Changing the game. AI in Education

Alexandra Zbuchea, Florina Pînzaru, Cristian Vidu (Eds.)

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Foreword: AI Opening Up New Perspectives for Education

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Cristian Vidu, Florina Pînzaru, Alexandra Zbuchea

Artificial intelligence (AI) has probably been the buzzword for 2023. Most media and business publications – at least – concentrated on the relevance and impact of AI on society, businesses, and everyday lives. In many cases, the impact of AI on education has been stressed as being highly significant and with long-term effects. Therefore, it is essential to understand all these aspects to design AI technologies properly and use them effectively to benefit all educational stakeholders. This is the main aim of this volume we propose to you.

We would have liked to say that our volume is a definitive answer to all your questions on how AI is reshaping education – unfortunately, it is not the case. Our discussions should be considered mostly an invitation to an open debate on what is happening now in education, how educators are prepared for the new AI challenges, and possible scenarios in the future. Schools worldwide have already tried to ban the usage of ChatGPT and similar AIs, fearing plagiarism and all kinds of cheating concerns. However, the reality is that students already use AI widely, and, in some cases, we dare to say wisely. We have experienced in our university the case of students becoming quickly able to solve statistics

problems by addressing the proper prompts to ChatGPT: is it plagiarism, or should it be considered a creative form of solving something unknown? In any case, these students proved to be efficient and, thus, they might be regarded as closer to future productive employees – the desiderate of any enterprise. This situation reminds us of those who lived in the 90s, when professors demanded students to write projects by hand, fearing cheating if using Microsoft Word or something similar. Does it sound familiar?

We face many challenges in addressing the future of education in the AI era. While AI is conquering our present, people still try to define it. Is AI an electronic "me"? Is it an artificial form of life, as in SF movies? The first challenge for academia now seems to be understanding the concept we discuss: what is AI? An entire chapter of this volume is dedicated to this fundamental question. Still, we asked AI to define itself to have a point of departure in our discovery journey. Here are the answers we received from the most popular platforms, noting that when interrogated, AI considers itself already as something used widely (Perplexity.ai, Scite.ai), within ethical considerations in development, but without specifying which ones (ChatGPT):

ChatGPT:
> *Artificial Intelligence (AI) is the field focused on creating computer systems capable of performing tasks that typically require human intelligence. Two main types exist: Narrow AI, designed for specific functions like virtual assistants and image recognition, and General AI, an aspirational goal seeking human-like adaptability across diverse tasks. Machine Learning (ML), a subset of AI, involves algorithms enabling systems to improve performance without explicit programming, while*

Natural Language Processing (NLP) facilitates human-computer communication. Computer Vision, another AI branch, interprets visual data for applications such as image recognition and autonomous vehicles. AI's diverse applications span industries like healthcare, finance, and education. Ongoing research aims to enhance AI capabilities, while ethical considerations regarding its societal impact remain integral to its development.

Perplexity.ai:

Artificial intelligence (AI) refers to the intelligence of machines or software, as opposed to the intelligence of humans or animals. It is a field of study in computer science that develops and studies intelligent machines. AI technology is widely used throughout industry, government, and science. AI is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition, and machine vision. AI encompasses sub-fields of machine learning and deep learning, which are frequently mentioned in conjunction with artificial intelligence. These disciplines are comprised of AI algorithms which seek to create expert systems which make decisions, solve problems, and recognize patterns. Despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match full human flexibility over wider domains or in tasks (Copeland, 2023; Coursera, 2023; IBM; Laskowski, & Tucci, 2023; Wikipedia).

Scite.ai:

The definition of artificial intelligence (AI) encompasses the ability of machines to think, reason, comprehend,

and understand human intellect, as well as to exhibit intelligent behavior in perceiving, learning, communicating, and acting in complex environments. This definition aligns with the increasing application of AI in various domains, such as healthcare, marketing, and education, reflecting its potential to bring about substantial changes in strategies and behaviors. Moreover, the ethical considerations surrounding AI have led to the emergence of principles and guidelines for ethical AI from private companies, research institutions, and public sector organizations. As AI becomes increasingly integrated into daily life, it offers numerous benefits for society, emphasizing its rapid pace of adoption and its potential to positively impact various sectors.

The last platform, the "academic" among the three used above, details the definition of AI as follows:

Artificial intelligence (AI) is a rapidly evolving field with broad implications across various domains, including computer science, healthcare, education, and law. The definition of AI has been a subject of extensive debate and analysis. Wang (2019) emphasizes the importance of a clear and comprehensive definition, outlining four criteria for a good working definition of AI. This includes being similar to common usage, drawing a sharp boundary, leading to fruitful research, and being as simple as possible. Furthermore, Han (2023) highlights the emphasis on a machine's ability to think and reason in the present definition of AI, enabling computers to comprehend and understand human intellect. Additionally, Liu et al. (2021) provide insights into the nature of AI, focusing on intelligent behavior in artifacts and the development of machines

that can perceive, reason, learn, communicate, and act in complex environments.

The impact of AI is evident in various sectors. Davenport and Kalakota (2019) discuss the increasing application of AI in healthcare due to the rising complexity of data in the field. Similarly, Davenport et al. (2019) highlight the potential for substantial changes in marketing strategies and customer behaviors through AI. Moreover, Jobin and Ienca (2019) shed light on the ethical considerations surrounding AI, with the emergence of principles and guidelines for ethical AI from private companies, research institutions, and public sector organizations. The diverse applications of AI also extend to education, as evidenced by (Nguyen et al., 2022), who discuss the fundamental meanings of AI in education, including developing competence in understanding and processing AI, applying AI to effective teaching and learning, and AI expert training. Furthermore, the societal integration of AI is addressed by (Buiten, 2019), who emphasizes the rapid pace at which AI is becoming part of daily life, offering numerous benefits for society.

In conclusion, the definition and implications of AI are multifaceted, encompassing technological, ethical, and societal dimensions. As AI continues to advance, it is essential to consider its definition, ethical guidelines, and diverse applications across various domains.

Simply said, AI seems inevitable, complicated, broad, already here, and soon capable of almost everything humans do – except empathy. AI is necessary in a competitive world and is related to the intellect; it is intrinsically correlated to education – an education that is already brutally reshaped by the rise of the digital natives and their new learning habits. As seen from the bans of ChatGPT in many schools, educators are not ready to face

the arrival of AI, which proposes a broad development of education. In this respect, we also asked AI to discuss the impact of AI on education. Here are the answers of the three platforms:

ChatGPT

Artificial Intelligence (AI) has a significant impact on education, transforming various aspects of the learning process, administration, and accessibility. Here are some key ways AI influences education:

•   Personalized Learning: AI enables the customization of learning experiences based on individual student needs and abilities. Adaptive learning platforms use algorithms to tailor educational content, pacing, and assessments, promoting more effective and personalized learning paths.

•   Intelligent Tutoring Systems: AI-driven tutoring systems provide students with personalized feedback, assistance, and additional resources. These systems can adapt to individual learning styles and progress, offering targeted support in real time.

•   Automated Grading and Assessment: AI can automate the grading of assignments, quizzes, and exams, saving time for educators. It allows for faster feedback to students, enabling them to identify and address their weaknesses promptly.

•   Data Analytics and Predictive Modeling: AI tools analyze vast amounts of educational data to identify patterns and trends. This data-driven approach helps institutions make informed decisions, predict student performance, and implement strategies for improvement.

•   Virtual Classrooms and Remote Learning: AI facilitates virtual classrooms, online courses, and remote

learning by providing interactive and engaging content. Chatbots and virtual assistants can enhance the online learning experience by answering student queries and providing guidance.

•   Language Translation and Accessibility: AI-powered translation tools break down language barriers, making educational content accessible to a global audience. This is particularly beneficial for students who speak different languages or have diverse linguistic backgrounds.

•   Educational Content Creation: AI can assist in creating educational content, including textbooks, interactive modules, and multimedia materials. Content generation tools help educators develop resources that align with the latest educational standards and incorporate dynamic teaching methods.

•   Support for Special Needs Education: AI applications, such as speech-to-text and text-to-speech technologies, assist students with special needs. These tools help create an inclusive learning environment by accommodating different learning styles and abilities.

•   Identifying Learning Gaps: AI tools can identify gaps in students' understanding or areas where additional support is needed. This information allows educators to intervene early and provide targeted assistance, reducing the risk of students falling behind.

While AI in education offers numerous benefits, it also raises ethical considerations, including data privacy, bias in algorithms, and the potential for widening educational inequalities. As AI continues to evolve, it is essential to address these challenges responsibly and ensure that technology enhances, rather than hinders, the overall learning experience.

Perplexity.ai

Artificial intelligence (AI) has the potential to transform education in many ways. One of the most significant impacts of AI in education is its ability to personalize learning according to each student's individual needs. AI enhances teaching strategies by giving pupils a distinctive educational opportunity. Through AI interactions, students can access materials outside of the classroom and get real-time feedback, opening up new opportunities for learning and development. AI can also reduce the burden on teachers and streamline administrative tasks, such as grading and lesson planning. However, there are also concerns about the ethical considerations that come with AI-powered education, such as privacy and bias. Additionally, there is a risk that students and teachers may become overly reliant on AI-driven technology, which could stifle learning and critical thinking. Overall, AI has the potential to revolutionize education and address long-standing challenges in the field, but it is important to balance the benefits with the potential risks and challenges (Baily, 2023; Chen, 2023; Keymakr, 2023; RegenApps, 2023; Schiller International University, 2023)*.*

Scite.ai

The impact of Artificial Intelligence (AI) on education is multifaceted and transformative. AI technologies, such as machine learning and natural language processing, are being increasingly integrated into educational settings to enhance the learning experience (Hinojo-Lucena et al., 2019). The use of AI in education has the potential to revolutionize traditional teaching methods by enabling personalized and autonomous learning

modes (Wang et al., 2023). Moreover, AI can contribute to improving learning outcomes for students, increasing access, retention, and decreasing the cost of education (Hutson et al., 2022). It also facilitates the automation of administrative tasks, personalized education, and intelligent use of data to support students (Hinojo-Lucena et al., 2019). However, the integration of AI in education presents challenges and future directions, particularly in terms of research, policy-making, and industry practices (Luan et al., 2020). While AI offers promising opportunities, its impact on learner-instructor interactions and the cultural norms in educational settings remains an area of ongoing exploration (Seo et al., 2021). Additionally, the use of AI in educational assessment has adapted to technological advancements, leading to the generation of feedback through AI systems (Bulut & Wongvorachan, 2022). Overall, the integration of AI in education represents a significant paradigm shift, offering both opportunities and challenges for the future of learning and teaching.

How accurately does AI automatically uncover these answers and perspectives in the academic literature it can access? We challenge you to read this volume to judge for yourselves. The discussion of risks should be detailed but without trying to impose absurd barriers to AI adoption per se. We know from history that people adopt something despite warnings when the benefits are visible and attractive. AI is, without doubt, very attractive: it makes you solve problems faster, gives easier and quicker solutions to various challenges, increases productivity, and allows, with proper prompts, regular individuals to propose credible solutions for issues reserved until now to creative minds. Therefore, its wide adoption is only a question of time.

As we embark on a journey to discover how education is affected by the (re-)discovery of AI tools, you are invited to join the authors in exploring the various facets of Artificial Intelligence and, given our Romanian background, how they apply the debates on AI in education to both the Romanian pre-university and university systems as well as business and management training. The authors face multiple challenges ahead, from properly defining and aligning the term, ensuring that the technology will help the students instead of hindering their learning experience, and explaining the new skills that will (or maybe they won't) be essential in an AI-driven economy, the legal framework surrounding this '*new*' concept that suddenly appears to be everywhere around us as well as the extraordinary potential for new opportunities in increased efficiency, personalized learning paths, accessibility, and sustainability. These topics, and many more, are analyzed and investigated in detail in this volume.

AI is not new. It has been around for a long time, but something has changed over the past few years, culminating in the release of ChatGPT and generative AI: scale and availability. From a tool used by a select few people with high domain-specific knowledge, it is now available to anyone. This opens up immense opportunities for businesses and responsibilities for educators and scholars to ensure that the technology is not misused and that we provide our students with the critical thinking tools required to properly use this entirely new (for some of them) technology. Such challenges are universal. Hence, we decided to discuss them in English for a broader coverage of the topics. Despite legal and cultural differences between educational systems, we face the same new things as the rest of the world. We will see

if some systems are more equipped to transform these challenges into benefits sooner.

Cătălin Vrabie starts the volume with an introduction to what AI is and its origins. Setting the tone and providing context allows us to lean on past experiences as a familiar reference when evaluating the current AI boom. Past evolutions of AI have had some limited societal implications. However, the recent disruptive evolution promises a significant upheaval of our work methodologies, and the question emerges: how can this be ethically, legally, and reliably integrated into the educational process? Ana-Maria Costea and Ioana Roxana Melenciuc-Ioan analyze this through the lens of a game-theoretical approach, considering both zero-sum and win-win scenarios. At the same time, Mădălina Cocoşatu looks at the regulatory framework, focusing mainly on the new EU AI Act and its impact on education.

Andreea Mitan contributes valuable insights into the Romanian higher-education landscape. Like the other authors, she emphasizes the transformative impact of AI, notably ChatGPT, on education since its release, stressing the profound influence of AI tools in academia and research and within the context of the 4th Industrial Revolution. She also highlights concerns about diminishing educator roles and academic dishonesty. Andreea Mitan advocates for a human-centric perspective and addresses systemic challenges in integrating AI into Romanian tertiary education, emphasizing collaborative efforts among scholars for a smooth transition. Also, Roxana Marcu and Claudia Oprescu focus on Romania's specific case, considering AI's transformative potential in secondary education. They discuss the teacher's challenges in navigating digital tools, emphasizing the lack of a framework to explore this new learning universe

and the need for a unified approach among teachers with varying levels of openness to change, to support them in integrating the ever-evolving AI tools in education.

Victor Ciuciuc and Mădălina-Elena Stratone investigate the diverse synergies between AI, education and managerial practices. They develop a brief review of the literature up to now, highlighting a few lines of further research to better understand the impact of AI education and managerial practices. A recurring theme throughout recent years has been replacing human labor with AI tools, thereby rendering many professions obsolete. Such an evolution has high potential consequences, and one alternative proposed extensively is augmenting human knowledge with extensive AI capabilities. However, this is not an easy task. The authors in our volume are discussing both the new skills that are emerging in this context, such as prompt engineering, as discussed by Raluca Ciochină, as well as the perspective taken by Mădălina-Elena Stratone, Victor Ciuciuc, and Laura Oprea who are looking at the the requirement for maintaining domain-specific knowledge to keep the current AI tools on the path and prevent workers from being led astray by AI hallucinations (the technical term for AI generating false or misleading information). Adina Săniuță and Valentin Stoica also discuss practices in adequately training the employees to face the new challenges raised by various AI-empowered technologies. The analysis of business training is complemented by Camelia Crișan and Mihaela Boicu's investigation of using LLM models in Romanian organizations. Their study shows the extensive use of ChatGPT in businesses, as well as that professionals rather believe that no additional training and skills would be necessary for using this specific tool. Nevertheless, the research shows that prior education and experience

in various professional domains are required to use AI effectively and to discern and use accurate information provided. Therefore, businesses should be aware of the importance of the characteristics and experience of the workforce using AI tools, and training might be an element to optimize these processes and make the human factor work correctly and effectively with them.

The last chapter, of Monica Bira and Alexandra Zbuchea, discusses another aspect of using AI for educational purposes. Considering the broader landscape of new technologies, the authors map the Romanian museums' use of Extended Reality (XR) and Artificial Intelligence (AI) to enhance the educational dimension of museum visits. These technologies help museums be interactive partners for those seeking a learning experience. Integrating new technologies, such as XR and AI, into museum activities has provided numerous benefits, including enhancing the museum experience and education in museums and online. Lastly, ethical concerns must be addressed when adopting new technology into museum operations, including using AI-generated materials in museums and ensuring multiple voices when reusing data. As in the case of education or museums, AI has the potential to create robust and adaptive immersive learning experiences in other fields, which await to be investigated in the future.

