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Introduction to Artificial Intelligence in Education

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Abstract
Human history is intimately linked to technological progress. From the first tools used in prehistoric times for hunting and subsistence to achievements such as the wheel, the metal industry, the printing press and the steam engine, technology has been a fundamental driver of social development. The educa-

tional sphere is not left out, as Artificial Intelligence (AI) is being firmly incorporated into all sectors, transforming the professional and leisure scopes. The 1956 Dartmouth Summer Research Project is considered to be the origin of AI as a field of study, bringing together leading thinkers to explore new research directions. Today, AI generates advanced digital content, such as generative Artificial Intelligence (GAI), significantly impacting education. For example, online search engines employ AI to provide relevant results from large volumes of user-contributed data. This rapid change in educational practices reflects technology's profound influence on our lives.

Integrating AI in education has brought new possibilities, such as individualizing learning, automating administrative tasks, and creating more interactive and adaptive learning environments. Moreover, AI has proved to be an invaluable tool for enriching the efficiency and effectiveness of educational processes, allowing teachers and students to access personalized educational resources tailored to their specific needs. With the exponential evolution of AI, its impact on education will increase, changing how the world teaches and learns.

1.1. Introduction

Human development depends on the evolution of technology. Thus, in prehistory, we find the first technological advances, where primitive humans began to use tools to hunt and survive (sharp stones, sticks, etc.), which allowed them to obtain food and protect themselves from the dangers of the environment.

As time went by, technological advances followed: the wheel, the metal industry, the printing press and the appearance of the steam engine. These laid the foundations for the Industrial Revolution and ushered in a new era in human history.

Then, the computer revolution, marked by the development of computers in the mid-20th century, allowed people to perform complex calculations faster and more efficiently. In the 1990s, with the emergence of the Internet, the general public could access unlimited information, make purchases, communicate instantaneously, and so on. Another significant milestone in recent decades has been the development of smartphones, which have become an integral part of our daily lives. Today, we are facing another technological breakthrough: the Artificial Intelligence revolution.

Thechnology has consistently and pervasively influenced society throughout the evolution of humankind (Segbenya et al., 2023). It is undeniable that technology has had and continues to have a significant impact on different aspects of our daily lives, transforming how we communicate, how we work, how we learn and how we have fun (Segbenya et al., 2023). It provides us unprecedented opportunities but poses challenges (such as the digital divide and over-dependence on screens) and concerns (privacy, security) or ethical issues like Artificial Intelligence.

Technology insertion into our contemporary society has been pervasive (Hoehe & Thibaut, 2022; Schindler et al., 2017). Undoubtedly, almost every facet of human endeavor has been altered by technology (Haleem et al., 2022). In this sense, as we move towards an increasingly digitized society, it is essential to understand how technology has influenced our human development. According to Cooper (2023), Artificial Intelligence (AI) plays a crucial role in the increasing digitization of society. AI's ability to automate tasks, process vast amounts of data, and provide predictive insights will increasingly revolutionize various aspects of our daily lives (Yang, 2022).

The term 'Artificial Intelligence' is derived from the combination of the words 'artificial' and 'intelligence', i.e., something is said to be artificial if it has been manufactured or fabricated by people rather than naturally occurring. Intelligence can be defined as the ability to acquire and use knowledge and skills (Bolatito, 2024).

1.2. Artificial Intelligence

Today, in the different actions we carry out throughout the day, from how we interact to how we learn, inform ourselves, or make decisions, everything revolves around Artificial Intelligence (European Commission, 2022). It is part of our daily lives (Aoun, 2017). At a general level, and according to the OECD (2019), Artificial Intelligence (AI) is a general-purpose technology that can improve people's comfort, contribute to positive, sustainable global economic activity, increase innovation and productivity, and help respond to global challenges (Bolatito,

2024). For Arslan (2020), Artificial Intelligence is one of the most essential technologies worldwide.

Artificial Intelligence (AI) has become pervasive in everyday life (Adiguzel, Kaya, & Cansu, 2023). A wide range of examples illustrate how AI has penetrated various aspects of human life, such as access to information via the Internet, the consumption of news and entertainment, facial recognition surveillance systems that identify individuals, the performance of financial markets, and the way drivers and pedestrians move around (Williamson & Eynon, 2020). As AI advances, possibilities that were once only speculative may soon become tangible. Recently, a new application called "Sora" has emerged, allowing us to create high-quality videos from text. Therefore, AI can potentially revolutionize different aspects of society, from the business sector to healthcare and education (Alawi, 2023).

According to Solomonoff (2023), the Dartmouth Summer Research Project on Artificial Intelligence, which was held between June 18 and August 17, 1956, is considered the origin of AI as a research discipline. Organized by John McCarthy, Marvin Minsky, Claude Shannon and Nathaniel Rochester, it brought together several dozen leading thinkers in AI, computer science and information theory to explore future lines of research.

