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Artificial Intelligence and Education: How Can They Complement Each Other?

ABSTRACT

Artificial intelligence is invading all facets of our society. The education sector must also ask itself what its contribution will be. The questions addressed in this article are: What will we gain? What will we lose? What position should we take to bring the benefits of AI to students? After defining what it is and can be, we focus on descriptions and illustrations of its functions in teaching and learning: how to differentiate? Interact? Guide? Assess? for the benefit of the learner?

Keywords: artificial intelligence, contribution, benefits for students, functions

1. Introduction

Artificial intelligence is intellectually seductive, capable of defeating world chess champions (Deep Blue – 1996) or Go champions (AlphaGo – 2016); of making itself understood by a smartphone by giving it verbal instructions (Siri – 2012, Alexa – 2014; Google Assistant – 2016) and accessing it through facial recognition (Face ID – 2017) or even translating text from English to French in real time (Google Translator – 2005, DeepL – 2017).

It also plays an increasingly prominent role in films and television series: Hal 9000 in 2001 "Space Odyssey" (Kubrick, 1968) as one of the precursors. In "Her", by Spike Jonze (2013), Samantha, the artificial intelligence integrated into the operating system of Theodore's computer, is endowed with a sensitivity which, solely thanks to vocal conversations, allows for the creation of in-depth human relationships (friendship, complicity, love, etc.). Ava, the artificial intelligence in "Ex-Machina" (Garlang, 2015), has a body and can manipulate feelings

and developing her own strategies to free herself from the dependence of her human designers.

1.2. What will we gain?

Although artificial intelligence is obviously not currently capable of being autonomous in the way these fictions present it, its capacities in very specific fields are sometimes much more effective than those of human beings. And the impacts can be positive: for example, in the field of health, the recognition of skin cancers (Sciences et Avenir, 2018) by an AI has proved to be better (with 95% efficiency) than those of 58 dermatologists. Is it therefore still necessary to train radiologists in 25 years when a few months are enough to develop a more competent AI? In terms of travel safety, the impact of intelligent systems makes it possible, on the one hand, to optimise routes according to traffic density and, on the other hand, to avoid road accidents (90% less according to Bertoncello & Wee [2015]) thanks to intelligent systems enabling autonomous driving.

Almost all sectors of activity will be impacted by digital technology in general and AI in particular, with positive effects for the well-being of individuals, but of course also with points of attention that should not be overlooked.

1.3. What will we lose?

A – Jobs? Yes, some will disappear. Those for which automation can help make the job less arduous. Where repetitive procedures that are not necessarily rewarding for humans can be taken over by a form of automation. For example: data encoding, driving heavy goods vehicles, etc.

If some professions have to implement a process of renewal of their core business or risk becoming irrelevant, history has shown us that other professions are emerging. The day cars began to populate our roads at the expense of horse-drawn carriages, ironmongers and horse traders gradually disappeared in favour of mechanics and coachbuilders. In the digital age, drone pilots, digital lawyers and electronics engineers will have new job opportunities as the economy improves.

B – The ownership of our private data that we willingly (or unwillingly) give to the GAFAMs (Google-Apple-Facebook-Amazon and Microsoft) may be out of our hands. Data protection processes must be properly activated by manageable and reasonable procedures that allow everyone to say how they want their per-

sonal data to be used so that they retain control. Without becoming paranoid, without prohibiting use in schools at the risk of not educating for intelligent use.

C – The values we wish to defend can be undermined by inappropriate uses of AI: the implementation of electronic chips in the brain to boost our cognitive capacities, being located everywhere and all the time, favouring the transmission of false information (fake news), etc. Ethics is at the heart of dealing with AI issues. It is a democratic issue.

1.4. What do we need to put in place to make the digital transition a success?

If we are vigilant, we will lose nothing. It wasn't better before (Serres, 2017) as some chagrins feel they must claim! As long as everyone takes hold of these digital issues (and those of AI in particular) to regulate the evolution of these uses in favour of human well-being. This is a civic issue. It is one of the investments that education must not miss at the risk of missing the turn of the digital transition. Companies like Kodak or Nokia did not negotiate it in time, and are now reduced to a trickle. If we do not want the school as an institution to be deprived of its educational prerogatives, we need to determine how these digital issues will be taken into account so that our educational approaches fit into the current and modern societal context. The world of education cannot remain on a path that ignores the existence of artificial intelligence and its effects. "For if we make the digital, the digital also makes us" (Cardon, 2019, p. 9).

