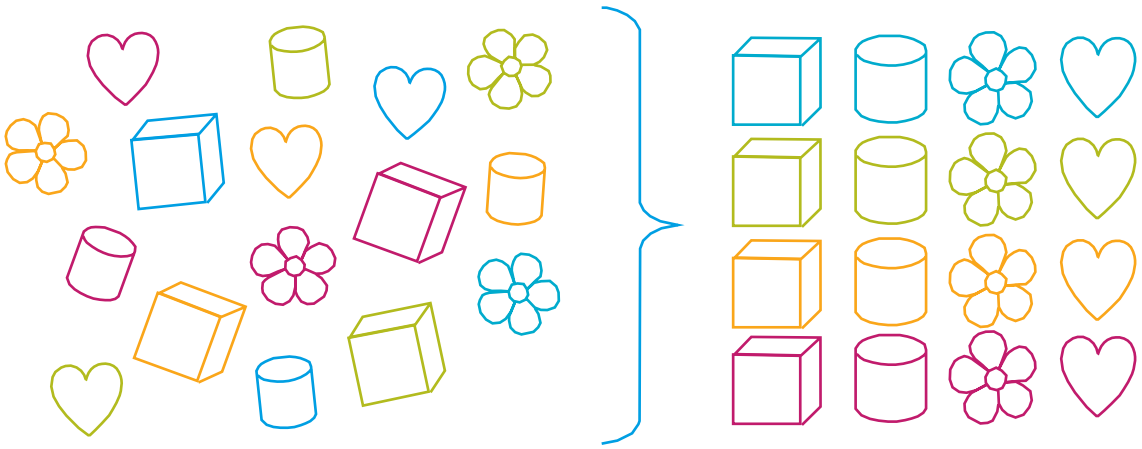
This is an example of a citizen science project: when individual users contribute to the big task of gathering data for further processing.

Our activities can often be a source for data for AI systems, even when we're not aware of it. Every action online – every click, every website visited, every like or share on social media – can leave a data trail that can be stored and later processed by algorithms. We must be aware of our digital footprint and its potential. We can and should limit the information we share online, make sure it's not private (full name, age, birthday, phone number, school name), and share personal information carefully (hobbies, interests, favorite things). Children should be aware that the recommendations to be careful with personal and private information have solid grounds and treat them seriously.

ARTIFICIAL INTELLIGENCE ALGORITHMS

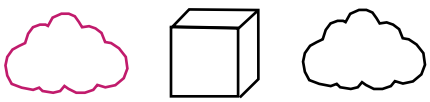
After receiving a lot of data, the AI technology uses some complicated algorithms to make sense out of all this data. Usually it means recognizing the category an object belongs to.

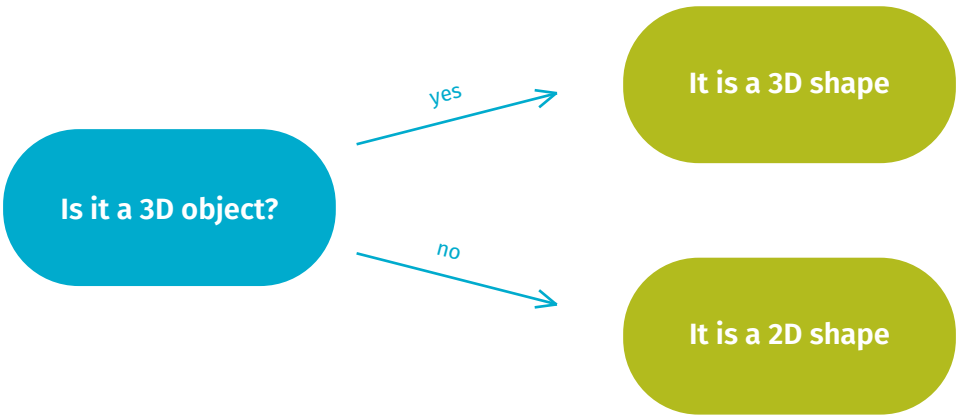
Check out these geometric shapes. This set is data. We can clearly see that there are multiple ways to categorize these objects. In this case, at least three: by color, by shape, and by dimension.