However, John McCarthy is considered the inventor of this concept. According to McCarthy, Artificial Intelligence "is the science and engineering of making intelligent computer programs with intelligent machine properties" (Arslan, 2020; Adiguzel, Kaya, & Cansu, 2023).

In this regard, it is worth mentioning that we are increasingly using Artificial Intelligence (AI) systems, sometimes without even realizing it. For example, search engines, intelligent assistants, conversational robots, language translation, navigation applications, online video games and many other applications use Artificial Intelligence in our daily lives (European Commission, 2022).

At the European level, the Artificial Intelligence Act defines it as "software developed using one or more of the following techniques and strategies (machine learning strategies, logic and knowledge-based strategies, statistical strategies, etc...) and that can, for a given set of human-defined objectives, generate output information such as content, predictions, recommendations or

decisions that influence the environments with which it interacts" (European Commission, 2022).

Therefore, we can say that AI is the ability of a machine to manifest human-like capabilities such as reasoning, learning, creating and planning (Arslan, 2020). Therefore, AI is nothing more than using computing machines to think and act humanely and rationally (Allam et al., 2023).

Regona et al. (2022) define AI as "tasks that can be operated automatically by autonomous mechanical and electronic devices using intelligent control". For these authors, there are three conceptualized types of AI: 1) Narrow Artificial Intelligence (N AI), whichis a type of Artificial Intelligence used in language translation and weather forecasting; 2) Artificial General Intelligence (AGI), a type of future AI that will be able to solve complex problems with its thinking and disposition; and 3) Artificial Superintelligence (ASI), which a type of futuristic AI that, if developed, will surpass human capabilities in several areas. As can be seen in Figure 1.1, the principal subfields of AI are (a) machine learning, (b) knowledge-based systems, (c) computer vision, (d) robotics, (e) natural language processing, (f) automated plan-
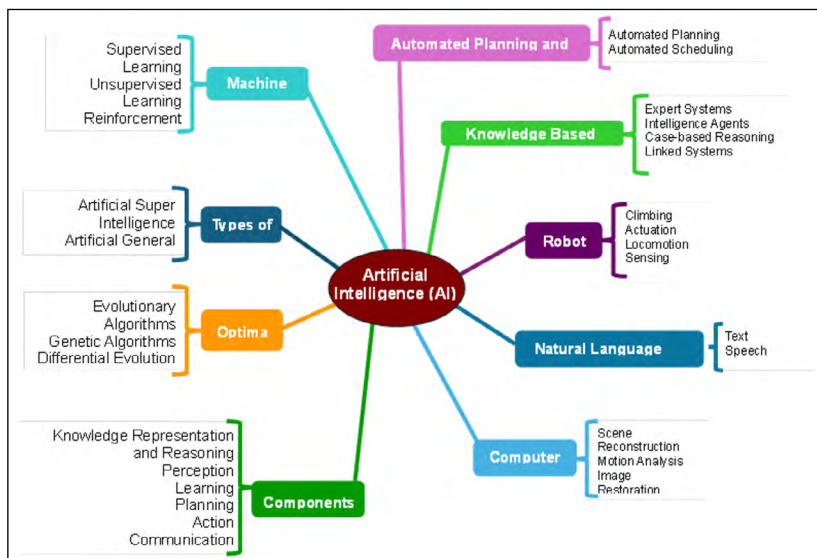
Figure 1.1. According to Regona, Yigitcanlar, Xia, & Li (2022), the components, types and subfields of AI.

ning and scheduling, and (g) optimization (Regona et al., 2022; US Department of Education, 2023

According to the European Parliament (2023), the AI groups are:

- Software: virtual assistants, image analysis software, search engines, voice and face recognition systems
- Embedded Artificial Intelligence: robots, drones, autonomous vehicles, Internet of Things

Figure 1.2 shows some everyday and future uses of Artificial Intelligence according to the European Parliament (2023).

The following are some of the applications of Artificial Intelligence that we use regularly and are not aware of, as reported by the European Parliament (2023):