2. Artificial intelligence (AI): what is it?

The definition given by Kurzweil (1990) is as follows: it is "the field of research relating to the construction of machines performing tasks considered to require intelligence". Behind one of the ways of characterising it, let us try to understand what it covers more precisely.

Historically, Alan Turing was the first to talk about the intelligence of machines in 1950. The term Artificial Intelligence was first used in 1956 by McCarthy. His team at Stanford had the ambition of making the machine so intelligent that it would supplant humans. A few years later, in 1968, Engelbart took a different position, namely that of the digital machine "augmenting" rather than replacing humans.

It is still this position that, several decades later, we believe we must defend: the complementarity of human intelligence and artificial intelligence.

2.1. From symbolic AI to connectionist AI to generalist AI

Algorithms are finite and unambiguous sequences of operations or instructions for solving a class of problems ("Algorithme", 2022). The first steps in AI were in the direction of trying to reproduce, in the form of algorithms, the logic of natural reasoning. The mechanic's diagnosis is broken down into rules which are transferred to the computer which must make decisions like a human mechanic. This is symbolic AI. These expert systems have shown their limits in terms of efficiency. Mainly because many variables could not be taken into account in the decision-making process: emotions, context, intuitions (Houdé, 2019). As a result, the field of action of symbolic AI remained circumscribed. Programmed for chess, it is not capable of driving. And the one that helps with navigation cannot detect cancerous spots. To develop an intelligence closer to human reasoning, AI would have had to be able to build bridges between domains (multidisciplinarity), to judge the relevance of its actions (critical thinking and common sense). This is something it absolutely does not have

A different approach has been taken. Rather than teaching it what it needs to know, let it learn by itself: this is machine learning. Instead of coding, let's confront it with multiple examples from which, by an inductive method, the AI will gradually learn the rules in an increasingly subtle way. By providing many (thousands or even millions) of videos of football matches, the AI will be able to isolate the rules for kick-ins, indirect free-kicks and even offside. It uses probabilistic methods that allow it to build bridges between similar situations. This is connectionist AI. By successive approximations, it manages to discriminate and generalise concepts from one another.

However, the possibilities for cross-disciplinary thinking remain limited. One attempt to move towards this multidisciplinary thinking is to reproduce the functioning of the brain. This is deep learning. Starting with perceptions to gradually reconstruct reality through the pattern that would be followed in a neural network. The billions of faces that are analysed make it possible at some point in the process to affirm, with an increasingly high percentage of success, that it is yours or your sister's or you can see why your photos on Instagram are highly prized in order to feed these learning machines.

However, these still need to be helped by humans. The system thinks it is your sister in this photograph and will therefore ask you to confirm it or not. This is supervised learning. And so, little by little, the system adjusts itself to recognise your face, your cat, cancerous spots, pedestrian crossings, etc. Once again, you can see why, under the guise of security, you are helping to teach an

artificial intelligence what it will have to recognise one day without your help by identifying objects in images.

But we are still a long way from strong, generalist AI, the kind that will begin by being transdisciplinary, intelligent in many fields and capable of building bridges between them. We are not at all at the dawn of autonomous AI that will become independent of the human being who designed it. We are far from this reality and opinions on whether it will ever happen are not at all convergent among the experts themselves (Alexandre, 2017). But who knows? Let's keep our eyes open. And let's prepare our children... from school onwards.

3. Artificial intelligence has its place in schools

Digital, social networks, artificial intelligence, technologies must be present in schools. It is a social imperative (de la Porte, 2017)! Because if the most digitally deprived (and we are not talking here about digital equipment) are not educated in the appropriate uses of the tools, the digital divide of the second degree (the uses of the digital) or of the third degree (the exploitation of the information available from these digital networks) will become more pronounced between the haves and the have-nots, for whom the school will have failed in its mission.

It is therefore essential to integrate these artificial intelligence technologies, as they can help to facilitate all aspects of the teaching and learning process, both in terms of organisation and regulation. From guidance to the provision of targeted content, from interaction management to learning monitoring and assessment, all the many tasks that a teacher can benefit from AI inputs.