In a nutshell, the volume starts discussions on skills, new techniques, regulations, policies, and benefits of using AI in various forms of education, from pre-university schools to academia and continuous training, from formal education to informal, as in the case of museums' experiences. A reflection on what we already know and what to expect, the following pages are an invitation to everyone interested in education – educators, parents, managers, and decision-makers. There is no argument:

AI is here to stay. As with any new technology, we are just beginning to discover its many uses and, in this process, some of the abuses. It is up to us to see how we can turn it into a driving force for good and ensure that we will use it to improve education.

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Artificial Intelligence – from Idea to Implementation. How Can AI Reshape the Education Landscape?

Cătălin Vrabie

Abstract

This introductory chapter provides an overview of the evolution and impact of Artificial Intelligence (AI) technologies in today's society. Beginning with a historical context while exploring a few general definitions of AI, the author provides a timeline of the used technologies, highlighting its periods of stagnation, commonly referred to as "AI winters," and the subsequent resurgence fueled by relentless enthusiasm and investment. The narrative then transitions to focus on the transformative effects of AI on society at large, with a particular emphasis on educational applications. Through examples, the paper shows how AI technologies have moved from theoretical constructs to practical tools that are reshaping pedagogical approaches and student engagement. The essay concludes by discussing the prospects of AI in education, emphasizing the need for a balanced approach that considers both technological advancements and societal implications.

Introduction

We have learned from our mistakes throughout history to adapt to a hostile environment. We have also

learned how to refine the tools we develop to guarantee that they continue to be beneficial. For example, after inventing fire, which often got out of control, we went on to invent fire extinguishers, fire alarms, and develop fire services. Similarly, the invention of gunpowder and firearms led to the creation of bulletproof vests and armor-plated vehicles and the development of guard and protection services. The invention of cars was followed by the introduction of seat belts, airbags, and, more recently, self-driving automobiles. It is safe to say that technology is an expression of human will. Through technological advancements, we seek to extend our control over various aspects of our environment – be it distance, nature, or even interpersonal dynamics. Each of the tools we developed possesses the power to influence our perspectives and shape the future (Vrabie & Eduard, 2018; Vrabie, 2016). For example, farming tools have revolutionized agricultural practices, and lab instruments have opened new frontiers for scientists. Books, maps, and similar devices, often called "intellectual technologies" (Goody & Bell, 1975), have expanded our world understanding. These last ones, in particular, have had the most significant impact on society as we know it.

Today, computers and the Internet are among our most personal tools – when IBM decided to market its first microcomputer (1981) as a PC (Personal Computer), it was not a coincidence (The New York Times, 1981). They serve as platforms for self-expression and play a crucial role in shaping our personal and public identities and fostering relationships within our communities (Lazar, Zbuchea, & Pînzaru, 2023).

Artificial Intelligence (AI) represents a relatively new category of technological tools, referred to as "smart technologies" (Campbell, 2023; NanoWerk, 2023) and

they are primarily built upon intellectual ones. However, unlike them, smart technologies aim not only to amplify or complement our native capabilities but to augment them – and sometimes, even to replace them.

In search of a definition

The term "Artificial Intelligence" is notably challenging to define. At times, it is employed to describe tasks difficult for computers to execute, such as engaging in verbal dialogue, as opposed to functions they already excel at, like spreadsheet calculus and computation. Recently, amid the growing hype surrounding AI, IT companies have started to label their latest products as "innovative" by using the term to emphasize virtually any capability computers possess, including, for example, the operation of traditional databases.

The concept we aim to explore throughout this chapter is often mentioned in the media and casual discussions, giving the impression that it is well-understood. However, it eludes a single, indisputable definition. Numerous competing definitions exist, encompassing logic and understanding, planning ability, emotional development and awareness, creativity, problem-solving, and perhaps most importantly, the ability to learn.

The psychologist and Harvard professor Howard Gardner focused on an individual's aptitude for finding solutions in various situations during his career. He defined human Intelligence as the ability to solve problems within one or more cultural contexts (Gardner, 1983; Vidu, Zbuchea, & Pinzaru, 2021). In stark contrast, the term "artificial" is relatively straightforward, denoting something not naturally occurring. This creates an

apparent oxymoron[1] when paired with "intelligence," which is a natural phenomenon.

Informally, many use "artificial intelligence" to refer to tasks challenging for computers, such as understanding spoken language or optimizing routes via driving apps, instead of tasks where they excel, like high-precision calculations.

A crucial distinction exists between "narrow AI" and "general AI." Narrow AI involves computing systems designed to solve specific tasks within a bounded framework, like chess or Go-playing systems (Gregory Unruh & David Kiron, 2017). General AI, on the other hand, refers to systems capable of solving diverse problems autonomously, much like humans. As of this writing, all AI applications are in the realm of narrow AI. While general AI remains a subject of intense scientific interest, its successful implementation appears to be years, if not decades, away.

We'll begin with a straightforward definition of AI: machines that exhibit seemingly intelligent behavior[2] (Vidu, Zbuchea, Mocanu, & Pinzaru, 2020). While this catchy definition aptly encapsulates the term's contribution to IT, the reality is far more complex. To elaborate, I will provide background information on the history of AI, which will coalesce into a comprehensive definition of the concept under study.

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[1] This idea has engendered considerable scholarly discourse across various scientific disciplines. However, the present article does not aim to provide a definitive resolution to these nomenclatural debates; rather, it concentrates on substantive elements of the subject matter.
[2] From a human perspective.

Hello, world![3]

Modern discourse on the potential of intelligent systems can be traced back to as early as 1950 when Alan Turing published his seminal paper, "Computing Machinery and Intelligence" (Turing, 1950). Even then, researchers were exploring methods of automatic computation that could transform various aspects of life – from performing complex arithmetic to playing chess. Alan Turing was aware that defining Intelligence – especially in the context of machines – was a difficult task. Therefore, he introduced what became known as the "Turing Test." According to this test, if a human could not determine whether they were chatting with a computer or another human within five minutes, the computer would have passed the test and thus be deemed intelligent. At that time, conducting this dialogue verbally was not feasible, so it was carried out in written format[4].

Turing's primary aim was not to test Intelligence *per se* but rather to address the various objections people had about the feasibility of associating Intelligence with machines. In his paper, he explored a wide range of arguments. He cited the work of Charles Babbage, who attempted to build the Analytical Engine between 1828 and 1839. Also, he mentioned Countess Ada Lovelace, often considered the first programmer, who stated in 1842 that "the Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform." However, he disagreed by suggesting that we can "order" the machine to be

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[3] This formula is conventionally employed as the initial output when executing a newly developed computer program. This practice serves as a humorous ritual among software developers, symbolizing the 'birth' of the application.

[4] The technology was called teletype (TTY).

original by programming it to produce answers we cannot predict (Turing, 1950)… Turing's core assertion was that there is no reason to doubt that machines will eventually achieve thought.

Over a decade after the publication of "Computing Machinery and Intelligence," researchers like John McCarthy, Marvin Minsky, Allen Newell, Herb Simon, Nathaniel Rochester, and Claude Shannon began establishing laboratories focused on computer science. This marks the birth of artificial intelligence as a formal field, specifically in 1955, with "A proposal for the Dartmouth Summer Research Project on Artificial Intelligence," dated August 31 (McCarthy, Minsky, Rochester, & Shannon, 1955). This was the first academic initiative aimed at investigating the subject in depth. The outcome of this initial effort was a strategic breakdown of tasks. In essence, the participants outlined an agenda for initiatives that would span not just years but, ultimately, decades.

• First on their agenda was the development of rational machines capable of performing tasks similar to humans – such as playing chess, solving algebraic problems, proving geometric theorems, and even accurately diagnosing diseases. These tasks are generally perceived as problems that require reasoned solutions.

• Another key focus was enabling computers to understand the world around them. This entailed the creation of programming languages that could encode the existence of various elements, allowing machines to comprehend them.

• The third priority was to equip computers with the ability to navigate and plan within the world. This involved understanding how to move from one point

to another, assessing routes, and determining the least risky options.

• Understanding and replicating human language, whether written or spoken, also emerged as a significant area of focus. The challenge lay in teaching machines to understand sentence construction and contextual meaning despite lacking human emotions and thoughts. The ultimate goal was to "teach computers as much as possible about what all these things mean."

• Lastly, perception – how we see, hear, and react to our environment – was identified as crucial for activating machine intelligence. This required the development of sensors and algorithms that could generate feedback based on sensory input. Initial experiments employed video cameras for observation and mechanical arms for task execution based on what was "seen."

The aspiration was that foundational elements for developing artificial intelligence could be established by enabling computers to perform the aforementioned tasks successfully. This included aspects like emotional intelligence, creative reasoning, intuition, and more. The goal was not to hard-code[5] human-like behavior into computers but to allow them to develop or acquire these capabilities through experiential learning, akin to the learning processes in children.

John McCarthy dedicated his career to leveraging mathematical tools to advance computer science. He invented Lisp in 1958, making it the second-oldest

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[5] A term in programmers' jargon indicating that the response of a machine is built-in and not the result of a process of analysis and/or computation.

programming language after Fortran[6]. On the other hand, Allen Newell and Herb Simon concentrated on understanding human thought processes. They developed systems that solved puzzles and simple problems in ways they believed mirrored human cognition. Marvin Minsky emphasized the importance of context, arguing that computers should be programmed to mimic either human intuition or mathematical computation. He posited that relying solely on either approach would be insufficient for a comprehensive understanding of machine intelligence, a viewpoint he elaborated on in his 1960 paper, "Steps Toward Artificial Intelligence" (Minsky, 1960).

In the early 1960s, a software industry pioneer, James Slaglerote, developed a program as part of his doctoral thesis that integrated symbolic expressions commonly used in mathematics (Slagle, 1961). The program aimed to emulate the problem-solving approaches of students new to mathematics. Remarkably effective, the program not only managed to solve routine calculations but also opened up new avenues of exploration. Due to its success, it is often cited as a flagship program of the first wave of AI. James Slagle's pioneering work was swiftly followed by other advancements, and by 1970, programs could interpret drawings, learn from examples, and even construct complex geometric structures like fractals and architectural elements.

In Romania during that time, the Polytechnic University of Timişoara developed the MECIPT-1 computer[7], which was instrumental in designing the dome of the Bucharest exhibition pavilion (Romexpo) and the Vidraru Dam on the Argeş River in 1965 (Baltac, 2017; UPB, 2021).

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[6] Which is only a year older.

[7] The acronym stands for Electronic Computing Machine of the Timisoara Polytechnic Institute [Maşina Electronică de Calcul, Institutul Politehnic Timişoara].

While trying to fulfill the fourth priority, it's worth noting that even in those early days, computers could respond to queries like modern-day voice assistants like Siri and Alexa. Romania saw its first automatic computer translation from English to Romanian in 1962[8], marking a national debut in what we now refer to as Natural Language Processing (NLP).

These historical efforts impart a crucial lesson: if we accurately represent cognitive mechanisms, we come significantly closer to understanding and developing AI. The idea of representation is central to defining what Artificial Intelligence entails. In essence, AI involves models of thinking, perception, and action (Winston P. H., 1990). This naturally raises the question: what constitutes a model? A model is a construct we develop to approximate reality with some degree of accuracy. Models help us understand, explain, and even predict and control various outcomes, encapsulating the essence of scientific inquiry.

The importance of representation cannot be overstated. It serves as the foundation for models of thinking. In broad terms, representations are conventions used to describe real-world situations. For example, in a history museum, lead soldiers symbolize frontline troops; in mathematics, operators like "+" and "-" denote specific operations; in biology, a representation might involve listing the key characteristics of a cell; and maps serve as excellent examples of spatial representations.

Therefore, we can further refine the definition of Artificial Intelligence: AI involves representations that

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[8] The translated phrase was: "You explain the development of science and we help describe the examples". Compared to what was happening overseas in this field, where unpaid efforts to translate from Russian into English and vice versa (the Cold War was in full swing, hence the need) led to the withdrawal of funding, Romania was in in the middle of a technological boom.

underpin thinking, perception, and action models. Moreover, the actual value of a representation lies in its ability to expose constraints, which in turn enable specific modes of operation. While this may sound complex – and indeed it is – the complexity escalates when we consider that these models must be organized within an overarching system capable of implementing them. This results in a highly intricate and complex architecture.

Artificial Intelligence can thus be defined as an architectural system that implements methods enabled by constraints exposed through representations, which support models of thinking, perception, and action (Winston, 1990). Importantly, this definition encompasses not just the act of doing whatever it is meant to do but also the capacity for learning how to do it (Minsky, 2006) – each component of this definition is crucial.

The technology that fueled the second wave of AI emerged around fifteen years after the first wave. In the mid-1970s, Edward Shortliffe developed the MYCIN[9] system for diagnosing medical conditions. Much like James Slagle's program, MYCIN achieved remarkable success, diagnosing certain conditions nearly as accurately as a general practitioner. This second wave focused on rule-based systems for representing knowledge, and it was propelled by the rise of the so-called "expert systems." These systems dominated AI research for the subsequent decade, while rule-based approaches remain a vital part of the AI toolkit.

By the mid-1980s, the lofty promises of AI began to seem unattainable, leading to a period commonly referred to as the "AI winter." Few software programs or applications succeeded in supplanting human experts.

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[9] The name is given by the suffix of antibiotic-type drugs.

Many startups aiming to do so failed, and the term "AI" became synonymous with failed investments in the stock market. Despite this "winter," there was a gradual yet consistent advancement in knowledge, paving the way for new applications. Enthusiasts persevered, undeterred by social, political, or financial pressures, even though AI largely remained under the radar until its third wave.

In February 1996, world chess champion Garry Kasparov, who had held the title for over a decade, accepted a challenge to play a six-game match against IBM's Deep Blue, the most powerful computer of its time. Kasparov won 4–2. However, a May 1997 rematch featuring an upgraded Deep Blue resulted in a 3½-2½ victory for the machine. This win, although controversial, marked a historic moment in both AI and chess, which increasingly began to benefit from computational assistance (Garry & Mig, 2017).

The research and development in AI technologies continued smoothly. In February 2010, Siri was launched on the Apple App Store, allowing iPhone users to communicate verbally with their devices. In 2011, IBM's Watson defeated the human champion on "Jeopardy," signaling a sort of AI renaissance.

Spurred by these developments, tech giants like IBM, Google, Meta/Facebook, Amazon, Microsoft, and Apple have intensified their efforts in developing AI systems. The third wave has been further fueled by the abundance of online data and increasing computational power. This has facilitated statistical analysis, trend identification, and pattern recognition, leading to a resurgence in Machine Learning (ML)[10] and the growing use of Neural Networks (NN).

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[10] A term first introduced long ago, in 1959, by IBM and further elaborated in 1974 by Paul Werbos in his Harvard PhD thesis.

Neural networks can self-learn. Specifically, using mathematical techniques, they can differentiate contextual elements by analyzing relevant data sets. Despite their potential, they initially received little attention until British programmer Geoffrey Hinton showcased impressive results in a 2012 image classification competition (Image net, 2012).

This resemblance between biological neurons and artificial neural networks has led to skepticism and critiques. Communities of individuals enjoy demonstrating how these networks, and computers in general, can be fooled. A recent example involved a Tesla car mistaking the moon for a yellow traffic light, causing the vehicle to slow down. The incident made the car owner publicly mock Tesla's AI capabilities on Twitter (JordanTeslaTech, 2021). What is often noticed in reports from techno-skeptics is a forced comparison between computational phenomena and similar occurrences in nature. Such comparisons are misleading. While there may be similarities, they are insufficient grounds for direct comparison. For instance, comparing an airplane's wings to a bird's wings is futile, even though both enable flight and are heavier than air... similarly, there will never be a race between a car and a runner, and so on.