Problems arise when we need to categorize a new object, one never seen before. Can you say where these objects belong? What's the explanation for your decision?

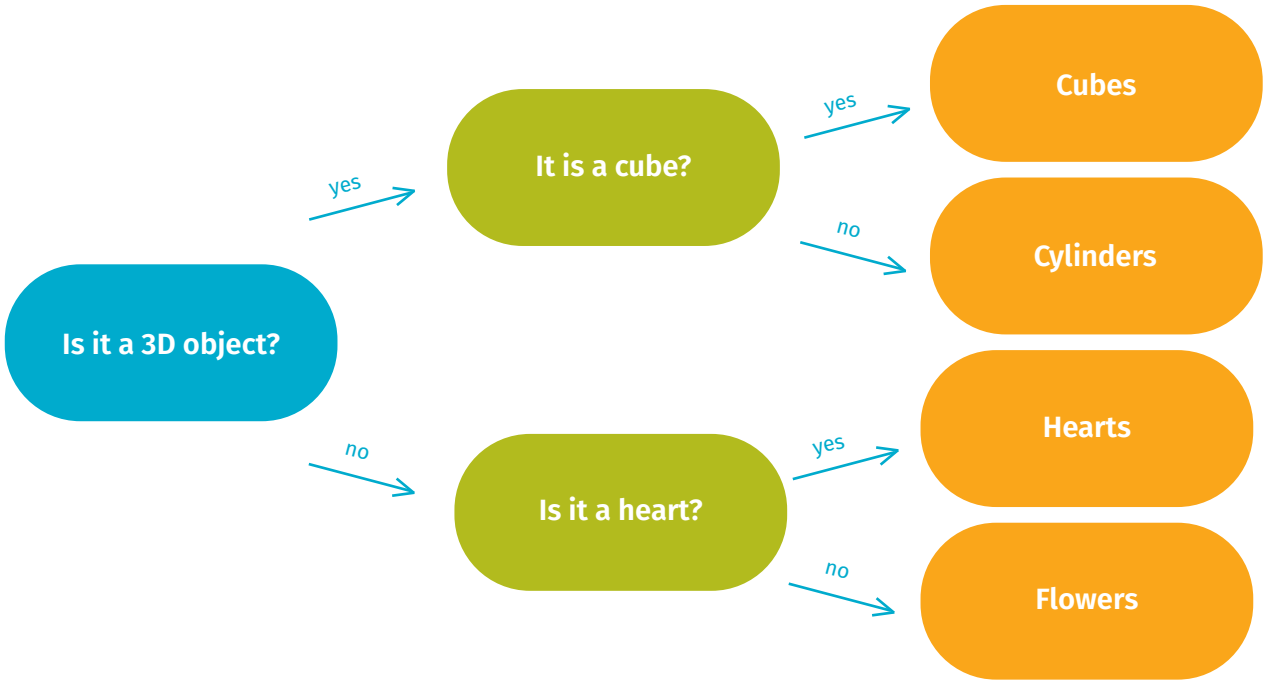
Obviously, the answer will depend on the chosen classification. Let's say we're classifying these objects by dimension.





If we had just two categories, 2D and 3D shapes, it would be quite easy to put new objects into these categories. Clouds would go to the 2D section, and a cube would be placed with other 3D shapes. It's pretty straightforward. However, the two categories are very broad and possibly not useful for further decision-making.

If we're creating four categories, then we can classify an object by getting answers to three questions, as pictured below.



Now it's quite easy to put a cube with other cubes, but clouds would technically require a new category. Or, if we follow this model, clouds will fall with suns (since the answer to "Is it a heart?" is negative).

Imagine we initially classified shapes by color (try creating this classification model yourself). In this case, the red cloud would fit into the red category. But then it would be a challenge to put blue objects into the system.