- Online shopping: AI is used to create personalized recommendations for consumers based on, for example, their previous searches and purchases or other online behavior.
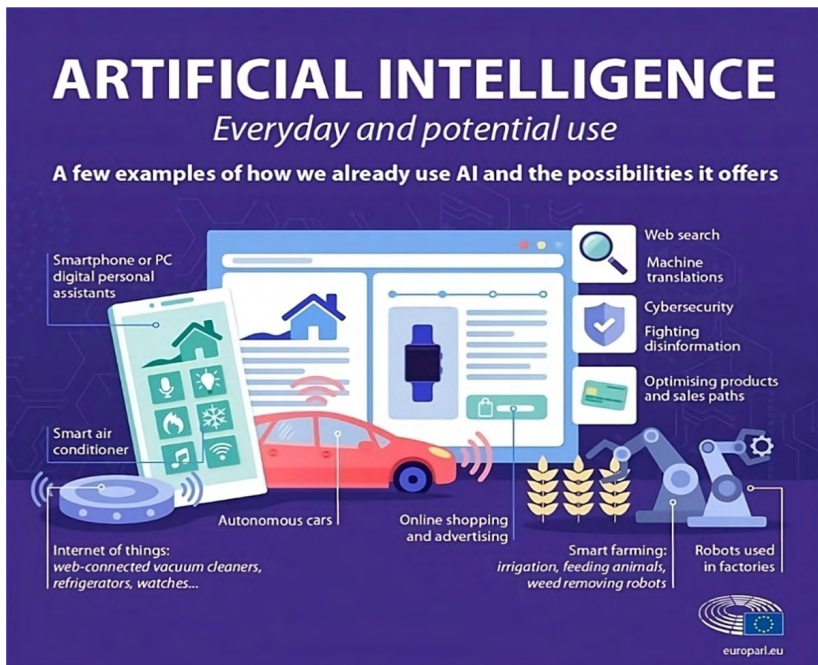

Figure 1.2. Every day and future uses of Artificial Intelligence.

- Internet search: Users provide a lot of data in an Internet search, used by search engines to provide relevant results for users.
- Personal assistants: Smartphones use AI to make the product as relevant and personalized as possible. Virtual assistants answer questions, make recommendations and help organize their owners' routines.
- Machine translations: Artificial Intelligence provides and improves translations or automatic subtitling.
- Smart homes, cities and infrastructure: all the home automation in our homes is learning from our behavior and saving energy; smart villages are aiming to regulate traffic to improve connections and avoid traffic jams.
- Vehicles increasingly use AI-developed safety functions that detect dangerous situations and accidents.
- Cybersecurity: AI helps recognize and fight cyber-attacks and other threats based on the data they receive, recognizing patterns and preventing attacks.
- Disinformation: Some AI applications can detect fake news and disinformation by extracting information from social networks, searching for sensational or alarming words, and identifying authoritative sources.
- Health: AI can analyze large amounts of health data to find patterns that could lead to medical discoveries and other ways to improve individual diagnoses.
- Transport: Artificial Intelligence could improve rail traffic's safety, speed and efficiency by minimizing wheel friction, maximizing speed and enabling autonomous driving.
- Manufacturing: Artificial Intelligence can help companies become more efficient by using robots, optimizing sales routes or with timely predictions of necessary maintenance or breakdowns in 'smart factories'.
- Food and agriculture: AI can be used to build a sustainable food system, ensuring healthier food by minimizing the use of fertilizers, pesticides and the amount of water needed by plants, improving productivity and reducing environmental impact. Many farmers use AI to control their livestock's movement, temperature and feed consumption.
- Public administration and services: By using vast amounts of data and recognizing patterns, AI could foresee natural disas-

ters, enable adequate preparedness and reduce their consequences.

Thus, technologies associated with AI cover a wide range of areas, such as intelligent robotics, natural language processing, language recognition, advanced image recognition, intelligent expert systems, neural networks and machine learning (Adiguzel et al., 2023).

1.3. Artificial Intelligence in Education

Throughout history, technologies using language have been major turning points. These include the invention of writing, which enabled the symbolic treatment of language; the printing press, which facilitated the broader and faster dissemination of knowledge; and the creation of computers capable of processing binary language. All of these milestones led to the age of digital information and technology (Bozkurt, 2023).

Today, a simple academic Google search for the term "Artificial Intelligence in Education (AIED)" yields 4,490,000 results, giving us a glimpse of its enormous scope, with the attention it is receiving evolving at a dizzying pace (Patel & Shahapurkar, 2021; Ilham et al., 2024).

For Grassini (2023), the world has endured a dizzying change in educational practices in the last decade, mainly due to technological advances. Among these technologies, the most influencial has been AI. Recent progress and expansion of machine learning have led to the generation of sophisticated digital content, such as Generative Artificial Intelligence (GAI), capable of aiding education (Bozkurt et al., 2023).

AIED is the practice of using computers and other devices to simulate human perception, decision-making and other processes to accomplish a task. In other words, AI refers to the process by which robots fit complex patterns and learn as they do so (Allam et al., 2023).

According to the European Commission (2022), AI can change the education of students, educational agents, and educational institutions. Nowadays, AI systems help identify specific learning needs, provide students with experiences tailored to

their learning pace, and help schools make effective decisions to use the school's teaching resources efficiently. From this definition, we can identify two types of AI:

- Software: virtual assistants, image analysis software, search engines, and voice and face recognition systems.
- Integrated Artificial Intelligence: robots, drones, autonomous vehicles, Internet of Things.