Setting criticisms aside, it's worth examining the current state of machine learning and, more specifically, neural networks. While these networks perform impressively, they neither see nor think like humans – in fact, they don't think at all. Their algorithms are geared towards recognition, akin to training. They represent a significant achievement in the intersection of mathematics and computer engineering and constitute an important chapter in the AI narrative (LeCun, 2020). However, they are not the entire story. The current consensus

suggests that we need more from machine learning than neural networks have provided. This subject continues to generate both excitement and concern, fueling ongoing debate.

Elon Musk (2014) once remarked that Artificial Intelligence is akin to "summoning the demon" and represents our greatest existential threat. While this statement is alarming, it's worth noting that Musk is known for his provocative tweets[11]. He is neither the first nor the last to express such concerns. Marvin Minsky himself warned in 1970 that once computers gain control, humanity might never regain it. He continued, saying, "If we're lucky, they might decide to keep us as pets." Also, Allen Newell and Herbert Simon[12] shared a similar sentiment, stating that symbol systems modeling human problem-solving capabilities could be a threat, and the public should be alerted.

However, Edward Feigenbaum offered a different perspective in 1982. In his book "The Handbook of Artificial Intelligence" (Barr & Feigenbaum, 1981), he argued that rule-based systems could mitigate such threats. He also incorrectly predicted that Japan would use computer systems to dominate the world economically. Around 1990, Rodney Brooks drew parallels between the evolution of robotics and the colonial expansion of the 14th and 15th centuries. He believed that once robots could be miniaturized to the size of insects, the rest would be straightforward. While we have made

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[11] The statement is, however, surprisingly similar to the "tickling the dragon's tail" made by physicists at Los Alamos during the Manhattan Project, the project that developed the atomic bombs that were later dropped on the Japanese cities of Hiroshima and Nagasaki.

[12] Nobel Laureate in Economics (1978) "for his pioneering research on decision-making in economic organizations" and known for the concept of "bounded rationality".

significant advancements in robotics, replicating Human Intelligence remains elusive. Interestingly enough, Elon Musk has recently invested heavily in AI, contradicting his earlier stance.

Currently, we are in a period of rapid development in neural networks. The work of researchers like Geoffrey Hinton, Yann LeCun, and Yoshua Bengio, who won the 2018 Turing Award for their groundbreaking image labeling program, has significantly fueled interest in this field[13].

What's inside?!

So far, this first chapter provided an overview of artificial intelligence. Next, it will briefly describe how society can benefit from this industry since we are still in the introductory chapter.

Many AI applications employ mathematical techniques like linear regression, optimization, and probabilistic reasoning – techniques that have been part of the mathematical toolkit for decades, if not centuries. However, AI is not just computational power. So, what's next? In the coming years, most AI researchers will focus on the cutting edge of machine learning, particularly in the area now known as Deep Learning (DL). It seems computing power and large databases – commonly called big data – remain the most crucial elements.

In this new information age, the assets that IT companies (and others) will protect are shifting from applications to data. Google has made its Deep Neural Networks system, TensorFlow, available to all interested parties. This ensures that new hires will be more proficient in using it than those at competing firms. However, like

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[13] Awarded by the Association for Computing Machinery (ACM) and which is the equivalent of the Nobel Prize in Computer Science.

other major players in the global IT landscape, Google does not share the data they consider a competitive advantage.

Today, we see processing systems with enormous power – unimaginable a decade ago – being offered to users free of charge by companies in the field. This has led to a surge in the number of people taking up the study of Artificial Intelligence, drawn by the successes of Deep Learning. However, on an AI timeline, we may be at a stage similar to where Traian Vuia was when he first flew in March 1906[14] – at that time, no one was contemplating drones capable of delivering packages, transporting passengers, or networks of artificial satellites orbiting the planet. It all began with an idea that a few enthusiasts invested time and effort into.

In the AI industry, the next frontier appears to be insight systems – those equipped with advanced skills. These systems should be capable of summarizing, conceptualizing, and even generating content. While we often read about the manifestation of self-awareness in various articles (Yalalov, 2023; The New York Times, 2023), it is still at such a rudimentary stage that science wouldn't even consider it hypothetical (OpenAI, 2023; IEEE Spectrum, 2023; Fast Company, 2023).

Terms like "intelligence," "creativity," and "consciousness" have broad meanings and current AI technologies only encapsulate a fraction of these. However, AI systems are defined by a range of specific objectives, methods, constraints, representations, and architectures; no single hardware or software solution can meet all these require-

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[14] Aviation is another area that has enjoyed spectacular growth. While the first flight in a self-propelled, heavier-than-air aircraft was made in December 1903 by the Wright brothers, some sixty-five years later – less than a man's lifetime – Neil Armstrong stepped on the moon in July 1969.

ments. Therefore, many successful AI applications either automate routine tasks or enable human-machine collaboration, achieving results that neither could accomplish alone. While Machine Learning / Deep Learning is often touted as the future of AI, it is not the complete representation of what AI can be. Moreover, trustworthy AI systems must be able to explain their actions. To achieve this, we need to develop systems that think and learn in ways similar to humans.

Certainly, technological progress comes with its own set of risks, as has always been the case. However, it's crucial also to consider the benefits. In the post-"fourth wave" future, we can expect smarter apps capable of explaining their actions and understanding ours. This advancement will not only deepen our self-understanding but also improve our understanding of others, ultimately enhancing our quality of life.

Artificial Intelligence can improve the quality of services and/or products by introducing previously unattainable features. For example, Google's competitive edge in online search is partly due to intelligent software and database functions that deliver highly relevant results swiftly, sometimes even providing direct answers to user queries. Systems like IBM's Watson assist doctors in diagnosing patients by drawing upon extensive medical literature. Another prime example is the recommendation engines employed by Netflix and Amazon, which suggest books and movies tailored to individual customers (Vrabie, 2022).

As it should be clear by now, virtually all practical applications of AI involve a human-computer partnership. Humans primarily engage in software creation and maintenance. They are also the decision-makers when it comes to selecting applications and troubleshooting machine failures. Most crucially, humans are indispen-

sable for performing tasks that computers are currently incapable of handling on their own.

Therefore, the systems we aim to optimize and design are not merely computer systems in the strictest sense but human-machine systems. To achieve this, we first need to address two questions. The first is, "Which tasks should be performed by computers, and which by humans?" The second is, "How can we improve this human-machine system over time?"

Starting with the first question, an ideal approach is to allocate tasks based on each entity's strengths: let machines handle what they excel at and let humans do what they are better at. For instance, machines excel at storing and recalling vast amounts of information, while humans generally have a more remarkable aptitude for social interactions. The goal shouldn't be to replace one with the other wherever possible but to determine how these symbiotic systems can perform tasks more effectively than any individual or computer – or even groups of individuals or networks of computers – could achieve independently.

Let's take Google's search engine as an example. Depending on some perspectives, it could be considered the most widely used IT/AI system today. In this system, humans primarily create and link content, while machines store enormous amounts of information, aiding users in finding the content most relevant to their needs. While the Google search engine has in some ways supplanted librarians, who performed a somewhat similar function in the past, it has also democratized content creation and facilitated more exhaustive searches in the vast online library of knowledge. Although one could argue that Google has contributed to the decline of the librarian profession, it has also created numerous new jobs that involve both

searching for relevant information and generating new content, as well as advertising it to users – consider YouTube as an example, a platform that helps millions to build a well-rewarded business in various domains.

Wikipedia is another well-known and successful case. While humans are still the primary creators and editors of content, machine algorithms, like Wikipedia's software bots, excel at quickly scanning for issues such as inappropriate language or plagiarism. This symbiotic relationship between humans and machines is more effective than either working independently. Wikipedia has not only supplanted printed encyclopedias to some extent but has also significantly broadened the scope and timeliness of the information available, becoming our go-to source for quick and, to some extent, reliable information.

Cybersecurity tools like antivirus software and firewalls are further examples of effective human-machine collaboration. In these applications, machines excel at detecting unusual network activity, while humans are better at discerning which types of "unusual" activity are actually legitimate actions. In the realm of cybersecurity, collaborative efforts between humans and machines have proven to be highly effective, detecting up to three times more malicious attacks than electronic systems operating independently (Almahmoud, Yoo, Alhussein, Farhat, & Damiani, 2023; Sommer & Paxson, 2010).

(Few) "roles" of AI

To better understand the division of tasks between humans and computers, it's helpful to consider the roles computers can play in relation to us.

Firstly, computers often serve as tools, performing tasks under close human supervision. Examples include

word processors with auto-completion and correction features, spreadsheets, and cars equipped with cruise control. Most computer applications today serve as tools or platforms that connect people to other people or machines (Schachtner, 2021). Consider email, the World Wide Web, Netflix, and Facebook as instances of this. Increasingly, apps are being developed to facilitate human communication through innovative collaborative features. This phenomenon, often termed "hyperconnectivity," represents a significant way information technology contributes to creating smarter institutions and organizations.

Another avenue for creating smarter institutions and organizations lies in developing more intelligent machines. These machines should benefit both the service recipients and the staff of institutions employing AI technologies. A prime example of this dual role comes from Google. As mentioned above, its search algorithms serve as tools, delivering results almost instantaneously. However, another component of Google's technology continuously scans and indexes the web, functioning more as an assistant than a mere tool. Unlike tools, assistants can operate without the user's direct attention and proactively assist in problem-solving. They may even initiate operations independently when triggered – consider semi-autonomous cars as a form of driver's assistance.

IBM Watson technology, aptly named after Sherlock Holmes' assistant, offers another illustrative example. It has ingested vast amounts of medical literature and is increasingly aiding doctors globally in diagnosing various medical conditions. This success hinges on an interactive dialogue between the doctor and the application. The doctor provides specific case information, and the

application employs mathematical reasoning – based on statistics and probabilities – to generate possible diagnoses and the logical pathways leading to them. These analytical results are then presented to the doctors, who can probe further if needed and ultimately make the final decisions on diagnosis and treatment.

Other compelling examples of assistants are found in industries that previously relied heavily on large call center departments, such as mobile operators and airlines. Nowadays, robots or chatbots handle customer queries and issues through social networks or even phone calls. Artificial intelligence software generates suggested responses to customer messages. However, these suggestions are often reviewed by human agents who may choose to override the machine-generated response with their own.

In some cases, machines can function in a role similar to that of humans, essentially as equals. In these scenarios, machines perform tasks that closely resemble those carried out by humans. Take the insurance company Lemonade as an example (Lemonate, 2015). Customers can use mobile apps to file insurance claims, and if a claim meets certain predefined criteria, the AI system can automatically approve and pay out the claim within seconds. However, the claim is rerouted to a human operator for review in atypical situations.

Another striking example of a computer functioning in a role akin to humans is in the realm of chess. AlphaZero, an application we discussed earlier, serves as a personal trainer for the former world chess champion, Magnus Carlsen (AlphaZero, 2019). A few years ago, intricate moves in a game would be analyzed post-match by an entire team aiming to uncover better or defensive moves, thereby making various predictions. Today, analysis

engines offer insights of a depth unparalleled by human cognition. These engines provide strategic game plans designed to catch opponents off guard[15]. Notably, these games are played without real-time computer assistance; the game's dynamics rely on the players' comprehension of the machine's advice and their ability to remember it (Silver et al., 2018).

There have also been "centaur" experiments in chess, named after the mythical creatures from Greek mythology that combine a horse's body with a human torso, symbolizing the union of human intelligence and animal strength. These experiments, approved by the International Chess Federation (FIDE), involve top world players who are live-assisted by computers during the gameplay.

Here are a few instances where computers act in roles traditionally filled only by humans – or even entire teams of strategic analysts and tacticians. Additional examples can be found in stock market trading, where software robots execute buy/sell orders based on deep market analysis. Recently, social media platforms like YouTube have been scanned by software bots for keywords. These bots collect, edit, and aggregate videos with similar content – such as nature, travel, or humor – and present them to users for viewing, all without human intervention. The effectiveness of such a software bot directly correlates with its ability to generate views.

Lastly, computers can also serve in a managerial role in relation to humans (Boce, Tomço, & Hyra, 2022). While the idea of a machine acting as a manager may raise concerns for some, this is not a new concept –

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[15] During the Norway Chess Open, Magnus Carlsen defeated American Wesley So with an amazing concept that AlphaZero had found in a training game.

consider traffic lights, which essentially manage traffic flow at intersections, effectively replacing human traffic police. Most people find this automated management entirely acceptable.

Certainly, there are many scenarios where computer systems, if given the authority to manage humans, would do so in entirely unacceptable ways. However, the focus here is on systems that can effectively take on tasks traditionally reserved for humans.

Another excellent example of managing intellectual capital is the research system CrowdForge, developed by Carnegie Mellon University in the United States (Carnegie Mellon University, 2023; Kittur, Smus, Khamkar, & Kraut, 2011). Researchers used this system to coordinate a group of people in writing encyclopedia articles, and one of the most successful articles was about New York City. To accomplish this, they enlisted individuals from Amazon Mechanical Turk's online job marketplace, where participants engage in "micro-tasks" (small tasks often lasting just a few minutes and paying only a few cents). For the New York City article, the researchers first asked a group to create a table of contents that included sections on sights, history, culture, and so on. Subsequently, they tasked another group to generate or find relevant facts for each section in the table of contents. These facts were then passed on to different individuals who crafted coherent paragraphs from them. Finally, the computer system assembled these paragraphs into a complete article. In this scenario, humans served primarily as executors of specific tasks, aside from those handling the technical aspects required to keep the computer system running smoothly. When independent observers were asked to evaluate these articles, they found them to be of higher quality than those written by a single individual for the same

cost. The articles were also deemed roughly equivalent in quality to Wikipedia articles.

In this project, humans executed all the tasks, while the machine merely coordinated the workflow, delegating tasks to different teams. While the machine's role in this project may not have been particularly complex or reliant on advanced artificial intelligence, researchers are now developing more sophisticated methods for task assignment. These methods enable machines to decide who should perform specific tasks based on past performance in similar roles.

Starting from this successful example, we can envision a future where artificial intelligence systems excel at managing workflow and task allocation within institutions. Such systems could not only streamline internal operations but also facilitate interdepartmental collaboration.

Another managerial role often involves staff appraisal. One example is the Cogito system (Cogito, 2023). Cogito is designed to help phone representatives enhance their conversations by providing real-time feedback on the emotional quality of their interactions. While the system doesn't collect enough data to continue the conversation independently, it listens for subtle cues like tone of voice and response time. This allows it to offer valuable feedback to phone operators, helping them improve their empathy and communication skills.

So far, we've primarily discussed how tasks can be divided between humans and computers. The other crucial question we need to address is how this human-computer system can improve in the future. A few decades ago, the business sector – and not just it – was keenly focused on analyzing all processes to make them more efficient. This led to a shift in investment toward automation, which gradually became the primary goal for many companies.

Public institutions soon followed the lead of their private counterparts, overhauling their entire information flow to better meet citizens' demands. However, artificial intelligence goes beyond mere automation. As software applications continue to improve, often learning from their own experiences, the line between tasks that can only be performed by humans and those that can be automated will increasingly blur (Vrabie, 2023).

This perspective aligns with the views of Andy Clark, who not only outlines a future landscape but also encourages us to see the human-computer partnership as an ever-evolving system. This system learns from experience to become increasingly efficient (Clark, 2003). There are at least three avenues through which this can be successfully achieved.

- Firstly, there's the human component. We need to figure out how to improve upon what we're already doing. To illustrate this point, we should focus on streamlining processes by identifying and eliminating redundant steps.
- A second approach involves programmers continually refining machine capabilities. For instance, as are the developers at Meta/Facebook and other tech companies, Google's engineers are always tweaking and improving search algorithms.
- A third avenue is through machine self-improvement using various machine learning models. I previously mentioned chatbot applications, supervised by humans to sometimes correct the AI's suggested responses. When this occurs, the AI system learns from the experience, becoming more adept at providing a human-like answer in similar future scenarios (Vrabie, 2023).