That's the kind of challenges that AI algorithms try to solve. It's fairly easy to put some things into categories, but with many others we need to consider a lot of factors to make a decision. And often, the final decision will not be the perfect fit. Quite probably, however, it will be the best fit given the data we have.

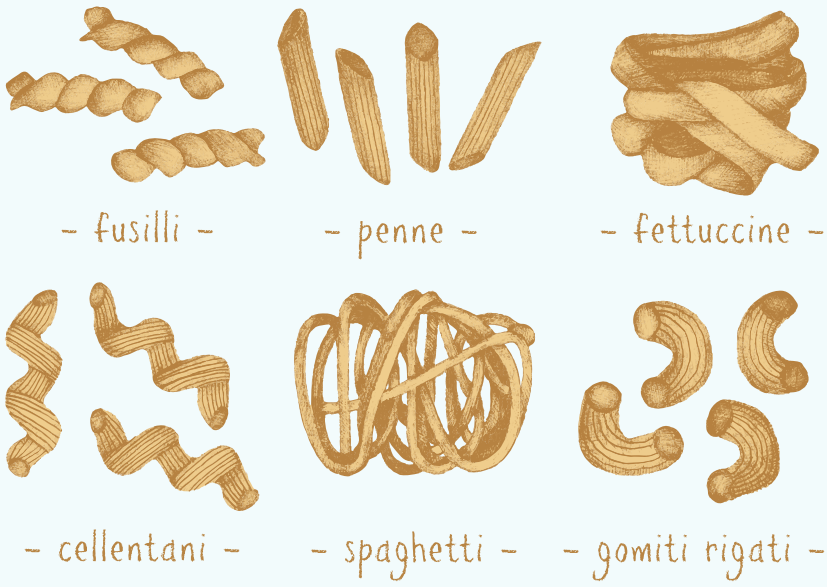
"Pasta sorting"

There are pictures of pasta of different shapes. Can we create a model to classify these shapes? Choose several categories that might be suitable for this task (you may change your decision later).

Look at each kind of pasta and think how it is different from the other kinds. Those would be properties that are used for classification. If students are struggling with identifying key properties, the teacher hint that there are different kinds of pasta:

- long and short;
- straight and curved;
- solid and hollow;
- spiraled and waved.

We can classify pasta by only one parameter or by several. For instance, penne is not only short, but also hollow.



After creating a classification, teachers should encourage students to think about the following questions: Do you know any other type of pasta? How would it fit into your classification? Would you need to update your classification model?

Reference Framework of Competences for Democratic Culture (RFCDC) links:

- Skills of listening and observing
- Analytical and critical thinking skills
- Flexibility and adaptability
- Tolerance of ambiguity
- Valuing (cultural) diversity

The process of putting items into categories becomes extremely complicated when it comes to human beings with unique personalities. It's important that algorithms are not too strict and account for the diversity of the world. It's very dangerous to overlook biases. Therefore, any application of AI needs detailed and responsible supervision.

Extension activity

The collection of activities **AI Unplugged (6)** provides a set of offline activities with explanations of AI concepts, suitable for primary school children.

DECISIONS

After AI systems make the decision about which category an object belongs to, they can provide further recommendations or suggestions. For example, after analyzing previously bought items, AI suggests more goods to buy for a customer. Or, after analyzing the road situation, AI suggests an optimal route for a self-driving car.

But in order to be able to trust these decisions, we have to be sure that they are based on correct algorithms and solid data. For example, if we have been shopping for gifts for family members, the recommendation system would not be tailored to our personal needs. Instead, it will keep suggesting items suitable for others.

"Bias"

Teacher asks students to draw a firefighter, a nurse, a teacher, a scientist, a computer scientist, and a robot.

Can you find common features in your drawings? Is there any bias? (most commonly, unfortunately, we'll see male/female bias in these pictures).

If we train AI based on these pictures, it will always think that a girl cannot be a scientist, and a boy can never be a nurse.

You can also do a Google image search of these professions. Can you spot any bias?

