TÍTULO: La inteligencia artificial y el aprendizaje.

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RESUMEN: La inteligencia artificial se está extendiendo cada vez más en la sociedad, por lo que los ciudadanos necesitan saber qué es realmente. A través de este trabajo se da una definición de Inteligencia Artificial, y las posibles implicaciones en los procesos de aprendizaje, considerando fortalezas y debilidades. Se enumeran las principales tecnologías en las que se basa su funcionamiento general, y finalmente, lo que debe saber un docente cuando decide utilizar la Inteligencia Artificial como herramienta de apoyo a los modelos tradicionales de enseñanza.

PALABRAS CLAVES: inteligencia artificial, aprendizaje, educación, machine learning, deep learning.

TITLE: Artificial Intelligence and learning.

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ABSTRACT: Artificial intelligence is increasingly spreading in society, which is why citizens need to know what it actually is. Through this paper, a definition of Artificial Intelligence is given, and the possible implications in learning processes, considering strengths and weaknesses. The main technologies on which it is based, its general functioning are listed, and finally what a teacher should know when he decides to use Artificial Intelligence as a support tool for traditional teaching models.

KEY WORDS: Artificial Intelligence, learning, education, Machine Learning, Deep Learning.

INTRODUCTION.

The word Artificial Intelligence (AI) refers to the discipline that deals with the development of software and hardware systems, which given a complex objective, are able to act by interpreting data and "formulating" decisions, based on available data, in order to take the best actions to be carried out in order to achieve the goal setting, even in situations not explicitly foreseen first.

Artificial intelligence, if used incautiously, can generate significant risks for society.

The growing diffusion of Artificial Intelligence is changing the way of life of our society. Citizens' use of Artificial Intelligence systems shifts attention to their ability to self-determine themselves, and to the possibility of finding adequate training in the use of these systems. This means that all citizens must be able to know the potential, limits, and criticalities of Artificial Intelligence. This implies that the systems must be transparent and explainable even to the user who does not have advanced scientific and technological knowledge.

The impact of these technologies is important because it leads to the disappearance of some workers, the creation of new ones and the reconversion of others. The fourth industrial revolution is changing the world of work and the required figures at great speed, it is necessary to spread a digital culture as much as possible. Therefore, it becomes necessary to improve the skills of teachers and to update the educational programs of schools. Artificial Intelligence could open up new scenarios for teaching practices, if used as a resource to improve learning and teaching processes.

The main goal of Artificial Intelligence is to create systems that can "think" and "act" like humans.

There are several factors, which can play an active part in learning in education, one of these is motivation, which in turn is related to different components.

DEVELOPMENT.

Literature review.

Today, there is no univocal definition of Artificial Intelligence, this is also due to the fact that it is a constantly evolving field, which is expressed in very different solutions, from disciplines such as high-performance computing, computer science, data mining, machine learning, and deep learning. Today's AI is primarily based on machine learning and natural language processing, and it is used for a variety of applications, including text generation, computer vision, robotics, and problem solving.

Artificial intelligence is a discipline belonging to computer science that studies the theoretical foundations, methodologies and techniques that allow the design of hardware systems and software program systems capable of providing the electronic computer with performances, that to a human observer, would seem pertaining exclusively to human intelligence[1].

Artificial Intelligence deals with developing algorithms and systems capable of carrying out activities that normally require human intelligence, such as reasoning, learning, language recognition, problem solving, perception and understanding of natural language. It refers to systems that exhibit intelligent behavior in analyzing their environment and taking actions, with some degree of autonomy, to achieve specific goals. Systems based on Artificial Intelligence can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, voice, and facial recognition systems) or they can be embedded in hardware devices (e.g., advanced robots, autonomous cars, drones, or Internet of Things applications).

Norvig & Russel (2002) defined Artificial Intelligence as "*the creation of artificial systems that can perform tasks that require human intelligence, such as speech recognition and problem solving*", while Grosz & Stone (2018), as "*a discipline that seeks to understand and create artificial agents that exhibit intelligent behavior*".

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[1] **Somavico M. (1987),** *Intelligenza Artificiale*, **Hewlett Packard.**

Artificial Intelligence techniques and tools are today benefiting from the enormous amount of personal and environmental data that is recorded every day by computer systems. The quality and interoperability of this data are a determining factor for the very possibility of applying new technologies. Among the main Artificial Intelligence techniques that can be used to process such data, for example, there is that of the so-called supervised learning. In this case, the data must be "annotated" by humans who teach machines how to interpret it. This operation is very onerous because it requires conspicuous and complex human work. In addition to the long time required to carry out this annotation work, the discretion of the annotators could generate inhomogeneous datasets (that is: similar data annotated in a different way), weakening the functioning of the machines and propagating errors and bias[2].