The realm of artificial Intelligence is in a constant state of evolution, with advancements sometimes occurring so rapidly that they astonish even the most seasoned experts in the field. There's already a push to integrate AI into every aspect of our lives, making the potential for progress virtually limitless. Consider Google Translate as an example; it has evolved from a basic text-based tool to a sophisticated system capable of facilitating real-time voice conversations between users who don't share a common language. Google Duplex, also known as Google Assistant, is another impressive system that can conduct phone conversations with people and handle tasks like making restaurant reservations or scheduling different appointments.

Research and development in autonomous vehicles (AVs) continue to amaze automotive and technology enthusiasts. Initially, these vehicles were designed to follow well-mapped routes and struggled with unexpected situations, especially in busy urban areas. Nowadays, they can change lanes and overtake other cars in a manner that mimics human behavior. Additionally, the MapLine app has been developed to assist AVs in navigating roads that haven't been electronically mapped before. The future of autonomous vehicles is becoming a distinct subfield within artificial Intelligence.

AI in education

In a recent study (Vrabie, 2023), following a project entitled "Digital Media for Enhancing Educational Quality and Facilitating Labor Market Entry: Leveraging Visual Technologies in Virtual Pedagogical Environments – E-qual-EDU" led by a team of researchers from Smart-EDU Hub within the National University of Political

Studies and Public Administration (SNSPA) (Smart-EDU Hub, 2021), the author substantiated through empirical analysis the pivotal role of Artificial Intelligence (AI) and gamification mechanisms in increasing student engagement and facilitating knowledge retention. Despite specific reservations and limitations, the study finds that educational frameworks are poised to integrate AI and gamification methodologies (Vrabie, 2023), thereby gaining increasing momentum in the forthcoming years (Patruti, Zbuchea, & Pînzaru, 2023).

The research delineates the nuanced distinctions between the concepts of digitization and digitalization, accentuating that the latter facilitates active user engagement and capitalizes on AI methodologies for a more dynamic transformation of content (Tarziu & Vrabie, 2015). As academia transitions into the paradigm of Education 3.0, higher education institutions confront a critical inflection point. Swift acclimatization to emergent technologies is imperative for student recruitment, notwithstanding the disparate levels of student commitment and extant societal limitations. The literature review and the aforementioned research project corroborate that contemporary e-learning platforms substantially amplify student performance by enhancing both the retention and understanding of information (Iancu, Vrabie, & Ungureanu, 2021). Within this context, the potential for AI to serve as pedagogical adjuncts can also be contemplated.

Moreover, one can envisage an AI-driven pedagogical agent capable of "translating" instructional materials and autonomously generating assessments – tailored to individual psychographic profiles, such as specific interests (e.g., athletics), cognitive preferences (e.g., visual learning modalities) and personality traits (e.g., extroversion). Such personalized interventions could invigorate student

engagement and stimulate a more profound learning experience (Krumova, 2017). During the learning process, students can ask a virtual assistant – enriched with chat capabilities such as GPT-4, relevant questions on the subject in focus. The "assistant" can reply by elaborating on the course material or even going beyond it and searching for relevant information on designated bibliographic resources.

Additionally, in the realm of career development, it is often observed that younger individuals frequently lack a definitive vision for their vocational trajectory. One could hypothesize the deployment of an AI-based career advisory system capable of discerning each student's hobbies, interests, innate talents, and coping mechanisms. Utilizing this data, the system could facilitate the exploration of bespoke career pathways, drawing upon the vocational experiences of analogous professionals. Such an AI career advisory system could further guide students in optimally seizing these vocational opportunities, thereby maximizing their career potential.

Takeaways

To harness the transformative potential of AI in the educational domain, it is imperative to adhere to a set of guiding principles:
- The AI system must be endowed with a comprehensive and accurate knowledge base sourced from academically rigorous course materials.
- For AI to generate personalized life scenarios, it necessitates an in-depth understanding of user psychographics alongside other user-specific attributes.

- Incorporating human expertise is essential for rectifying algorithmic inaccuracies or errors, thereby serving as a corrective mechanism within the AI system.

We stand at the cusp of a nascent era in AI, one that has already expanded the horizons of what was previously conceivable. While the liberal application of this technology is not without its risks—evidenced by the evolution of platforms like Facebook from collegiate social networks to conduits for election interference and extremist propaganda—these unintended consequences should not overshadow the manifold benefits. This article's author contends that society will adapt to the challenges posed by generative AI, much like other technological and industrial innovations that also carry inherent risks.

AI: beyond computing

The discourse surrounding artificial Intelligence (AI) has elicited a spectrum of perspectives among experts in the field. While there is a general accord regarding AI's transformative potential within the computing industry, its broader implications – spanning economic, legal, and military domains – remain enveloped in a veil of uncertainty. This ambiguity complicates not only the understanding of AI's current impact but also the forecasting of its future trajectory. In this context, the present paper's efforts were to investigate the strategic deployment of AI technologies to increase societal well-being.

By adopting a multi-disciplinary approach, we aim to contribute to the ongoing dialogue and offer actionable insights for the responsible integration of AI into various sectors of society.

Acknowledgment

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AI in Education: A Win-Win or a Zero-Sum Game?

Ana Maria Costea, Ioana Roxana Melenciuc Ioan

Abstract

While artificial intelligence is gaining more and more coverage internationally, being present in military developments, wartime situations, social media, engineering, etc., it was relatively natural to have it migrate into the educational sector. On the one hand, we can highlight the benefits of this type of technology, like simulations, scenarios developed much faster than a human being would do, and practically all the open sources available at your disposal. On the other hand, apps like ChatGPT are raising legal and ethical concerns in terms of reliability of the sources, originality, plagiarism, correct citation, and the development of analytical skills that the researchers/students may feel unnecessary to develop. Under this framework, the current paper aims to develop an analytical view of the pros and cons of using AI in education, highlighting the current international/regional and national approaches regarding AI (in this case, ChatGPT). From a methodological point of view, the paper makes a conceptual analysis using concepts like zero-sum games and win-win ones and applies them to the dynamics of AI in education. Secondly, the research encompasses international players and universities' strategies when dealing with AI. Lastly, the paper analyses several universities' official positions regarding ChatGPT.

Introduction

Technological development is among the most debated issues at national and international levels since it touches all aspects of our current society, from the individual level to the international one. The digitalization process, the increase of internet coverage, the internet of things, and the development of AI and its usage in approximately all aspects of everyday life is already the status quo, be it intrinsically acknowledged by its users or not. The benefits of modern technology are huge, from increased life quality of an individual, reduced processing time or errors when using smart technology to the development of high-level military operations that do not rely on humans anymore nor are they so time-consuming, thus cost more money (e.g., autonomous drones, automatized missile shields, etc.). Among the most successful modern technology, we can pinpoint artificial intelligence (AI), which is used at the macro level, not only by banks, the military sector (Nurkin & Siegel, 2023) in peace or wartime situations (Franke & Söderström, 2023), social media platforms such as Facebook and Instagram (Clegg, 2023), or Tiktok (n.d.), but also education (Chen, Chen, & Lin, 2020). In this sector, there have been developed several AI-based applications, from the famous ChatGPT (OpenAI, n.d.) to programs that detect plagiarism, robots, computers that use AI to create simulations, predictions, and even programs that change the music according to the mood that the AI is sensing as coming from the persons that are in the room at that time (Chen, Chen, & Lin, 2020). On the other side, we can identify vulnerabilities, threats, and legal and ethical issues that arose from the increased usage of these technologies. Firstly, there are the cybersecurity threats to which we are exposed every day. Economically, we can translate these

threats into cyber attacks that lead to massive financial losses. For example, "*Cybersecurity Ventures expects global cybercrime costs to grow by 15 percent per year over the next three years, reaching USD 10.5 trillion annually by 2025, up from USD 3 trillion in 2015.*" (Morgan, 2023) Another element is the legal aspect since the regulation is a very time-consuming process that must go through several procedures and align the necessities and interests of numerous stakeholders.

Additionally, it tends not to keep up with the technological developments. Thus, it is not a matter of being unable to make predictions and, consequently, develop norms that meet those vulnerabilities. However, it is a matter of being unable to adapt to the very fast speed of the technological process. Lastly, ethical aspects arise from using AI in critical domains like education and how universities deal with these fast-track developments. Under this framework, the present papers aim to develop an analytical view of the pros and cons of using AI in the educational process, especially in the case of ChatGPT.

From a methodological point of view, the paper will make a conceptual analysis using concepts like zero-sum games (Miroiu, 2007) and win-win ones and apply them to the dynamics of AI in education. Secondly, the research will encompass international players and universities' strategies when dealing with AI: Do they have an approach dedicated to mitigating AI's risks?; Do they have an ethical code regarding AI?. Thirdly, the paper will search for official positions that universities took when dealing with ChatGPT, if there are universities that developed their strategies in relation to the usage of this app, and how they are dealing with the challenge that it poses from an ethical and legal point of view.

Theoretical background

Zero-sum games and win-win ones are concepts developed within the game theory framework by John von Neumann and Oskar Morgenstern (1953) in their book *The Theory of Games and Economic Behavior*. Later on, the notion of zero-sum appeared within the concept of the Prisoner's Dilemma exemplified by Barry Krusch (1994); according to this, the players tend to defect rather than cooperate when they are within a framework characterized by mistrust and lack of communication. Additionally, Prisoner's Dilemma is a game of interests in which every player has his/her own set of interests that need to be fulfilled. Nevertheless, people's interests are not objective facts but based on and defined by perceptions. As Axelrod and Keohane (1985) suggest: *"beliefs, not realities... conduct"*.

In this light, the Dilemma reveals that "*the greater the conflict of interest between players, the greater the likelihood that the players would, in fact choose to defect.*" (Axelrod & Keohane, 1985) Therefore, if we were to meet a conflictual situation, the expected and predictable result would be defection by at least one player. But mutual interest can also be met in a bilateral relationship, as the prisoner's dilemma is not a non-exit situation, or it should not be, especially in the case of today's globalized and largely digitalized world. Given that we do not have only one game to play, the game is indefinably itinerated. In this sense, the scholars have tried to find ways in which the Prisoner's Dilemma could be broken, and they succeeded in developing several conditions that could transform this dilemma into a win-win solution. Parfit (1984) thought cooperation among the players was a viable solution. It can occur in the context of shared norms and principles among

players (Axelrod & Keohane, 1985). Cooperation can be achieved, for example, if the costs of defection are too high because then players tend to cooperate. Cooperation can also be achieved by enforcing significant expenses. Here, there must be taken into consideration several aspects: in large groups, it is challenging, if not impossible, to identify the defector; players must be able to respond effectively to betrayal; they also must be able to impose retaliation against defectors; and last but not least, players may lack incentives to punish the defectors. When sanctioning, the danger of cooperation collapsing is very high; therefore as the defector, it must take responsibility for its action and the punisher must do the same (Axelrod & Keohane, 1985). Another way a Prisoner's Dilemma could become a win-win game is by allocating some compensations or increasing the level of duty. In this way, the temptation to defect would not be so great. Chammah and Rapoport (1965) also believe communication is another critical aspect. If the communication is more frequent, the level of cooperation is increasing.

Last but not least, we must define the concept to analyze AI implications in education. According to the European view, it "*commonly refers to a combination of machine learning techniques used for searching and analyzing large volumes of data; robotics dealing with the conception, design, manufacture, and operation of programmable machines; and algorithms and automated decision-making systems (ADMS) able to predict human and machine behavior and to make autonomous decisions*" (EP, 2019, p. 2; Caradaică, 2020). In addition to this, over the last decade the members of the academia started to use Natural Language Processing (NLP) programs, which practically "*process and analyse thousands of articles at a time to extract key themes and quantifiably track their*

development in the literature" (Odden, Marin, & Rudolph, 2021). This type of technology would allow researchers, professors, and students to develop much faster solutions to ongoing issues and conduct simulations that consider more data and parameters than a human brain could do in a minimal period. This is where ChatGPT and Google Bard intervene, two examples of NLP programs that have the potential to change the status quo since they prove to be capable of breaking the existing norms, especially in the education sector, creating, thus, the framework for a zero-sum game.

Therefore, the theory is translated in education as cooperation between the professors and the students within the education process under the existing norms and principles. The typical example refers to the students who have assignments to do to receive their grades. If the assignment is not done, thus the student defects, then the teacher has the prerogative to punish the defector with a lower grade. On the other side, in the absence of norms and principles, the theory, as mentioned above, indicates that the students may tend to defect, thus, not do their assignments, or do them by committing plagiarism using AI tools or relying solely on the AI results without processing the information using their academic skills. This will later become a lack of critical and analytical competencies to conduct various operations. Also, this has the potential to transport a largely cooperative relationship into a sort of prisoner's dilemma in which neither the professors nor the students trust each other, the universities having to develop institutional relations with OpenAI to detect the AI-generated texts and even so not being able to 100% claim the plagiarism since the majority of universities did not adopt a public strategy regarding NLP tools.

Additionally, there is a technical matter of identifying the texts generated by AI. In this case, even GPT Zero publicly acknowledges that it cannot identify 100% of the information generated by ChatGPT (n.d.) since the system is always learning, thus maybe changing the answer to the same question. In this context, it is quintessential for universities to have an official position regarding the usage of AI tools, especially NLP ones like ChatGPT (thus to create norms or at least principles in the absence of national, international bidding regulations that make defection costly, thus restores the status quo to a win-win framework).

AI in education. The strategic view

In 2019, more than 100 states joined under the UN framework to discuss the usage of AI concerning education reforms: the strategic goals, the different methods of implementing them, etc. (Yang, Peng, & Li, 2021). This meeting was not generated by a new element brought into the education sphere. Historically, scholars started using AI in their education more than 60 years ago. One example in this sense would be the Dartmouth Workshop from 1956. At this workshop, Simon and Newell presented a program that was "*capable of proving logical theorems from Russell and Whitehead's Principia Mathematica (a foundational text in mathematical logic) by manipulating "symbol structures*" (Doroudi, 2022). Their work later served as an alternative to the main paradigm adopted in the 1950s in the field of education, namely behaviorism. Thus, in the 1970s, information-processing psychology or cognitivism became the main paradigm (Simon & Newell, 1971). At a practical level, in the 1980s, the MIT Media Lab developed the early Lego Mindstorms kits (Stone et al.,

2016). Today, the landscape has changed completely, and AI has gained more and more importance over recent years (Rodríguez-Abitia & Bribiesca-Correa, 2021; Teker, Teker, & Basak Tavman, 2022; Maltese, 2018; Payr, 2003) due to its efficiency (for example professors no longer verify themselves manually if a paper is the result of plagiarism, and some programs deal with the admission of students, even their grading according to specific parameters that are individually set for each student according to their performance, interests, programs that are dealing with curriculum development, simulation techniques that use VR, thus deepening the students' comprehension regarding specific topics, students have access to various platform from where they can have access to materials and other learning tools that they can use for educational purposes, etc. (Babu, & Wooden, 2023). Being more cost-efficient in the long term, "*AI in education is expected to be worth $6 billion by 2024*" (Miao et al., 2021). At the same time, as mentioned above, the regulation did not seem to follow close by. Thus, universities and decision-makers seem nowadays to go on unchartered territories when referring to AI, a fact acknowledged at the international level through the report conducted by UNESCO from 2023. For example, according to a survey done in May of the same year from more than 450 universities, less than 10% have adopted specific formal guidelines and/or institutional policies regarding the use of generative AI applications (UNESCO, 2023). At the European level, in October 2022, the European Commission released a set of *Ethical Guidelines for Educators on the use of AI and data in education* (EC, 2022), in line with the European view of a human-centric approach to AI. This document was adopted under the *Digital Education Action Plan (2021–2027)* (EC, n.d.). At the macro level, the EU,

through the European Commission, published in 2019 a Coordinated Plan (EC, 2018) on AI to coordinate the EU member states AI-related national strategies. This human-centric approach and ethical guidelines are some of the main elements that separate the EU from other international players like the US (concentrating on private initiatives and self-regulation) or China (focusing on a rather public authorities framework over the AI initiatives) (Madiega, 2019).