Today, it is paramount to study how Artificial Intelligence (AI) can improve the teaching-learning process and how AI technology can enable education systems to use modern tools to enhance the equity and quality of education (Allam et al., 2023).

According to Domínguez-González et al. (2023), Artificial Intelligence (AI) is changing the teaching-learning process and reshaping the educational landscape (Naidu & Sevnarayan, 2023; Nipun et al., 2023). For Jamal (2023), "The potential of AI in teacher education is significant, but its application requires careful consideration of ethical, social, technical, and cultural factors. While AI can potentially improve the quality of teacher education, potentiate teacher skills, and facilitate personalized learning, it also raises issues related to data privacy, bias, and cultural acceptability (p.144)". Perhaps the Chat Generative Pre-Trained Transformer (ChatGPT) is the technological development with the greatest impact; it has been trained by deep learning algorithms to generate conversational interactions with user prompts (Fergus et al., 2023). The trained model can answer follow-up questions, admit mistakes, question incorrect premises, and reject inappropriate requests (ChatGPT). As Naudi & Sevnarayan (2023) tell us, "The limitations of ChatGPT are that the quality of the answer provided by ChatGPT (output) will depend on the quality of the question or input. Clear questions and input will generate better responses from ChatGPT" (p.12).

In addition, it has enabled the personalization of learning on a scale that was unimaginable in the past. Thus, it is possible to adapt the content and pace of learning to the individual needs of each student (Istrate, 2019), favoring more effective learning and promoting diversity in the classroom (Biswas et al., 2023). However, the future of AI in education poses significant challenges (Naudi & Sevnarayan, 2023). There is concern that AI

may dehumanize education, reducing teacher roles and human interactions in the learning process. Another challenge is that the implementation of AI in education must be done ethically, avoiding discrimination and ensuring student data privacy (Kerrigan et al., 2022).

The importance of Artificial Intelligence cannot be ignored in this era of innovation and transformation in many fields, including education (Ilham et al., 2024).

1.4. The Possibilities of Artificial Intelligence in Education

According to Karsenti (2019), AI has 26 contributions to education, namely: 1) personalized learning; 2) increased academic success; 3) automatic correction of certain school assignments, thus freeing up time for teachers to work on other tasks, but in this sense the human contribution is still important; 4) continuous assessment of students; 5) teachers can personalize their courses to the limit; 6) intelligent tutoring platforms for distance learning; 7) new ways of interacting with information; 8) educational feedback; 9) personalized learning content; 10) increased opportunities for students to interact; 11) more interaction between students and academic content; 12) better teaching through facilitation rather than content transformation, i.e., as a teacher's assistant; 13) help with homework; 14) more learning, as students are able to interact with their own learning; 15) more learning, as AI can personalize exercises to make learning more meaningful and fun; 16) immersive or virtual environments; 17) dropout prevention; 18) more accessible and engaging distance learning; 19) learner autonomy, a key mission for educators; 20) better classroom management; 21) gamification potential and games contribute to learner engagement; and 22) more efficient administrative processing. In addition, according to Tejawiani, Sucahyo, & Sopian (2023), Maufidhoh & Maghfirah (2023), and Pardamean, Suparyanto, Anugrahana, Anugraheni and Sudigyo (2022), it has been shown that Artificial Intelligence (AI) can increase students' enthusiasm in the teaching-learning process, enhance their creativity and improve their performance.

1.5. Use of Artificial Intelligence

As we use AI, it will be discovered that there are still many problems to overcome in applying it to various processes. In this sense, the most critical question that educational institutions must address is what to teach students in this technology-based society and the many disruptive technologies that will alter how people work. Thus, students must understand that increasingly repetitive and routine work will eventually be mechanized and performed by robots, Artificial Intelligence and automation. However, jobs will always require creativity, intellect and emotional intelligence. Allam et al. (2023) point out that, at present, many institutions do not teach students the skills needed for their future careers. Alam and Hasan (2024) present a list of the current use of Artificial Intelligence in Education:

1. Artificial Intelligence is recently being used to teach knowledge and skills by assessing their skill level and creating guided instruction to make them proficient.
2. Artificial Intelligence is now being used to manage classroom audio-visual devices.
3. AI is now being used to help students learn another language. There are hundreds of languages that work with Artificial Intelligence.
4. AI is very important for preparing lesson plans. Lesson planning communicates to students what they will learn and how they will be assessed.
5. Artificial Intelligence is currently used in chatbots to help students.
6. Artificial Intelligence is currently used to teach students to program.
7. Artificial Intelligence is currently used to facilitate and manage educational games.
8. Artificial Intelligence is currently used to power interactive games that teach children basic needs.

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