In the field of the Internet of Things, one of the main challenges to be faced consists in the fact that the data collected by interconnected devices and sensors are different from those with which the scientific community of data scientists has had to deal with in the past. The greatest successes that have been achieved in the field of Artificial Intelligence concern, in fact, applications such as image processing, autonomous driving and web research that have been made possible thanks to the availability of large and relatively structured datasets, able therefore, to be used in the training of machine learning algorithms. Conversely, data from a multitude of connected devices can be fragmented, heterogeneous and distributed irregularly in space and time: a challenge of rare complexity for anyone who aspires to analyze data in a structured way.

Main Technologies.

The main Artificial Intelligence technologies include:

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[2] **Garrapa A. (2023)**, *Bias: il pregiudizio dell'Intelligenza Artificiale*, **Firmware 2.0 #00.**

1. Machine learning: these are systems that use algorithms to "learn" from data and improve performance over time without being explicitly programmed; this happens with the increase of experience and especially of data.

2. Neural Networks: an advanced form of machine learning that mimics the way the human brain works.

3. Computer vision: used to analyze and understand images and videos, to interpret their contents.

4. Natural Language Processing (NLP): used to analyze, understand, and generate natural language.

5. Robotics: Used to create robots and automated systems capable of performing tasks typically performed by humans.

6. Distributed Artificial Intelligence: multiple systems are used to create intelligent solutions that can overcome the limitations of centralized AI.

7. Generative Artificial Intelligence: use machine learning techniques to generate content, such as text, images, or sound.

8. Deep learning: a classification system which by processing a large amount of data and relying on artificial neural networks, allows a computer to imitate some processes of the human mind such as decision-making and self-directed learning.

9. Swarm intelligence involves the use of a large group of autonomous agents, each of which contributes to solving a problem.

10. Decision making provides context for decision making based on data analytics.

11. Speech recognition: ability to understand and interpret spoken language.

12. Chatbot or Voicebot: virtual agent for customer service or human speech interaction.

How artificial intelligence works.

From the point of view of intellectual abilities, functioning occurs mainly through four different functional levels:

- Understanding: through the simulation of cognitive abilities to correlate data and events, Artificial Intelligence is able to recognize texts, images, tables, videos, voices and extrapolate information from them.

- Reasoning: through logic, the systems are able to connect the multiple information collected (through precise mathematical algorithms and in an automated way).

- Learning: in this case, we are talking about systems with specific functions for analyzing data inputs and for their "correct" return in output (this is the classic example of Machine Learning systems which, bring Artificial Intelligences to learn and perform various functions).

- Interaction (Human Machine Interaction): in this case, we refer to the functioning methods of Artificial Intelligence in relation to its interaction with humans. It is here that Natural Language Processing (NLP) systems are strongly advancing, technologies that allow humans to interact with machines (and back) by exploiting natural language.

How they learn systems with Artificial Intelligence.

The way to creating intelligent machines has been long, hard and difficulty, but today, it has led to different learning methods, all enough effective, which differ not only in the algorithms used, but above all in the purpose for which the machines themselves are made. Depending on the type of algorithm used to allow machine learning, i.e., according to the ways in which the machine learns and accumulates data and information, three different machine learning systems can be divided: supervised, unsupervised and by reinforcement. The three learning models are used in different ways depending on the machine to be operated on, thus always guaranteeing maximum performance and the best possible result for the response to external request.

- Supervised learning consists in providing the computer system of the machine with a series of specific and codified notions, i.e., models and examples that allow for the construction of a real database of information and experiences. In this way, when the machine is faced with a problem,

all it has to do is draw on the experiences entered into its system, analyze them, and decide which answer to give on the basis of already codified experiences. This type of learning is, somehow, supplied already packaged and the machine must only be able to choose which is the best response to the request that is given to it. Algorithms that make use of supervised learning are used in many sectors, from medical to voice identification: in fact, they have the ability to make inductive hypotheses, i.e., hypotheses that can be obtained by scanning a series of specific problems to obtain a suitable solution to a general problem.

- Unsupervised learning, on the other hand, provides that the information entered inside the machine is not codified, i.e., the machine has the possibility of drawing on certain information without having any example of their use, and therefore, without having knowledge of the expected results depending on the choice made. It will therefore be the machine itself that catalogs all the information in its possession, organizes it and learns their meaning, their use, and above all, the result to which they lead. Unsupervised learning offers greater freedom of choice to the machine which will have to organize information intelligently and learn which are the best results for the different situations that arise.