When an AI system is trained on specific data, it can inherit biases from these data. The quality of decisions depends on the quality of data, which is often gathered from human actions. This doesn't mean that the technology or algorithm is created with purposeful discrimination. Rather, it means that there's a current injustice in the given area. We need to address this injustice before letting AI learn from these biased data, and make sure we have safeguarding measures in place.

It's important to consider diversity in all aspects of working with AI. If we fail to notice it from the start, the decisions generated by AI would only deepen the inequity.

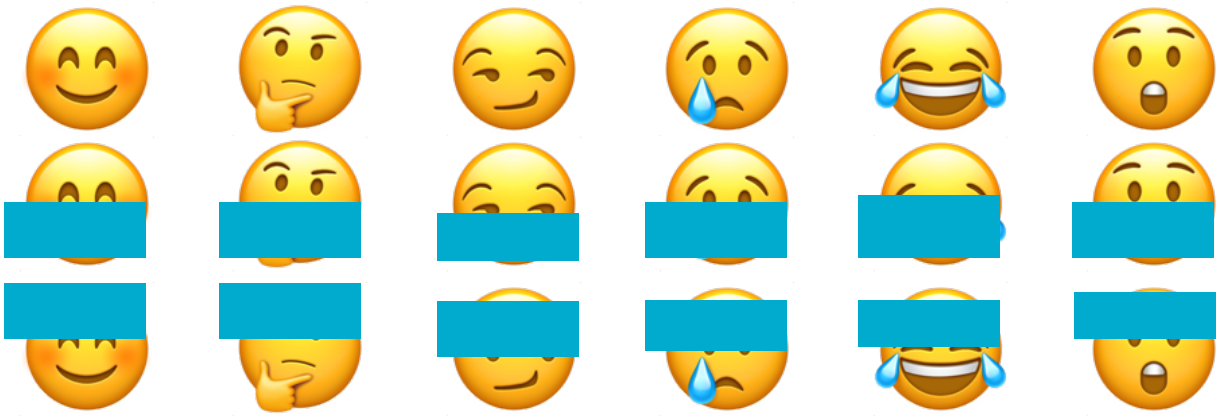
FUTURE

As we have seen, AI can bring a lot of benefits to solving problems, in many cases surpassing human abilities. But we must also be aware of the limitations of AI, which cannot be better at everything. For example, AI is not capable of true creativity. Remember, its specialty is making predictions and generating content based on previously seen data. It cannot go much further than that, always staying within the general limits of the original dataset. Creativity is what makes humans unique. It is our strength that cannot be replaced by technology.

Extension activity

An online resource **NightCafe (9)** can be used to illustrate the possibilities and limits of AI-based creativity. It's possible to apply some artistic filter, but it's certainly not original work.

Another area completely alien to AI is emotion and compassion. AI can identify some emotions, some of them can be mimicked, but no robot can actually feel these emotions. It's a uniquely human ability to interpret emotions of others and empathize with them. Humans are usually very good at perceiving emotions, even with distorted data.



Can you identify these emotions? Was it difficult to identify an emotion when half of the image was covered? Can you draw the missing half of the emoji?

With every technology, AI included, we need to think carefully about its impact on society. For instance, let's take self-driving cars. Can you explain why they might be good for us? What about the negative impact of self-driving cars, or risks they might pose? Consider the following groups of people. Would they benefit from this technology or be negatively affected by it?

- Manufacturers of self-driving cars
- Manufacturers of traditional cars
- People who cannot drive
- People whose job is to drive

Every example of AI application opens the floor to conversation and extended discussion about the pros and cons of using it; about its advantages and limitations, benefits and risks. Living, learning, and working in the digital world requires awareness of its opportunities and risks, derived from underlying mechanics. At the same time, we need to understand that technology itself is not good or bad; rather, it's a tool that should be applied responsibly and equitably.

"Online learning - good or bad?"

The teacher asks the students for their thoughts about online schooling. Everyone has likely experienced it, and can share the pros and cons of learning via digital technology.