At the practical level, as mentioned above, the use of AI in education institutions is of great value since it has a wide range of activities where it can be used, like plagiarism detection, admission procedures, grading system, personalized learning, 24/7 assistance for the students regarding the administrative aspects, access to a vast database of information and the possibility to sort the needed information in a faster way, a quicker processing tool for conducting research based on simulations and scenarios building, AI using VR could deepen the interests of students regarding a specific subject and help them make responsible decisions under the simulation framework etc. At the same time, we can identify some counterarguments regarding AI in education: gamification raises ethical concerns (Iorgulescu, 2021), relying on AI could lead to a lack of critical thinking, wrong decisions that are made as a consequence of a biased algorithm, decreased level of innovation, since AI generally uses the already existing information, not thinking outside the box. Also, there is a matter of transparency and ensuring that everybody has access to the information and the knowledge to use it. Again, the algorithms are not biased; thus, they do not create discrimination.

Within this framework, in 2022, ChatGPT was launched. As previously mentioned, it is an AI that has NLP

tools. Thus, it differs from any other standard AI we can find on the market. The only one that is similar is Google Bard, but the latter is banned from EU territories due to European regulations over privacy concerns (Langley, 2023). Returning to ChatGPT, it is a language model trained to produce text once you are asking it something. It has instant access to a considerable amount of open data; thus, it is capable of doing a literature review on a specific topic in minutes. Also, it is very user-friendly, being designed to reproduce a conversation with a human. Since it is an AI, it can learn by itself, considering past experiences, the questions the user poses, and the users' answers. Also, it can provide the user with the bibliographical sources from where it extracted the information (Natalie, 2023), thus generating even academic papers. This aspect poses a series of concerns, especially in the academic world, since by providing the sources of the information, it is debatable if this would represent an act of plagiarism or not from a legal point of view. It would be like having thousands of employees working for you to research. They put all the information regarding the data source; thus, legally, the author is not directly or indirectly implying that the creation is his/hers, especially if we refer to the literature review part. From an ethical point of view, there is a different discussion since the research is not the result of scholars' work.

Returning to the abilities of the system, the newest version of it proved to be able to even have initiative by itself and succeeded in bypassing the traditional CAPTCHA security test by tricking a human into believing that it was a blind person to pass the test (Cost, 2023). This can lead us to think that ChatGPT 4 can pass the famous Turing test (Stanford Encyclopedia of Philosophy, 2021) that no computer has passed until now, a fact that can add to

future concerns. Additionally, there were some cases in which the AI lied, thus creating false or misinterpreting information (please see Verma & Oremus, 2023). Thirdly, the system will use the data you provide for future answers to other users, posing a question of privacy and detecting fake news from objective, real ones. Last but not least, the system is still in the learning phase; thus, the user cannot rely 100% on its results, which OpenAI also acknowledges (Natalie, 2023).

To respond to the vulnerabilities that ChatGPT is posing, the European Union adopted in June 2023 its first AI regulation called the AI Act (EC, 2021). This project was not new since discussions existed before ChatGPT appeared on the market (2021). However, the negotiations intensified, and the European decision-makers were able to reach common ground faster once the app became more and more popular.

ChatGPT in higher education institutions

Considering all its capabilities and the vulnerabilities it brings, at the empirical level, this translated into thousands of students using ChatGPT to develop their academic papers. This also resulted from universities not having an official point of view regarding this tool. In terms of statistical data, according to a survey conducted in March 2023 by BestCollege, "*43% of college students have used ChatGPT or a similar AI application*" (Welding, 2023). Additionally, the survey confirms the above argument, stipulating that "*Over half of college students (54%) say their instructors have not openly discussed the use of AI tools like ChatGPT...... 6 in 10 college students (60%) report that their instructors or schools haven't specified how to use AI tools ethically or responsibly*" (Welding, 2023),

emphasizing a huge problem coming from the universities' part by not acknowledging the issue.

From an ethical point of view, below 41% of the students who participated in the survey considered using AI for exams or other assignments unethical. Also, 51% of them think that using this technology represents an act of plagiarism, but at the same time, they consider that this is part of the new normal; thus, there should be some solutions that integrate these technologies ethically and responsibly.

Source: Welding, 2023

After seeing the international and students' views on the matter, we will analyze how universities have positioned themselves to ChatGPT, particularly from a strategic level, and if they have developed ethical guidelines for using such AI.

Although AI is a new reality, according to a survey conducted by UNESCO in May 2023, only 13% of the 450 participating universities offered formal guidance to their staff and students. Although they have issued some guides regarding the topic at hand, they vary a lot. "*Only half have detailed instructions, the rest approve of AI but*

leave it up to users to decide how generative AI apps are applied. In 40% of cases, the guidance is not written, but only communicated orally" (Naujokaitytė, 2023).

Among the universities that adopted such strategies, we will focus attention on five of them: The University of Edinburgh (UK), The University of Ljubljana (Slovenia), The University of Tartu (Estonia), The University of Iowa (US), and The University of Arizona (US).

The *University of Edinburgh* (2021) has an official view over the ethical aspects of using AI, pinpointing towards using AI as a *force for good*, coordinating its research centers to take into consideration the five core themes, "*Developing moral foundations for AI; Anticipating and evaluating the risks and benefits of AI; Creating responsible innovation pathways for the adoption of AI; Developing AI technologies that satisfy ethical requirements; Transforming the practice of AI research and innovation*" (University of Edinburgh,2021), when conducting their activities. At the same time, the strategy tends to be more like a general guideline than a clear-cut position regarding the vulnerabilities the AI poses. Concretely regarding ChatGPT, the university issued in March 2023 a *Guidance for students on the use of Generative AI (such as ChatGPT)*. Officially, the university does not impose an explicit restriction on using AI tools but emphasizes the expectation that the students have to deliver original ideas. Also, the document mentions the limitations of such tools and acknowledges the fact that students are using them or, in some cases, are even advised to use them; thus, the University of Edinburgh is among the few universities that not only allow the use of AI but also integrates this type of technology in the educational process but do not have a clear procedure regarding these aspects (University of Edinburgh, 2023).

The *University of Ljubljana* published its guide in September 2023. As in the case of the university mentioned above, this institution acknowledges the use of AI, emphasizes its limitations, and encourages its users to check the generated information and not take it for granted. At the same time, it is very specific regarding the possibility of using it as a copy/paste instrument or when the teacher forbids it. Thus, the university, as we will see in other cases, gives the professor the liberty to decide if their students are allowed to use ChatGPT in classes or for assignments/exams (University of Ljubljana, 2023).

The *University of Tartu* developed its guide in April 2023. Besides the general principles and the acknowledgment of AI use in the educational process, it sets specific grounds for ChatGPT usage by its students. Compared with other universities that give the choice to the professor, this university formally allows the use of AI, and the teacher decides the degree to which the students should use it. Also, the university allows papers generated by AI as long as they have the appropriate references and the author establishes from the beginning that they result from AI processing. Since providing this information and presenting the paper as one's work would be considered academic fraud, the guide encompasses even ways to correctly cite AI-generated information (University of Tartu, 2023).

The *University of Iowa* adopted the Guidelines for the Secure and Ethical Use of Artificial Intelligence in September 2023. As in the above cases, it acknowledges the existence and the use of AI, such as ChatGPT, as well as its limitations, but it does not integrate its usage into the university's practices. Also, it pinpoints the policies of OpenAI (University of Iowa, 2023), which establishes the ground rules for its usage: the company disallows the

use of its products for illegal or unethical purposes such as fraud, plagiarism, discrimination, etc. (OpenAI, 2023).

The *University of Arizona* has developed a student guide for using ChatGPT, thus integrating its use into an institutional framework (the University of Arizona Student Guide). At the same time, the university does not have an established policy, leaving the decision at the level of each professor ((University of Arizona Student Guide – Integrity).

Therefore, there is no unity regarding how universities should react/adapt to AI technologies, not even at the level of the EU member states. A large part of the universities did not even develop a guide regarding its use by their staff and their students, leaving the situation in a grey area, where practically the professors cannot forbid their students to use ChatGPT in a percentage of 100% for their papers without proper references, given the lack of institutional framework. Additionally, since no program can currently detect AI-generated information, the student remains the deciding factor. From a rational point of view, returning the game theory defection would be a winning strategy in the absence of norms, transforming AI in education into a zero-sum game in which time and high grades are won and critical thinking and analytical skills are lost.

Conclusions

Although AI in education is a new reality, the decision-makers are falling far behind, as is the case with the majority of the regulations of new technologies (e.g., cyberspace). Although it comes with vast opportunities for students, but also for professors and researchers, it also comes with different challenges regarding the loss of critical thinking, ethical issues, and biased algorithms/

limited knowledge or access to it. Professors gain time regarding the evaluation of their students, and students also gain time by having a literature review done in a matter of minutes, etc. But this comes at a cost; relying on ChatGPT to generate ideas/ analyses will decrease its users' analytical skills and critical thinking. Additionally, this will limit the possibility of developing new ideas, out-of-the-box ideas that create paradigm shifts, etc. Also, rationally speaking, without the proper bidding rules, the student would tend to choose the most beneficial action with the minimal cost: generating papers, essays, and arguments in due time with limited effort (via AI), thus defecting for an immediate result, a higher grade, than the end game, their academic skills/carrier. Therefore, one aspect is certain: all the educational institutions around the globe that have access to the internet or computers will have to give answers to these pressing issues. Secondly, they would be responsible for continuing the educational act ethically and beneficially for all participants. Thus, they will have to transform a potential zero-sum game into a win-win one with integrated guidelines on incorporating AI-based technologies and increasing innovation, analytical skills, and critical thinking. Therefore, one thing is for sure: there is no right or wrong answer, but an answer is for sure required.

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The Lure and Allure of Using AI Tools in the Romanian Higher Education

Andreea Mitan

Abstract

I asked ChatGPT to write an abstract for this chapter. This is the result: 'AI, epitomized by ChatGPT, has reshaped education since its 2022 release, fuelling a surge in scientific articles. The 4th Industrial Revolution's imminent impact is evident in globally accessible AI tools, prompting authors to examine positive and negative implications, emphasizing a human-centric perspective. In 2019, a UNESCO conference in China and the 2023 AI Safety Summit in the UK underscored the international discourse on AI's future and associated risks. AI's dual role of benefit and potential misconduct is evident in education, promising reduced professorial workload and tailored learning experiences while raising concerns about educators' roles diminishing and facilitating academic dishonesty. This chapter, amid rich literature, argues that systemic challenges must be addressed before integrating AI into Romanian tertiary education. Advocating a human-centric approach, it urges collaboration among scholars to transition smoothly towards an AI-empowered education system, enhancing the Romanian student experience.'

An ideal and a truth

The essence of the Renaissance Scholar is deeply connected to the freedom to pursue knowledge in a rather quiet place, and without the pressure of delivering results on a schedule. Many Scholars still choose to spend their lives in the monasteries of the mind, thinking about writing grants to conduct research on their chosen topic and to finance their conference attendance costs, publishing projects, and daily living. Life in a monastery of the mind can be comfortable, yet it is odd, at least to the nonbeliever in the God of Science and Time. The pace of the World's wheels is impacted by the ideas born in the monasteries of the mind where Scholars spend their lives. Nevertheless, sometimes, these wheels speed up and threaten to disrupt the established order.

Academia exerts a certain mystique and is seen by many as a bridge to the future – at least to prepare the future workforce and discover some valuable things that would improve the quality of life of the Everyman and Everywoman. The people outside of Academia rarely tap entirely into what it actually means to be there to those inside. The inviolability of the academic space makes it seem privileged, and perhaps it is, as it must allow the skilled Scholar to pierce through layers of reality that are not even visible to the people outside of the monastery until later dates. Some believe that the Scholars are even (relatively) disconnected from the mundane reality, living comfortable lives in their ivory towers of yet-to-be-proven-useful knowledge. On these grounds, it is not uncommon for outsiders to label members of the Academia as conservative, change-averse, or even narrow-spirited (Marks & Al-Ali, 2022).

From time to time, as any reader would be able to perceive, the silence of the monasteries of the mind is disturbed by the piercing sounds of the sirens that announce the discovery of a new technology or a ground-breaking idea. The sirens might claim that the latest discovery leads to the birth of something that will disrupt human existence as we know it. For example, sirens announced disruptive events in the past, such as the full sequencing of human DNA, the emergence of the World Wide Web, the creation of the personal computer, or the landing on the Moon. Every time the sirens go loud, a particular saying appears written with golden letters even on the walls of the largest monasteries of the mind: „The World is infinite, and, in this human form, you are but a grain of dust." Demotivation might arise as the Scholars (re)discover that they are nothing but beings living under the prejudices of a limited lifespan, with a relatively limited capacity for knowledge gathering and sharing. For the fearless and visionaries, opportunities are best seen during these times when sirens sing. But, indeed, sometimes the sirens signal hurricanes that could erase much of what is by announcing paradigm shifts.

The human mind, the mind of a Scholar, is fascinated by knowledge and has a desire to discover the causes and effects of any variable moving in a different direction, to break rules, and to create rules, to prove that they made it one step further than the rest. Most Scholars desire to leave the world a better place than they found. So, during the wildest hurricanes, they don't hide, but they embark on novel quests to unravel the intricacies of the tapestry of the World. Plans are made, and Scholars regain that amazing feeling that tells them they are now able to grasp and even control a part of the vast reality. Research avenues open. Moneys flow. The „new normal" is born.

Once again, the day after tomorrow is there for all of us, Scholars, to live thinking of.

Between fascination and fear: a peek into the realms of AI

The door opened by the ideas of post-humanism, the desire of Scholars to become creators of sentient technologies, the popularity of the works of Yuval Noah Harari (2017a, 2017b), as well as the fear of 3D printed meat, eating locusts, or GMOs, of losing one's freedom to travel by being confined in 15 minutes cities, and of finding our lives reduced to a purely mechanical experience, have somehow touched many during the last decades, and even more so after the COVID-19 pandemic. The magnitude of change that the 4th Industrial Revolution is about to bring can already be felt, and it is quite normal to expect that even more dramatic changes will occur in the years to come, and that these changes will lead us to embrace novel solutions to older or newer problems of the World. The fact is that Augmented Reality, Virtual Reality, Machine Learning, Generative AI, explainable AI (XAI), and the like are easing their ways into the usual vocabulary, together with more concerning concepts, such as 'climate refugees'.

Sometimes, the tech novelties come towards us at a pace that is beyond our capacity to react, primarily due to us being limited by our mental, institutional, and legislative walls. Pursuant to the discoveries that seem to lead humanity towards Singularity by the 2030s, which would release AI from human control (Newcomb, 2023), a paradigmatic shift is expected to happen soon in Academia and not only. And this has been brewing for quite a while.

Over fifty ministers from multiple countries and around 500 international representatives from more than

100 UNESCO Member States, United Nations agencies, academic institutions, civil society, and private sector entities met in May 2019 in Beijing, the People's Republic of China, to discuss the implications of AI for the future of work and skills development, to plan for a potential reshaping of the processes of training, learning and the education system in its core structure. Some of the main takeaways of the discussions were included in a document titled `*BEIJING CONSENSUS on artificial intelligence and education*` (UNESCO, 2019): first, it is underlined that professors cannot be replaced by machines and that their rights must be protected, second, the roles of professors must be redefined and they must be trained to be able to work in AI-rich education settings, third, the curricula would be adjusted to promote the integration of AI tools and solutions, fourth, pilot tests should be run in schools to be able to draw conclusions and scale-up evidence-based practices, fifth, AI tools should be applied to foster adaptive learning processes, as well as large-scale remote assessment, sixth, as the job market is expected to change substantially due to large scale AI adoption, AI-related skills and technical and vocational education should be embraced in the new curricula, including teaching AI literacy skills and making it available to all ranges of population, seventh, it is of utmost importance to support higher education and research institutions to create a massive pool of local AI professionals that would be able to develop AI systems.