- Reinforcement learning probably represents the most complex learning system, which requires that the machine is equipped with systems and tools capable of improving its learning, and above all, of understanding the characteristics of the surrounding environment. In this case, therefore, the machine is supplied with a series of support elements, such as sensors, cameras, GPS, etc., which allow it to detect what is happening in the surrounding environment and make choices for better adaptation to the surrounding environment. This type of learning is typical of self-driving cars, which thanks to a complex system of support sensors, are able to navigate city and non-city streets, recognizing any obstacles, following road signs and much more.

Artificial Intelligence systems can make use of augmented reality, virtual reality, and data mining.

Augmented reality.

With regard to the possibilities offered by augmented reality, new innovative, inclusive and engaging educational environments could arise in schools, capable of encouraging interaction with and between students, combining training needs and technological innovation.

Virtual reality.

The word virtual reality identifies various ways of simulating real situations through the use of computers and the aid of specially developed interfaces.

Data mining.

A simpler and much more effective use of Artificial Intelligence in schools could be support for individual study, as a self-assessment tool through the automatic preparation of additional exercises and virtual questions.

Human learning vs Artificial Intelligence learning.

As far as learning for humans is concerned, it is a much more complex and general process than that for Artificial Intelligences. Humans learn through perception, experience, and interaction with the environment. Learning for humans can be classified into different types, such as learning by association, learning by imitation, learning by trial and error, etc. Furthermore, humans have the ability to adapt and change their behavior as needed, while Artificial Intelligences need to be reprogrammed for to do so. In general, learning for an AI is a much more limited and specific process than learning for humans since AIs cannot interact with the environment autonomously and must be trained using specific data.

Artificial Intelligence at the service of education.

It becomes fundamental first for the teaching staff and then for the students to learn and understand what artificial intelligence actually is. So, there is a need to include what Artificial Intelligence is in the training or update course of teachers. Artificial Intelligence could help improve education in the following ways:

- Automatic tools for assessing students more efficiently and accurately, using natural language processing and speech recognition techniques to assess understanding and communication skills.

- Personalization of pupils' didactic material, such as texts, images, exercises, and videos.

- Personalization of learning paths, according to their individual needs and preferences.

- Personalized tutor, using referral tools to keep attention, provide feedback and individualized support to students, adapting the content and pace of learning according to their needs and level of understanding.

- Suggestions regarding personalized variations to be introduced in the school program.

- Extraction of predictive indicators of school dropout risk.

- Update attendance/absence in real time.

- Develop electronic report cards.

- Manage the lesson schedule.

- Produce the digital certification which objectively certifies the level of skills acquired.

- Gamification. An Artificial Intelligence can be used to make learning more engaging and fun, creating interactive games and learning-based challenges.

- Analyze student data, such as student performance and behavior, to identify problems and opportunities and personalize learning.

Overall, AI can be used to make learning more efficient, personalized, and engaging, helping students achieve their learning goals faster and more accurately. However, it is important to note that Artificial Intelligence cannot completely replace human interaction and experience-based learning of teachers.

Criticality in the use of Artificial Intelligence in educational processes.

There are several critical issues related to the use of Artificial Intelligence in educational processes. Here are some of the main ones:

- Access problems: AI can be expensive and may not be accessible to all students, creating inequalities in access to educational resources.

- Education quality issues: AI can replace teachers but may not be able to provide the same quality of education and personal support.

- Privacy, security, and data protection issues: Artificial Intelligence often uses large amounts of personal student data, and there is a risk that this data could be misused or could be vulnerable to privacy breaches.

- Bias Issues[3]: Artificial Intelligence can be programmed with implicit prejudices, which can impact student education and access to educational resources.

- Personalization Issues: AI can generate personalized content for students but may not be able to account for students' individual needs, and therefore, not be able to deliver effective instruction.

- Dependency issues: students may become addicted to AI and not learn to learn on their own.

- Motivation: Artificial Intelligence alone without the presence of teachers may not be sufficient to motivate students to learn.

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[3] **A bias is a systematic error of judgment or interpretation, which can lead to an error of evaluation or to formulate a less objective judgment. It is a form of cognitive distortion caused by prejudice and can influence ideologies, opinions and behaviors.**

- Difficulty in recognizing images: artificial intelligence systems have difficulty recognizing unclassified images, leading to an error in its cataloging.

- Difficulties for AI to perceive and deliver emotions from and to students, where emotional intelligence plays a huge role in student learning.