While students share their experiences and compare them, it's important to see different sides to the story. This way we encourage empathy and analysis of multiple perspectives. We learn that in many situations the choice is not between simply "good" or "bad", and there are often different factors to consider. This is particularly applicable to new technology: we need to remember that while embracing the benefits, we must also consider the challenges and strive to minimize and mitigate them.

Reference Framework of Competences for Democratic Culture (RFCDC) links:

- Skills of listening and observing
- Autonomous learning skills
- Flexibility and adaptability
- Conflict-resolution skills

Having learned quite a bit about AI, as well as the possibilities and limitations of technologies, students can proceed to evaluating the performance of different tasks by humans and computers. This is an element of problem-solving competence, when we choose a way of solving a problem and applying technology, if appropriate.

”Who can do it better?”

The teacher asks the students to reflect on who would better perform a given task: humans or computers?

- [ ] Add huge numbers
- [ ] Make friends
- [ ] Work all day and all night
- [ ] Create a funny joke
- [ ] Solve puzzles (rebus)

Students should explain and justify their choices. They can expand the list of tasks that are better solved by different actors.

Obviously, technological transformation is at full speed. We’ll see many more applications of AI in numerous areas quite soon. It’s very important that children are not simply aware of the current state of digital development, but are also ready to embrace the future opportunities (and challenges).

”Imagine your day in the future”

We can see a trend of making smart things, building technology into everyday objects.

- Name the things you use every day (toothbrush, spoon, book, car, bus, bed, mirror, etc.)
- Add some AI features to these objects.
- Write an essay about the future of AI in your everyday life: how will we eat, build houses, travel, cook, and learn in the future.
- Alternatively, create any other deliverable: a short video, a cartoon, a presentation, a drawing, a poster, etc. Students may work in groups to promote collaboration and communication skills.

Extension activity

The book **”Artificial Intelligence & Me” (10)** can be used to summarize the learning and get an overview of important ideas in AI (namely Perception, Representation and Reasoning, Learning, Natural Interaction, and Societal Impact) for students.

There are additional resources, such as the Digital Citizenship Education Handbook (8) and Digital transformation and digital competence from the practice of Education for Democratic Citizenship and Human Rights Education (7), that can be recommended as resources for teachers to learn more about digital citizenship education and human rights education in the context of digital transformation.

USEFUL RESOURCES

AI for Oceans https://code.org/oceans Learn about artificial intelligence (AI), machine learning, training data, and bias, while exploring ethical issues and how AI can be used to address world problems.

Minecraft AI for Good https://education.minecraft.net/en-us/lessons/minecraft-hour-of-code Program the Minecraft Agent to collect data about forest fires. Learn coding basics and explore a real-world example of artificial intelligence.

Quick, Draw! https://quickdraw.withgoogle.com/ Can a neural network learn to recognize doodling?

Seeing AI https://www.microsoft.com/en-us/ai/seeing-ai A free app that narrates the world around you in a variety of languages.

A-to-Z of AI guide https://atozofai.withgoogle.com/intl/en-US/ A series of simple, bite-sized explainers to help anyone understand what AI is, how it works and how it is changing the world around us.

AI Unplugged https://www.aiunplugged.org/english.pdf Activities and teaching material on artificial intelligence.

Digital transformation and digital competence from the practice of Education for Democratic Citizenship and Human Rights Education https://competendo.net/en/images/f/f5/Competendo_learning_the_digital.pdf

Digital Citizenship Education Handbook https://rm.coe.int/16809382f9 Information, tools and good practice to support the development of competences to empower and protect children, enabling them to live together as equals in today's culturally diverse democratic societies, both on- and offline.

NightCafe https://nightcafe.studio/ Create various types of artwork through its unique preset effects, which includes, cosmic, oil painting, and more.

Artificial Intelligence & Me: The 5 Big Ideas That Every Kid Should Know https://www.amazon.com/Artificial-Intelligence-Me-Special-Should/dp/1087929792 The book introduces & explains the 5 Big Ideas (Perception, Representation and Reasoning, Learning, Natural Interaction, and Societal Impact) in Artificial Intelligence.

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