Although not very new, Generative AI, the current star of the tech soup, grabbed the general public's attention during the last trimester of 2022, when ChatGPT was launched and reached 100 million users in just two months (Hu, 2023). As with any new discovery, it gathered many enthusiastic voices preached that it could support a

person's documentation endeavors and write better codes, scripts, essays, and even poems (Chatterjee & Dethlefs, 2023; Terwiesch, 2023). ChatGPT, the `popular` Generative AI that many have already tried, is considered to offer easy access to information to tutors and students as well, to help professors plan their lessons or otherwise decrease their workload, to help students learn in a personalized manner, or to learn interactively, even by debating with the program (Farrokhina, Banihashem, Noroozi, & Wals, 2023). Although the opportunities that Generative AI brings to students and teachers are discussed in recent works (Pavlik, 2023; Zhai, 2022), the general focus of the researchers and the persons in power seems to be regulating and limiting its influence.

Some less-than-ideal features of ChatGPT have been pointed out numerous times. For example, it was stated that, at the moment, it does not have the capacity to fully grasp the concepts it operates with (Bogost, 2022), that it generates information that may or may not be accurate (Choi et al., 2023; Lecler, Duron, & Soyer, 2023; Sallam, 2023), especially when dealing with events and information newer than 2021 (Stokel-Walker & van Noorden, 2023), that is not free from biases (Zhai, 2022), that is thought to stimulate plagiarism (Gašević, Siemens, & Sadiq, 2023), and that it provides fake information in response to some queries (Tlili et al., 2023). Chomsky (Open Culture, 2023) even suggested that Generative AI tools such as ChatGPT are nothing more but a way of avoiding learning and embracing plagiarism using high-tech, while other authors go as far as to discuss banning Generative AI in schools and cite measures that governments have already taken to ban it altogether (Dibble, 2023; Lukpat, 2023). The paradoxical nature of Generative AI has been described by Lim, Gunasekara, Pallant, and Pechenkina (2023), who

underline four streams: it is both a 'friend' and a 'foe,' it is 'capable' yet 'dependent,' it is 'accessible' yet 'restrictive,' and it gets even 'popular' when 'banned.' However, not all Generative AI gets to be perceived the same; by far, this is applied to the most popular product that reached the general public, ChatGPT.

Afraid of the possibility of soon becoming characters in an upsetting *Black Mirror* episode powered by sentient and malevolent AI, a number of Scholars began setting up a taskforce to counterattack at least Generative AI and its uses and misuses in Academia. The game recently became even more exciting or... worrisome. On November 1st and 2nd, 2023, an *AI Safety Summit* held in Great Britain gathered representatives from more than 25 countries, including China, the US, and the EU (Sandle & Coulter, 2023). The participants signed '*The Bletchley Declaration*,' engaging to cooperate on designing, developing, deploying, and using AI in a manner that is safe, human-centric, trustworthy, and responsible, all the while engaging to identify and mitigate together risks that might arise from AI, as these would inherently be international in nature (UK Government, 2023).

Some insights from the Romanian educational landscape

While new technologies and software are developed in large amounts these last decades, and while they are or at least seem to be widely available to the public, including to the Romanian student population, one must not fear that a high-tech future is about to destroy the established order in the Romanian educational system. Some Scholars might focus on generative AI, and programmatic documents might have been prepared years ago. Yet, the Romanian

context needs further exploration before unboxing the more innovative ideas.

Three of the points that I believe must be addressed prior to discussing the potential impact of using AI on a larger scale in the Romanian education system refer to the number of students who finish high school, to the number of people who graduate tertiary education, and to the level of bullying that can be witnessed in schools, which creates a rather unfriendly learning environment. Let us note that 42% of the EU population aged 25 to 34 had been or was currently enrolled in tertiary level education in 2022, while only 24.7% of the Romanians in the same age group did, with the region of South Muntenia scoring the lowest – 16% (EUROSTAT, 2023). This low attendance of tertiary education should not be viewed as a surprise, as Romania was among the last ten countries in the EU in 2020 in what concerns youngsters aged 20 to 24 who finished their secondary education (EUROSTAT in Cornea, 2021). That is, tertiary education is not a priority for many of the youngsters in Romania. Studies are needed to learn what these youngsters are doing and how they envision their future.

More so, perhaps the fear or awe of the powers of Generative AI concerning student education should be moderated by the grounding force that expresses itself as the lack of computers in many schools, especially in the rural regions, and by the fact that it is an association – Ateliere Fără Frontiere – and not an institution, which works since 2008 to collect computers from companies and people, to restore them, and to donate them to schools that do not have any (Boboc, 2023). In 2022, the Union of Informatics Professors underlined that the project through which schools were to be endowed with ITC equipment and furniture would have covered only half of

the necessities that schools have to be able to respond to the requirements made by law (Lefter, 2022). If we add to these the fact that 82% of the students have witnessed bullying scenes in the school they attend (Hotnews, 2021), the landscape is better contoured.

Consequently, all discussions regarding student experience and learning in the Romanian higher education system need to be placed under the umbrella of overall low attendance of tertiary education in Romania, and should be moderated by the type of access to tech resources and tech education that educators in Romania have. My point is that although the World is changing and AI tools are available, even though students can easily use ChatGPT or other AI tools, there are more pressing issues that the educational system in Romania needs to address before embracing the fads of 'what if AI is going to steal our jobs?' or 'what if students are not going to learn as much due to using AI tools?'. The facts show that we already have a declining student population and that their attitude towards learning has not dramatically changed due to the availability of AI tools but due to other pre-existing and systemic issues.

On a brighter note, I would invite the reader to meditate on 'What if the world becomes how we want it to be?'. Perhaps we, as Scholars, as educators, or as people interested in improving the conditions for future students, should first take a step back and ask ourselves what we can do to stimulate more heart-to-heart learning and to proceed with creating a more loving environment for learning to take place, before thinking of using any technology that we may or may not have resources to access.

Perhaps the levels of school dropouts, the number of NEETs in the EU and elsewhere, and the levels of violence

in schools are not a sign that youngsters become savages who do not want to learn, but a sign that the education system needs to welcome numerous changes, as the World changes on a deep level. Could AI tools be employed to upgrade the teaching and learning experience in schools, high schools, and universities in Romania and elsewhere? They could. Could they have negative influences as well? Yes. However, let us bear in mind that a tool is nothing but a tool, that leaders are capable of strategic thinking, and that the creation and use of strategic plans are still needed today, perhaps even more than a century ago, this time taking into account the unprecedented levels of technological development we witness. Large systems, such as the educational system, are known to be slow to embrace profound change. However, deprofessionalization is the most probable outcome if we continue to stand in awe of new tools and forget to envision and plan for the future. As a new global experience of the Middle Ages is not desirable, I now urge Scholars to open the doors of the monasteries of the mind, step into their public counselors' shoes, and work together to smooth out the transition towards a future we would like to live in together. Not doing that would most probably mean seeing the risks related to the spread of AI materialize.

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Regulations of Artificial Intelligence. Challenges and Solutions for Education

Mădălina Cocoşatu

Abstract

The present study aims to analyze the main initiatives of artificial intelligence legislation at the international and European levels, as well as their impact on AI developers, institutions, organizations, and citizens. The chapter underlines the importance of a technology-neutral and proportionate regulatory framework. In the context of the publication, in 2015, of Digital Single Market Strategy for Europe and, in 2018, of Artificial Intelligence Strategy for Europe, the European Union has taken an essential step toward the regulation of artificial intelligence by creating a legislative framework aimed at ensuring better conditions for the development and use of this innovative technology. The European Union could become the first jurisdiction in the world with AI legislation. Thus, as early as April 2021, the European Commission initiated the Proposal for a Regulation of the European Parliament and of the Council laying down harmonized rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union legislative acts, a proposal for a regulation "establishing harmonized rules on artificial intelligence." Also, due to the accelerated progress of new technologies, the G7 Summit in Hiroshima (Japan, May 19–21, 2023) decided to create a ministerial forum called the "Hiroshima AI process" to discuss issues related to generative artificial intelligence,

such as intellectual property rights and misinformation. Regulation of AI in education is crucial to promote responsible and ethical implementation of technologies, ensuring that they bring meaningful benefits and do not create problems or inequities in the education system.

Introduction

Artificial intelligence (AI) is an interdisciplinary area that deals with the development and study of systems and technologies capable of imitating or replicating human intelligence, not limited to a single technique or approach but including various methods and paradigms. The European Commission's High-Level Expert Group on Artificial Intelligence (AI HLEG) formulated the following definition, which was subsequently further discussed within the group: "Artificial intelligence (AI) refers to systems that exhibit intelligent behaviors by analyzing their environment and who take action – with a certain degree of autonomy – to achieve specific goals. AI-based systems can rely solely on software, acting in the virtual world (e.g., voice assistants, image analysis software, search engines, voice, and facial recognition systems), or AI can be embedded in hardware devices (e.g., advanced robots, autonomous vehicles, drones or IoT applications)" (FRA, 2021).

The legal definition of artificial intelligence is normative and not identified with the technical definition.

AI paternity is generally attributed to Alan Turing. In his article "Computing Machinery and Intelligence," published in 1950, he established the so-called "Turing Test" to determine an artificial device's intelligence. This test is passed when an external third party cannot

distinguish whether the answers to their questions come from a machine or a human. The "Imitation Game" has generally been taken as an irrefutable demonstration that a machine is able to think and act like a human. The usefulness of this test has been appreciated but also questioned (Robles Carrillo, 2020).

Artificial intelligence represents an area of strategic importance in the state's plans to improve, through innovative technologies, citizens' quality of life, the services offered by public authorities, as well as economic performance and scientific progress. The EU's approach to artificial intelligence centers on regulation and excellence, aiming to boost research and institutional capacity while ensuring ethics and fundamental rights. As democracy and the rule of law must be essential guidelines in the work of all states, artificial intelligence must be used appropriately. Ethics, transparency of the legal framework, and intelligent use of AI must be components of effective governance that is ready for openness regarding its citizens (Moroianu Zlătescu & Marinică, 2020).

In recent years, it has become evident that the challenges of artificial intelligence require serious involvement from competent institutions to regulate this phenomenon. To date, no European Union or Organization for Economic Cooperation and Development member country has approved specific regulations on artificial intelligence.

Given the potential benefits of AI for society, the EU is acting to harness the opportunities of using AI. Thus, starting in 2015, there has been an intensification of actions and measures at the European level for the regulation of the field of artificial intelligence, the elaboration of national strategies, guidelines, investment plans, and the development of public policies. Some Member States are already considering national rules to

ensure that AI is safe, developed, and used in compliance with fundamental rights obligations. This will likely lead to two main problems: i) fragmentation of the internal market on essential elements regarding, in particular, the requirements for the AI products and services, their marketing, their use, the liability, and the supervision by public authorities, and ii) the substantial diminution of legal certainty for both providers and users of AI systems on how existing and new rules will apply to those systems in the Union. Given the wide circulation of products and services across borders, these two problems can be best solved through EU harmonizing legislation (CE, 2021).

The evolution of artificial intelligence regulations at the European Union level

Today, when AI becomes more and more present, ethical and legal responsibility is essential to ensure a beneficial and safe use for the benefit of humanity. Simultaneously with the development of AI technologies, we must also consider regulating their use. The legal regulation of AI does not keep pace with the accelerated evolution of Artificial Intelligence in the fields of human activity and with a political context in a continuous dynamic. The European Union wants a reliable AI, which should have three components fulfilled cumulatively: legal, ethical, non-discrimination, and fairness. Thus, the EU has an active and progressive approach to regulating artificial intelligence.

Just as the expression "Artificial Intelligence" has not been developed without controversy (the Dartmouth Convention, in 1956, is the reference for using that term), the legal regulation of the term has many controversies. As part of its AI Strategy, the European Commission has

joined forces with all Member States, as well as Norway and Switzerland, to promote the development and use of AI in Europe. The European Union is the first and so far the only international organization that has decided to resort to a firm legal regulation of AI.

On February 19, 2020, the Commission published the *White Paper on AI – A European Approach to Excellence and Trust* (EU, 2020). The EU proposals aimed to merge the legal framework on AI with a new plan coordinated with member states, this approach being possible only through a regulation complemented by new safety rules, which aim "to increase user confidence in the new versatile generation of products." In April 2021, the European Commission proposed the world's first regulatory framework for artificial intelligence: Regulation of the European Parliament and the Council laying down harmonized rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union legislative acts. This proposal delivers on the political commitment by President von der Leyen, who announced in her political guidelines for the 2019–2024 Commission, "A Union that strives for more" (von der Leyen, 2019), that the Commission would put forward legislation for a coordinated European approach on the human and ethical implications of AI.

By content, the Regulation of AI states proportional and flexible rules, contributing to limiting the risks specific to AI systems. It is based on the fundamental values and rights that form the basis of the European Union and aims to provide confidence in the adoption of AI-based solutions, appreciating that it must be seen as "a tool for people and a force for good in society, with the ultimate goal of raising the level of people's well-being so that people have confidence that "technology is used in a safe

way and in accordance with the law, including respecting fundamental rights" (Marinică, 2021, p. 30).

The proposal introduces requirements for AI systems that pose a high risk to safety and fundamental rights. These requirements include using high-quality datasets, traceability, information sharing, human oversight measures and robustness, safety, cyber security, and accuracy. The proposal also bans particularly dangerous uses of AI, such as social scoring by governments or systems that manipulate human behavior.

The Artificial Intelligence Act represents a world reference in the field of artificial intelligence regulation. This proposal constitutes a core part of the EU digital single market strategy. The legal basis on which the Artificial Intelligence Act project is the provisions of Article 114 of the Treaty on the Functioning of the European Union regarding the adoption of measures to ensure the establishment and functioning of the internal market, aiming to ensure the good functioning of the internal market by "developing, the placing on the Union market and the use of products and services that use AI technologies or that are provided as stand-alone AI systems. Some Member States are already considering national rules to ensure that AI is safe and is developed and used in accordance with fundamental rights obligations" (CE, 2021).

Regarding the European Union, the Agency for Fundamental Rights (FRA) published in February 2018 a report drawing attention to the danger of discrimination, presenting cases where the use of algorithms may violate Art. 21 of the Charter of Fundamental Rights and also referred to the ways to prevent such discriminations. Thus, these measures concern the transparency of information related to algorithms, and studies were carried out on

algorithms that affect fundamental rights; also, the data quality was checked (FRA, 2018, p. 11). At the beginning of 2019, FRA launched research to analyze the advantages and disadvantages of introducing artificial intelligence in public administration for the respect of human rights. In parallel, the European Commission tasked a group of experts with the reliable, safe implementation of artificial intelligence, respecting the rules in force and ethical principles, who provide orientations in the field of ethics (High-level Independent Group of Experts on Artificial Intelligence, 2019).

Member states of the EU play a crucial role in shaping the implementation of the AI Act. For Germany, a harmonized EU framework is essential to prevent fragmentation in the single market and ensure AI's ethical use, which, in turn, can boost economic competitiveness. The French government believes this act will help protect European values and maintain a competitive edge in AI, driving economic growth. Like several other Eastern European countries, Poland has expressed concerns about excessive regulation that might stifle AI innovation (Stekić, 2023). They advocate for a more flexible approach, especially for startups and small businesses, in a bid to foster economic entrepreneurship. The Netherlands emphasizes the need for clear rules and enforcement mechanisms, especially in healthcare and transportation sectors where AI applications can have significant societal consequences and financial implications. Sweden seeks to ensure that the AI Act does not hinder the development of AI technologies, particularly in the context of digital transformation and economic growth.

Artificial Intelligence and education

The applications of AI in education highlight the potential for huge advantages made possible by intelligent systems. The impact of AI can be seen in improved learning outcomes, time and cost efficiency, global access to quality education, and other benefits. Personalized learning and intelligent tutoring systems can help improve learning outcomes for students, especially in underserved populations (Kamalov, Santandreu Calonge, & Gurrib, 2023).