3.1. To differentiate

Position the student where he/she will be most able to learn effectively in the course. Take account of prior learning and offer challenging situations. Both the teacher and the pupil need such opportunities. The principle of adaptive devices is to have as complete a view as possible of the learner's progress in order to be able to propose relevant tasks in terms of progressiveness. No one is left in difficulty, no one is frustrated by being held back.

The Tacit software[1] developed at the University of Rennes is based on this live adaptation logic. From the results obtained by the learners, the statistical model

[1] https://tacit.univ-rennes2.fr/

(Rasch item response model) establishes a precise correspondence between the level reached (in inferential reading and vocabulary development) and the relative difficulty of the tasks proposed afterwards. The learning environment thus makes it possible to simultaneously differentiate student activity and better manage the heterogeneity of the students in the class. Lalilo[2] is a private version developed by others that adopts the same logic of using AI.

In the same way that social networking algorithms provide us with information or advertising based on our preferences, lessons can be illustrated according to some of our preferences. If a student has a strong interest in the prehistoric period, a series of examples could be provided based on this interest. The content is therefore personalised for each learner in such a way as to motivate them.

Khan Academy[3] is a learning platform that uses these techniques to offer learning paths that are differentiated in terms of the number of exercises, types of cues provided to students according to their personal characteristics.

3.2. To interact

To make the learner active, interactive situations are a valuable aid to learning. The conversational mode is an approach that we use on a daily basis. One of the great challenges of AI in education is to create systems that can address learners in natural language. Chatbots, software with which it is possible to have a conversation, often via instant messaging, are increasingly being used. In 2016, Facebook's massive investment in natural language processing increased the popularity of these programs. The interest in these conversation automation devices is all the more important as the number of users of instant messaging software continues to grow. It is estimated that there are over 1 billion users worldwide on smartphones alone in 2018. Asking for help from a technical support service now means being taken care of via a chatbot (conversational robot). The development of software such as Recast or Chatfuel offers the opportunity to develop chatbots quite easily using blocks of instructions to be organised with each other. Di Emidio et al. (2018) have thus developed a chatbot to enable the revision of geometry concepts for the end of primary school. Integrated into Facebook Messenger, the student interacts with the robot. The robot proposes different revision topics. The pupil is asked a question

2 https://www.lalilo.com/
3 https://fr.khanacademy.org/about

on a subject by the bot and formulates his answer. If the answer is correct, the bot moves on to the next question; if the answer is partial, the bot asks for the missing information and encourages the learner to clarify his or her answer. In the event of a wrong answer for which the cause is identified, the bot offers specific help; in the event of an answer for which the cause is not identified, the bot asks the learner to reformulate. The challenge of programming the bot is, of course, to achieve this last situation as little as possible. The exploitation of conversation traces is valuable, as it allows developers to identify frequent errors and improve the conversation algorithm. This communication between a human and software is also possible via the audio channel, like systems such as Siri or Alexa available on smartphones or via connected speakers (Amazon Echo, Google Home, Home Pod).

Hood et al. (2015) had the idea to reverse this process. The aim of the interaction here is to get the students to teach the robot (Nao) what it needs to know. For example, students who are learning to write by hand are then responsible for teaching the robot to form letters correctly. Pupils should therefore focus on the process of writing the letters correctly. The robot can learn from the student's demonstration of the correct process and from the reinforcement it has provided to achieve the goal.

3.3 To guide the learner

A factor of success in learning is the regulation of the process implemented by the learner. From a conceptual point of view, regulation can be defined as the process that allows a system to maintain a state of equilibrium (Raynal & Rieunier, 2009). In his work, Piaget (1992, p. 167) already put forward this idea of equilibrium: "the proper function of regulation is, in all domains, to inform a system in action about the results of its actions and to correct them according to the results obtained". This regulation task for a trainer quickly becomes complex in a situation where the number of learners is high (for example in a MOOC[4]) and may involve several thousand participants. To support this regulation, the system must interpret the calibrated values by comparison with a reference model set at the beginning. From this processing, the system then makes the decision as to whether or not to inform individuals in order to regulate their activity. Integrated in a learning context, the Duolingo assistance

[4] Massive Open Online Course https://fr.wikipedia.org/wiki/Massive_Open_Online_Course

tool[5] corresponds to this automatic guidance approach. On the basis of an analysis of learning traces, the system informs learners of their level of progress in learning and of the lexicon not mastered. By means of an e-mail, it delivers an automated notification to the learners with recommendations adapted to remedy the situation. At the psychomotor level, an interesting example is offered by Swimbot, a connected bathing cap[6]. Based on the above-mentioned principle of Deep Learning, the device analyses the activity of swimmers to give them feedback on the quality of their swimming in real time (head position, arm and leg movements, etc.). A sound signal emitted from the box in the swim cap sends information to the swimmers when a movement is not efficient. The task for the swimmer is to make this signal sound as little as possible when training in the pool, indicating that a correction of the movement is necessary.