- Adversarial policies: these are unforeseen situations, in which Artificial Intelligence will be faced with an unexpected situation, which it is unable to handle, in which case the system could crash, or the endless search for a solution.

- Human manipulation in the creation of algorithms for Artificial Intelligence models, and in the provision of data for training machines.

- Loss of knowledge: it could happen that in the creation of algorithms for Artificial Intelligence models, some notions, or authors, are deliberately not included, thus leading to a loss of knowledge.

- Lack of experimentation: to date, there is no experimentation of Artificial Intelligence in learning processes, so it is not possible to evaluate its impact and fallout.

In general, students should have a combination of technical and soft skills to be able to interact effectively with Artificial Intelligences in the learning process. Using AI with students in kindergarten can be effective in some cases, but it is important to consider their developmental and cognitive abilities.

Preschool students still need human interaction and hands-on experiences to develop their motor skills, language, and social skills. The use of Artificial Intelligence should therefore be limited and used as a support with other forms of teaching. Artificial Intelligence can be used to develop educational games that can help develop children's basic skills such as reading, math, and logic.

Artificial Intelligence can also be used to personalize learning for children with special educational needs, adapting the content and pace of learning to meet their specific needs, always of course as a support with other forms of teaching and with child supervision of the teacher.

For primary school students, the skills needed to effectively interact with an AI in the learning process may be different than for high school or university students. It is important that the use of an Artificial Intelligence in learning for primary school students must always be accompanied by an adult, and always used as a support to traditional teaching models.

In general, AI should be used as a supplementary and integrative tool for learning and not as a substitute for human interaction and hands-on experience, it is important that teachers are always present when learning with AI systems.

Teacher training for the conscious use of Artificial Intelligence.

Teachers who want to interact effectively with Artificial Intelligence in different grades, school should have a combination of technical and pedagogical skills:

- Understanding of the basics of Artificial Intelligence: teachers should have a basic understanding of key AI concepts, such as natural language processing, speech, and image recognition, machine learning, and logic.

- Ability to use AI tools: instructors should be able to use AI tools and frameworks, such as Python, TensorFlow, and Keras.

- Data analysis skills: teachers should have the necessary skills for analyzing collected data and understand its use in training Artificial Intelligence models.

- Pedagogical skills: teachers should have the pedagogical skills necessary to use AI to support student learning and evaluate the effectiveness of AI.

- Problem solving skills: teachers should have the problem solving skills needed to solve problems using Artificial Intelligence, such as creating personalized educational activities and adapting content according to students' needs.

- Awareness of the risks and opportunities associated with the use of Artificial Intelligence: teachers should be aware of the risks and opportunities associated with the use of Artificial Intelligence, to use it safely and responsibly and help students develop digital skills.

- Communication: teachers should have the ability to communicate effectively with Artificial Intelligences, either using natural language or through graphical interfaces.

- Ethics and accountability: teachers should have knowledge of ethical and accountability issues related to the use of Artificial Intelligence, such as privacy, security, and fairness.

Artificial Intelligence can also open up prospects for improving inclusiveness in schools. Examples are multisensory technologies, such as social robotics, used to encourage learning and relationships in children with autism spectrum disorders, or solutions to support students with Special Educational Needs (SEN) and Specific Learning Disorder (SLD).

CONCLUSIONS.

For citizens and businesses, for teachers and students, it can be very complex to approach Artificial Intelligence. Further research is needed to understand the implications of Artificial Intelligence for the School. Instead, what is required of research and educational policies is to question how Artificial Intelligence can promote human learning and make sure that educators themselves guide its transformation, addressing requests to technology companies.

Thanks to Artificial Intelligence, new assessment approaches based on personalized questions could be implemented to provide teachers and students with richer information in all areas of learning.

The availability of Small Data would support teachers to identify the strengths and weaknesses of student learning and to facilitate the personalization of content.

For students, having data would mean increasing awareness of their progress and self-knowledge in relation to the work done. Schools must not only be users of Artificial Intelligence, but active subjects in its understanding and use, as well as everything that revolves around it.

The use of Artificial Intelligence as a support to traditional teaching models in educational processes can offer many opportunities, but at the same time, it presents some critical issues that it is important to consider and absolutely must not be overlooked; in general, main problems deriving from the quality of instruction; of the privacy, security and data protection; bias; addiction, motivation and emotional intelligence; errors in the formulation of answers, adversarial policies, loss of knowledge and human manipulation.

The human mind still remains too complex to be reproduced by an Artificial Intelligence, which can only simulate one cognitive function at a time, so from this point of view, the development of Artificial Intelligence remains weak, making its use feasible only as a teaching aid.

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