The number of specific technologies based on artificial intelligence now used in education is increasing. We are increasingly seeing virtual assistants or robots in the teaching process to provide additional assistance and facilitate student interaction with the educational content. AI technologies do not have consciousness or understanding of the world in a way analogous to human consciousness; they work based on probabilities and statistical patterns learned from training data. The leading technologies used in education are:

- ChatGPT 4 (Generative Pre-trained Transformer 4) is a generative language model based on transformative neural networks.
- Thinkster Math is an online learning platform that focuses on teaching math to students from kindergarten through high school. Thinkster Math combines digital resources with personalized instruction provided by professional math coaches.
- Brainly is an online collaborative learning platform that facilitates the exchange of knowledge and help between pupils and students. It's a global community where users can ask questions, provide answers, and collaborate on solving problems. Brainly covers a wide

range of subjects, including math, science, languages, literature, and more.
- Jill Watson is an artificial intelligence virtual assistant developed to provide academic support and answer questions in an online "Knowledge-Based Artificial Intelligence" course at the Georgia Institute of Technology. It was created as part of the Georgia Tech Online Master of Science in Computer Science (OMS CS) project.
- Nuance represents a speech recognition platform used by students and faculty, capable of transcribing up to 160 words per minute; it is especially helpful for students who struggle with writing or have accessibility needs.
- Cognii is an AI technology, including a virtual learning assistant, used to support and improve traditional educational processes. In addition to assessing academic knowledge, Cognii can evaluate and provide feedback on soft skills such as critical thinking, problem-solving, and communication skills. Also, Cognii solutions can be integrated into various educational systems, including online learning platforms or learning management systems (LMS).
- Content Technologies is an AI learning system focused on "turning big data into information, and information into knowledge."

Content Technologies Inc. is a company developing AI learning systems that focus on "turning big data into information and information into knowledge." The company's education-focused solutions include (University of San Diego, n.d.):
- Palitt: built to help instructors easily create "your own custom lecture series, syllabus or textbook."

- Cram101: AI technology that can "turn any textbook into a smart study guide complete with chapter summaries, unlimited true-false and multiple choice practice tests and flashcards all drilled down to a specific textbook, ISBN number, author and chapter."
- JustTheFacts101: intended to function as the AI equivalent of an old-fashioned yellow marker, instantly highlighting and generating book and chapter-specific summaries

Implementing artificial intelligence in education aims to increase efficiency, personalize learning, and prepare students for future technological challenges. The main benefits of using artificial intelligence in education are:

1. Personalization of the learning process. AI systems can analyze individual student performance and adapt the learning process to suit their skill level. This allows each student to progress at their own pace and receive additional support in case of difficulties.

2. Instant feedback. Through the use of AI, both teachers and students can receive instant feedback on the progress of acquired knowledge, skills, and abilities. This prompt feedback can contribute to continuous improvement and timely error correction.

3. Adaptation of educational content. AI systems can analyze students' needs and preferences to deliver educational content tailored to their interests and learning styles.

4. Access to advanced educational resources. AI facilitates access to advanced educational resources, including online learning platforms, simulations, and interactive materials that can enrich the learning experience.

5. Detection and remediation of learning disabilities. By analyzing data, AI can identify patterns and trends that might indicate learning difficulties at the individual or classroom level, facilitating early intervention and remediation.

6. Efficiency in performance assessment. AI-based assessment systems can help assess student performance objectively and provide detailed information about their skills and progress. In the context of online evaluations, AI-based assessment systems can detect cheating, such as copying or using unauthorized resources during tests.

Although artificial intelligence brings with it numerous benefits in the field of education, there are also disadvantages and challenges associated with the implementation of this technology:

1. Inaccessibility and inequity. Implementing AI can lead to a more significant digital divide between schools or communities with different resources, creating inequity in technology access and its benefits.

2. Lack of Human Interaction. Some methods of implementing AI in education may lead to reduced human interaction, which could affect the development of students' social and emotional skills.

3. Personal Data Protection and Privacy. AI systems in education collect and analyze a significant amount of student data. This raises concerns about the privacy and security of this data, primarily if adequate measures to protect personal information are not implemented.

However, in addition to the benefits, we also face challenges. The challenges caused by the introduction of artificial intelligence in education can be summarized as follows:

– Not all students have equal access to high-quality technology, and this can contribute to increasing inequalities in education;

– The quality of the content generated by AI may vary, and some solutions may not be suitable for all groups of students;

– Dependence on technology can lead to a change in perspective on education, emphasizing automated testing and assessment at the expense of developing critical skills and critical thinking;

– AI-based solutions collect and process sensitive student data, which may risk their privacy.

With all these challenges, education and technology specialists have already identified solutions, such as:

– Governments and organizations must invest in digital infrastructure and provide equipment or internet connectivity for disadvantaged students;

– Developing clear standards for AI-generated content and working with education experts to improve content quality;

– The integration of technology in the educational process must be balanced, paying particular attention to the development of cognitive, social, and emotional skills;

– Implementing strict data security policies, encrypting information, and clearly informing the parties involved about data collection and processing practices, all in the context of creating and adopting the specific legislative framework for using AI in the educational process.

Like any field of activity, AI in education needs to be regulated. The education sector is largely unprepared for

the ethical and pedagogical integration of rapidly evolving AI tools. Thus, when regulating the use of AI, respect for human rights, such as privacy and data protection, equality and non-discrimination, and access to education and justice, must be considered.

A new UNESCO global survey of over 450 schools and universities found that fewer than 10% have developed institutional policies and/or formal guidance concerning the use of generative AI applications (UNESCO, 2023). Considering the use of AI in education, the UN, through the work of UNESCO, supporting its Member States, adopted in 2022 the "Recommendation on the Ethics of Artificial Intelligence" (UNESCO, 2022).

Also, the draft Regulation on Artificial Intelligence (AI Act), now on its way to finalization, is becoming a model of legal action in the matter. To address the legal issues related to AI in the educational process, not only international organizations and governments need to get involved, but schools/universities also need to take a multidisciplinary and proactive approach in developing their strategy for using AI.

Conclusions

Artificial intelligence development continues to significantly impact various industries and aspects of daily life, with a concomitant increase in the complexity and capabilities of AI systems. Considering the speed with which new technologies are developing, it is predicted that in 2050, artificial intelligence will be the one that will dictate the direction in which society will go. Basically, AI seems to be everywhere, with people becoming more and more dependent on it. "Everything is becoming digital data, digital storage, digital exploitation, digital results" (Ciurea, 2022).

Any technology must be developed to serve human beings and respect human rights. For this, it should be subject to control based on democratic decisions, public debate, and a wide distribution of benefits.

International organizations and institutions can facilitate collaboration between various sectors, including governments, academia, the private sector, and civil society, to ensure a comprehensive and balanced approach to AI regulation. The emergence and explosive affirmation of new technologies related to artificial intelligence have generated the establishment of new institutions and the adoption of coordinating documents in the field, such as codes of good conduct, guidelines, and recommendations.

The implementation of artificial intelligence in the field of education brings with it many challenges but also significant opportunities. Regarding education in the context of the development of AI technologies, I believe that integrating artificial intelligence in education must be carefully managed, considering ethical aspects, data protection, and ensuring fair access to educational resources. Maintaining a balance between technology and human interaction is crucial to creating a compelling and equitable learning environment. It is time to introduce learning about artificial intelligence, programming, and digital skills into the school curriculum to prepare students for future labor market demands. AI must be programmed and used to respect the fundamental principle of equality before the law and not to favor or disadvantage certain groups of people.

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How is AI Transforming Education?
A Research Study on Pre-University Teachers

CLAUDIA OPRESCU, ROXANA MARCU

Abstract

Artificial intelligence in the educational system is a subject of genuine interest in transforming the educational system in Romania. These digital tools and teachers bring many challenges that do not yet have a framework to help them explore this new universe of learning. AI offers many opportunities, such as automating tasks and providing students with a personalized digital experience. However, teachers must have a unified approach, as some are more open to change, while others do not want to change their teaching methods. This article explores the opportunities and challenges brought by integrating AI into education, an influential tool teachers must be prepared for. This chapter provides a comprehensive overview of how pre-university teachers in Romania understand AI tools, how they have integrated this learning method into their school curriculum, and their needs in this direction. There are many opportunities; the future is here, and for the Romanian education system, it can be an opportunity for reform. The education sector needs to be proactive in preparing teachers to use AI in education.

Introduction

Artificial intelligence (AI) is transforming society as we know it. Education is no exception, as AI is emerging as a pivotal instrument in the educational sector. Artificial intelligence, a transformative technology revolutionizing the world, is also driving innovation in education, enabling customized learning experiences, automating teacher tasks, and facilitating content creation (Chen et al., 2022). While the constant evolution of technology continues to reshape classroom instruction, the human aspect of teaching remains the most important, with teachers a central role in fostering effective learning. They are responsible for shaping the minds and futures of their students, guiding them through the learning process and emotional development.

Pre-university teachers can play a vital role in implementing AI in education, not only because they can use AI tools and resources in their classrooms. It supports their students in learning how to use AI effectively, but also because they can guide their fellow educators in implementing effective teaching strategies and fostering continuous professional growth (Ghamrawi, Shal, & Ghamrawi, 2023). Nonetheless, our understanding of how pre-university educators employ AI in their teaching environments and the associated challenges and prospects they encounter remains limited. However, being aware of teachers' challenges when using AI in the classroom is essential. Teachers need to be supported in developing skills in using AI and ensuring that AI is used in a way that benefits students and themselves in their professional development.

This chapter investigates the challenges and opportunities of integrating AI into pre-university education. This

study employed a data collection approach to integrate a deeper understanding of the perceptions surrounding artificial intelligence (AI) in education, drawing insights from individuals representing three pre-university teachers. The study employed semi-structured interviews to present perceptions of artificial intelligence (AI) in education and obtain more detailed information.

Literature review

The emergence and influence of artificial intelligence (AI) in various domains, especially education, have gained considerable attention in recent literature. McCarthy (2007) defines AI as the endeavor to create machines that would be considered intelligent if they were humans. This definition has been expanded upon by the Council of Europe (Holmes et al., 2021), which characterizes AI as a discipline aiming to replicate human cognitive functions, enabling machines to undertake intricate assignments that were traditionally reserved for humans. Similarly, UNICEF (2021) describes AI as machine-based systems programmed with specific objectives that can influence both tangible and virtual settings, often operating autonomously and capable of adaptive learning.

The term "artificial intelligence (AI)" was first introduced by John McCarthy during the 1956 Dartmouth Artificial Intelligence Conference. Esteemed scholars from various fields gathered to discuss subjects like content abstraction from sensory data, the interplay between randomness and creative thought, and further discussions that shaped the idea of "thinking machines." Many attendees pondered the potential of computers emulating human-like intelligence, with the central query being the timing and methodology of such a

transformation. Today, the growth and reach of artificial intelligence are unparalleled, touching almost every corner of the globe (Tegmark, 2015). Its influence on daily life continues to magnify. As more individuals embrace AI and machine learning, its incorporation into diverse gadgets, applications, and services escalate.

The educational sphere has been a significant beneficiary of the AI revolution. Xia, Chiu, and Ho (2022) affirm that AI can potentially transform various educational segments, including learning processes, teaching methodologies, assessment procedures, and overall administrative tasks. Bates, Cobo, Mariño, and Wheeler (2020) further emphasize AI's capability to furnish students with adaptive learning experiences tailored to their distinct requirements.

Chen et al. (2020) highlight educational institutions' escalating adoption of AI tools to augment diverse teaching and learning components. Hwang et al. (2020) observe that AI mechanisms interpret student data to cater to their particular academic needs and emphasize the role of AI in individualized learning. Moreover, Fidan and Gencel (2022) note the application of AI in heightening student involvement through innovative mediums like gamification and interactive chatbots.

From an administrative perspective, AI's influence is palpable. Johnson et al. (2021) remark on AI's utility in tasks ranging from scheduling to grading. Robinson (2019), who emphasizes the significance of predictive analytics in identifying and assisting academically at-risk students, supports this idea. Bertolin and Da Rin (2020) shed light on the growing dependence on AI-driven chatbots for instantaneous institutional communication, while Gonzalez and Guzman (2020) identify the rise of voice-activated virtual assistants in administrative activities.

However, this rapid AI integration is not without its challenges. Recent literature indicates limited studies focusing on AI education (Chai et al., 2020a, 2020b; Lee et al., 2020). Micheuz (2020) delineates the cognitive and educational obstacles associated with understanding AI, with Nisheva Pavlova (2021) critiquing the thematic limitations in many AI teaching methodologies. Zhai et al. (2021) call for an interdisciplinary approach, urging collaboration between educators and AI experts to bridge the gap between technology and pedagogical practices effectively.

In conclusion, while AI's influence in the realm of education is undeniable and multifaceted, there remains a need for comprehensive research and collaboration to optimize its integration and address potential challenges.

Challenges and opportunities of artificial intelligence in pre-university education

This study is based on qualitative research aimed at pre-university teachers. To ensure the quality of the information obtained from the interviews, we used pre-university teachers with more than ten years of experience in education in Romania as the main criteria for selecting respondents that would form the basis of the research. The three teachers interviewed teach civic culture, mathematics, and the Romanian language in class and are part of the middle school study cycle. They teach in Bucharest and its surroundings.

The objectives of this study are to identify the opinion of teachers regarding AI, if they have integrated AI into the classes, their interest in exploring these tools, and how prepared they feel for the changes that will lead to the transformation of the educational system in Romania.

A significant point of the interviews was determining the teachers' interest in understanding and using AI tools at school. The interviews revealed that AI is a concept familiar to teachers but has not been applied to classes. They learned about AI from other colleagues or conferences dedicated to education. Even though teachers do not use AI in the classroom, their students use these tools to do their homework, as confirmed in I-1: "My students know about the existence of AI. They told me that they had done some homework in biology and Romanian. Another example is that in the summer, I participated in a competition, and for the theoretical test, a student used artificial intelligence to search for some things about children's rights that were not well covered in school books."

However, teachers believe that students need guidance to use these tools constructively as I-2 identified, "I believe that if used correctly if children are educated how to use AI, they develop critical thinking, make learning more enjoyable, being linked to technology and digitization." There is, of course, curiosity among the teachers as I-3 said, "I only tested it for personal purposes and out of curiosity. However, the level of the responses seemed to me to be at a low level and without very much argued information. I believe the weakest point is that it cannot give you the links from which it sent you the information. However, I think it can be a helpful tool, complementary to other educational elements. AI in teaching can be used to stimulate student learning and improve their instruction at school. It offers ideas, arguments, different perspectives for a topic, clarifies concepts, provides explanations." Of course, just like any change, it also brings challenges among teachers.

Artificial intelligence has been an essential subject in the academic area, and now the tools are suitable for

secondary school. As we can identify from the teachers' answers, there is a reluctance to use these tools without training that prepares them in the field. Teachers need predictability, and a framework that clearly explains how to use these tools and how to rethink their lessons, as confirmed by two of the teachers interviewed. Understandably, teachers need this, especially since we are discussing new, innovative elements that require additional explanations and a course with an expert to help them constructively understand and use AI. The new AI tools are promising, and they can be implemented in the near future to improve education.

AI influences pre-university teachers in many ways, and they need to find ways to integrate AI into their lessons. At the same time, children are curious and feel the need for interactive, digital courses that allow them to become more engaged in learning (Haleem et al., 2022). Integrating AI into classrooms is a natural need that comes from the evolution of learning systems and methods. There is no clear policy on using AI in schools, so some teachers use it at their discretion, based on their personal experiences, as I-1 mentioned.

In general, pre-university teachers have a positive attitude toward integrating AI into education, but of course, some teachers are afraid that they will be replaced by artificial intelligence (Koehler & Mishra, 2009). However, it is important to consider the limitations of AI before making any predictions about the future of education. It can be used to automate tasks, such as grading papers and providing student feedback. AI can be a valuable tool for teachers to spend more time with their students and help them to develop. Overall, AI has the potential to revolutionize education but cannot replace the human element of teaching. Children need human support to

thrive, and teachers are some of the most influential mentors in their lives. They help them to develop and understand their emotions and how to interact with others. Teachers are the key to a balanced use of AI tools in the classroom. Without guidance and a framework, students can use them in a way that does not provide healthy development, as I-3 concluded.