3.4 To assess learning

The processing of open-ended questions in an evaluation is time-consuming and sometimes relies on the evaluator's subjective assessment. This complex task can be supported by applications for intelligent extraction of knowledge from text (text mining[7]). This involves automatic processing of natural language in a text and identifying those that correspond to our evaluation criteria. In education, the Readerbench[8] software (Gutu-Robu & al., 2018) is a good example of this approach. It is able to assess the textual complexity of writing, the degree of social collaboration within a group, and the evaluation of learners' summaries or personal explanations. In the hands of a tutor, this system offers a great opportunity to automatically generate specific feedback and to improve the validity of open-ended answer corrections in parallel.

4. Conclusions and perspectives

There are many more examples that could be mentioned here. On the one hand, our aim is to show that Artificial Intelligence can play a role for the benefit of students and their teachers. Whether we like it or not. But, if we, as those responsible for the education of our children, do not take this responsibility of

5 https://fr.duolingo.com/
6 https://www.youtube.com/channel/UCw1neiM8BKVP5vL0fK5NQjQ
7 https://fr.wikipedia.org/wiki/Fouille_de_textes
8 http://readerbench.com/

integrating digital technology into school activities, others will do so... and are already doing so (Facebook for Education[9], Google for Education[10], Apple for Education[11], etc). Education must take up the digital issue.

4.1 Tools for Education

These are learning tools that our students must learn to use appropriately to increase their skills in terms of technical mastery, but also and much more in terms of thinking about the issues that these technologies will confront us with.

4.2. Human intelligence is unique

Multidisciplinary artificial intelligence, endowed with common sense, critical thinking and autonomy, is not for tomorrow. These characteristics are (still) the prerogative of the human being, who is a being of sensitivity, emotions, and intuitions, capable of making decisions with his heart as well as with his reason. It is therefore these qualities that we must rely on so that intelligent tools are in their place and that we do not try to fight them where they exceed us (speed of calculation, reliability, processing of numerous data, etc.). Let's develop the skills of doctors to build bridges between their patient's data and their life, social, family and emotional context. Let us train carers to accompany patients to ensure their well-being and use the tools to diagnose physical or mental ailments faster and better.

Therefore, the school should focus on the mastery of technological tools (I know, I appropriate, so I make the best use of them) and, at the same time, on the development of soft skills (Mauléon et al., 2014) such as problem solving, empathy, stress management, creativity, etc. These are human assets. It is up to us to capitalise on them with full knowledge of the facts and for an efficient articulation with digital tools. These tools, of which Artificial Intelligence is one of the emanations, must be complementary to the specific and irreplaceable human qualities.

9 https://education.fb.com/
10 https://edu.google.com/intl/fr_fr/?modal_active=none
11 https://www.apple.com/befr/education/

4.3. Ethics

Thus trained, today's children, tomorrow's adults, will be able, in an enlightened manner (on the challenges of AI) and equipped (through the development of soft skills) to make the necessary decisions on how (!) to use digital tools and regulate their use. The algorithm that steers an autonomous vehicle is programmed by an individual who must determine, in the event of a dangerous situation, which choice to make: to send the car onto the tree at the side of the road or onto the pedestrian who has suddenly appeared? How will this decision be made? Who will make it? Will insurance companies consider the owner (non-driver) or the designer (of the algorithm) of the car responsible? Which lawyers will decide? On the basis of which laws? The professions of ethics and digital law have a bright future ahead of them. And this is essential if humans are to retain control over cold and rigorous algorithms.

4.4. Co-development

It is therefore co-development that must be ensured. That of the collaboration of humans with machines. Working together and jointly will be more profitable than opposing them. That of students and teachers. Because in order to train the students, the teachers must also be trained. It is therefore a simultaneous movement, even if it is asymmetrical. And, from this dynamic, the best possible production must emerge, combining the strengths of all intelligences for the benefit of the pupils.

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