Of course, the innovation brought by AI also brings anxiety (fear of the new technology, lack of control) for teachers, which is one of the main reasons behind their reluctance to try new things in the classroom. One of the reasons behind the anxiety associated with AI is also related to how AI has been promoted in the media, such as science fiction movies that promoted negative behaviors related to AI (Johnson & Verdicchio, 2017). And anxiety has been linked with the use of technology before the development of AI, being frequent among the population (Wang & Wang, 2019). Another critical reason to highlight is related to the comfort zone. Sometimes, teachers prefer to use unfamiliar materials that do not pose challenges (Herbert, Jenson, & Terzopoulos, 2021). Familiar materials provide a sense of predictability and control; teachers know how the materials work and how students respond to them. This predictability can reduce anxiety and make teaching feel more manageable. This sense of predictability can be brought about by organizing events for teachers that provide a framework for networking and paradigm shift (I-2). It is necessary to invest in teachers, as society is changing rapidly, and the reform of the educational system should focus on the development of the teacher. AI is a new and constantly evolving tool, which makes it unpredictable.

As for the positive effects identified by researchers, we can mention better learning outcomes, increased

student understanding, and easier access to information for students (Lin et al., 2021). AI has the potential to accelerate and improve student learning when integrated with quality teaching and learning resources. For teachers, the opportunities are linked with identifying student difficulties and potential challenges. Among teachers, there is curiosity, but the lack of time and a structured framework to explain the functionality of AI tools are the main attributes that have stood at the basis of the absence of integration of AI into the taught classes, as mentioned by I-1 and I-3.

At the same time, it is important to mention that it is necessary for schools to allocate a budget dedicated to these innovative actions and to cover the cost of using these tools. Currently, many schools do not have the necessary resources to integrate and maintain technology in the classroom, and solutions must be found, such as creating partnerships with other organizations. To overcome these mental barriers teachers have, some training courses are needed that go in two directions: 1. To teach teachers to use AI in classes through concrete examples and the sharing of best practices. 2. Discuss with teachers how they can inspire students to use AI tools to better prepare for school.

To ensure successful integration, a strategic partner is needed to help with the implementation and, of course, patience and allocating the time necessary for teachers to adapt to the new context. It is required to consider that teachers need to get used to this new way of working, and the adaptation time for each differs depending on experience, personality, and capacity for innovation. Emotions can be diverse among teachers: from excitement and the desire to personalize the students' experience to the fear that students can use AI in an unethical way, this

brings concerns among teachers. For example, a study revealed that using ChatGPT-3 among journalism faculty students positively affected their writing skills and critical thinking. These skills are also needed among students in primary school (Irfan, Murray, & Ali, 2023).

Conclusions

Teachers need to continue to learn, grow, and adapt, and then amazing things happen when they join forces and build together. As we look towards the future, new challenges will come, but we should be confident that teachers will find a way to integrate AI effectively in the classrooms. Teachers should use AI as a useful tool to facilitate access to education and increase interactivity among students (Kumar, 2023). AI tools can provide real-time feedback to students and can also be used to automate tasks such as proofreading. In this way, teachers can have more time for other activities to improve the students' class activity (Seo et al., 2021). Change comes from within, and we believe that is true. Teachers should be committed to providing the necessary resources and tools for students to grow, learn, and reach their full potential. They need to keep questioning the status quo and develop a growing mindset and skillset that will enable them to cope with and shape the infinite transformation of our future societies. The presence of individuals who possess self-assurance, knowledge, and good health is crucial for the development and stability of a robust societal framework. Through access to quality education, they contribute to a world where everyone can prosper and use their expertise and resources to reduce inequality. Of course, it is essential to use AI responsibly and ethically and to ensure that it is used to support human teachers. Artificial intelligence

(AI) in education encompasses various aspects, including transparency, realism in resource allocation, knowledge dissemination, and maintaining a balanced approach.

They are embarking on a journey that will allow them to remain relevant to their students, colleagues, and the communities they operate in in these changing times while also maintaining their core purpose. But they cannot realize their ambition without one core item: **confidence**. Thus, they engage in many activities and pursuits to benefit themselves, their students, and future generations. Students need to feel independent and knowledgeable to live a life supported by a proper education. They need to know that their knowledge will give them access to a sustainable, financially secure life—now as well as in the future.

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Exploring the Synergy of AI in Education, Managerial Strategies, and Organizational Performance: A Literature Review

Victor-Emanuel Ciuciuc, Mădălina Elena Stratone

Abstract

The objective of the present chapter is to scrutinize the intricate interplay between artificial intelligence (AI) and the realm of education, managerial strategies, and organizational performance. This investigation is dedicated to unearthing the conceivable advantages and profound alterations that the infusion of AI can bring about within educational and organizational settings. The empirical findings stress the affirmative influence wielded by AI on decision-making processes, organizational performance metrics, individual productivity, and the overarching organizational ethos. On top of this, the study elucidates the pivotal role of AI in augmenting educational excellence and the sophistication of knowledge management systems, thereby illuminating its indispensable contribution to the overall prosperity of an organization. The transformative potential of AI on the educational landscape, especially its capacity to elevate the standard of education, is singularised. The study elucidates the interrelatedness of AI and knowledge management, showcasing its potential to enhance knowledge management systems and organizational performance. In addition to the previous, the article endeavors to cast light on the affirmative influence of AI on organizational performance, education, and knowledge management to foster a more

profound comprehension of the prospective synergies that can be harnessed for future applications. This chapter contributes to the enlightenment regarding the substantial role played by AI in the domains of education and organizational performance. By amalgamating insights derived from diverse research endeavors, it aspires to furnish a comprehensive overview of the potential synergies and transformative influences arising from the integration of AI within educational and organizational contexts.

Introduction

Integrating artificial intelligence (AI) in education, managerial strategies, and organizational performance has become a focal point of interest in contemporary research and practice. As AI technologies continue to permeate various sectors, including education and organizational management, there is a growing need to explore their integration's potential synergies and transformative effects comprehensively. This literature review aims to delve into the symbiotic relationship between AI in education, managerial strategies, and organizational performance, shedding light on their relationship and the implications for future applications.

The significance of AI in decision-making processes, organizational performance, individual productivity, and organizational culture cannot be overstated (Chen et al., 2020). Therefore, the role of AI in enhancing educational quality and knowledge management systems has been a subject of increasing interest, with studies highlighting its vital contribution to overall organizational success (Zawacki-Richter et al., 2019). The transformative effects of AI on the educational landscape, particularly in enhancing overall educational quality, have been dwelled

on in recent research (Song et al., 2022). Additionally, the interconnectedness of AI and knowledge management has been demonstrated, showcasing the potential to enhance knowledge management systems and enterprise performance (Xu & Ouyang, 2022).

In addition to its impact on education, AI plays a crucial role in managerial strategies, particularly in driving effective performance by providing real-time data on employee performance (Ribeiro et al., 2023). The utilization of AI for decision-making processes and its comparative assessment in different educational contexts have also been subjects of scholarly inquiry (Rienties et al., 2020). In addition, AI's positive influence on organizational performance has been well-documented, with case studies demonstrating its transformative effects on organizational success (Wu et al., 2021).

Background and significance of AI in education

The exploration of artificial intelligence (AI) within the sphere of education marks a significant epoch in the evolution of teaching and learning methodologies. AI's integration into educational settings is an additive change and a transformative force that redefines the pedagogical landscape (Bozkurt et al., 2021). As educators and institutions increasingly recognize the profound implications of this technology, the shift towards AI-enhanced educational models has accelerated, signifying a paradigm shift from traditional learning paradigms to more dynamic, personalized, and efficient systems (Sapci & Sapci, 2020). This transition is further empowered by AI's potential to improve student learning outcomes significantly, offer tailored learning experiences, and augment the quality and accessibility of education globally.

The role of AI in education extends beyond mere academic assistance; it represents a critical tool for innovation and a catalyst for educational reform (Zawacki-Richter et al., 2019). The commitment to incorporating AI in educational strategies is evident from the increasing involvement of educators and practitioners in the iterative process of development, validation, and implementation of AI technologies (Charow et al., 2021). This collaborative approach ensures that AI tools are technologically advanced, pedagogically relevant, and ethically grounded.

Substantial advancements in educational data mining and learning analytics are further evidence of the progressive fusion of AI in educational practices. These AI-driven fields offer unprecedented insights into learning behaviors, enabling the creation of more effective and responsive teaching strategies (Bozkurt et al., 2021). The burgeoning interest in the synergy of "AI + Education" across various global regions emphasizes the universal acknowledgment of AI's role in sculpting the educational future (Zhao et al., 2022). As we stand on the cusp of a new era dominated by AI, the imperative for education systems to adapt and prepare learners with the requisite knowledge and skills has never been more critical (Yu & Yu, 2023).

In addition to its impact on higher education and academic research, AI's influence permeates all levels of education, including K-12 settings where fostering AI literacy from an early age is increasingly recognized as vital for future readiness (Di et al., 2021; Touretzky et al., 2019). Besides this, the integration of AI in the healthcare sector exemplifies its versatile applications, where it is used to not only enhance the learning experiences of medical professionals but also to prepare them for a future where AI-enabled technologies are ubiquitous in healthcare practices (Song et al., 2022).

Despite these advancements and the growing embracement of AI in educational contexts, significant gaps remain in the understanding and practical application of AI among educators. This highlights an ongoing need for comprehensive research, training, and policy formulation to ensure that the potential of AI in education is fully realized and accessible to all (Ryan et al., 2021). The burgeoning literature on AI's application in educational settings, characterized by an increasing number of scholarly articles and studies, reflects a growing consensus on the importance of AI as a cornerstone of modern educational processes (Wu et al., 2021; Latham & Goltz, 2019).

In summary, the burgeoning significance of AI in education is undeniable, offering revolutionary prospects for teaching and learning. Its impact transcends traditional education boundaries, promising enhanced personalization, efficiency, and accessibility in learning. As we delve deeper into this AI-augmented educational era, it is crucial that stakeholders from various sectors collaborate to steer this technological advancement in a direction that maximizes its benefits, addresses its challenges, and ensures ethical, equitable, and inclusive education for all. The journey of integrating AI into education is complex and multifaceted, requiring continuous research, ethical consideration, and adaptive policy frameworks to ensure that its full potential is realized for the betterment of educational systems worldwide.

The role of AI in educational quality and knowledge management

Artificial intelligence (AI) has emerged as a transformative force in shaping educational quality and knowledge

management systems. Integrating AI in education presents many opportunities to enhance learning experiences, personalize education, and optimize knowledge management processes. The role of AI in educational quality is brought out by its potential to revolutionize teaching and learning practices, providing adaptive and personalized learning experiences for students (Song et al., 2022). In addition, AI can support knowledge workers and build their learning and knowledge management activities, thereby enhancing the efficiency and effectiveness of knowledge management systems ("The efficiency-powering partnership of knowledge workers and AI," 2023; Sundaresan & Zhang, 2021).

AI's role in educational quality is also evident in its potential to foster a deeper understanding of complex concepts and facilitate experiential learning, thereby enhancing students' learning outcomes (Luckin & Cukurova, 2019). In other respects, AI has the potential to play a pivotal role in K-12 education, where it can significantly impact students' learning progress, interest in AI, and satisfaction with educational courses (Song et al., 2022). The application of AI in academic quality is further exemplified by its ability to evaluate online teaching quality and support the delivery of better educational services (Li & Su, 2020).

In addition to impacting educational quality, AI plays a crucial role in knowledge management systems, transforming knowledge workers' roles and processes in knowledge sharing and learning (Sundaresan & Zhang, 2021). Integrating AI in knowledge management activities can optimize knowledge-sharing processes, enhance learning, and provide tailored AI-enabled knowledge management systems for modern knowledge worker environments (Sundaresan & Zhang, 2021). Additionally, AI's role in knowledge management is evident in its ability

to support and challenge learners through pedagogical agents, address ethical issues, and design educational technologies in the age of AI (Richards & Dignum, 2019).

Accordingly, AI's role in educational quality and knowledge management is multifaceted, encompassing its potential to enhance learning experiences, support knowledge workers, and optimize knowledge management processes. The subsequent sections of this literature review will delve into specific case studies and examples that highlight the transformative effects of AI in educational quality and knowledge management. AI's integration into the educational sector is not a mere technological upgrade but a pivotal shift towards a more innovative, efficient, and effective education system. This shift is evidenced by the widespread adoption of AI technologies in various educational settings, from personalized learning pathways to intelligent tutoring systems and beyond. These AI-driven innovations are reshaping how content is delivered and consumed and how knowledge is constructed, managed, and transferred among learners and educators.

The personalization aspect of AI in education is particularly noteworthy. By harnessing data analytics and adaptive learning algorithms, AI systems can provide individualized learning experiences that adjust to each student's unique needs, preferences, and pace. This level of personalization is instrumental in accommodating diverse learning styles, thereby enhancing student engagement and achievement (Chen et al., 2020). AI's capability to analyze vast amounts of data also allows for the early identification of learning gaps and the provision of timely interventions, further bolstering educational quality.

Withal, the role of AI in knowledge management extends to curating and recommending learning resources, facilitating collaborative learning environments, and

enhancing decision-making processes within educational institutions. By analyzing patterns in data, AI can recommend relevant and context-specific resources to learners, thus enriching their knowledge base and learning experience. Also, AI-powered collaborative platforms enable learners and educators to share insights and resources effectively, fostering a more connected and informed educational community.

However, while the benefits of AI in education and knowledge management are manifold, it is imperative to address the challenges and ethical considerations associated with its use. Issues such as data privacy, algorithmic bias, and the digital divide must be thoughtfully considered to ensure that the implementation of AI technologies is responsible, equitable, and inclusive. As we continue to explore the role of AI in education, researchers, practitioners, and policymakers must collaborate to leverage the strengths of AI while mitigating its potential drawbacks.

Ultimately, the role of AI in enhancing educational quality and knowledge management is both profound and extensive. As AI continues to evolve and permeate various aspects of education, it promises to transform the educational landscape into one that is more personalized, engaging, and effective. By continuing to explore and understand the capabilities and implications of AI in education, we can harness its potential to create a future where learning is optimized for every individual and knowledge is managed in the most effective and efficient ways possible. This review will continue to explore specific case studies, ethical considerations, and future directions in the scope of AI's role in education and knowledge management, shedding light on the exciting possibilities and challenges ahead.

The positive impact of AI on educational quality

The positive impact of artificial intelligence (AI) on educational quality has been a subject of significant interest and research. Chen et al. (2020) and Chiu et al. (2022) have highlighted the transformative potential of AI in education, particularly in revolutionizing teaching and learning practices providing adaptive and personalized learning experiences for students. Their study emphasizes the role of AI in fostering a deeper understanding of complex concepts and facilitating experiential learning, thereby contributing to enhancing students' learning outcomes. Similarly, these researchers have insisted on the significant learning progress and increased satisfaction towards AI education among learners, indicating the positive impact of AI on knowledge comprehension and student engagement.

To boot, integrating AI into educational quality has been shown to support knowledge workers and enhance knowledge management activities, thereby optimizing knowledge-sharing processes and learning experiences. Sundaresan and Zhang (2021) argued that AI significantly impacts the management of customer relationships, highlighting its potential to transform knowledge workers' roles and processes in knowledge sharing and learning. These findings collectively accord emphasis to the positive impact of AI on educational quality, knowledge management, and student learning experiences.

The application of AI in education extends beyond adaptive learning systems to encompass intelligent tutoring systems, virtual reality simulations, and data-driven interventions, collectively working towards enhancing the quality of education. For instance, intelligent tutoring systems utilize AI to provide immediate feedback,

identify learning gaps, and offer customized instruction tailored to each student's learning pace and style. This level of personalization is crucial in cultivating a learning environment that acknowledges and addresses individual differences, thereby fostering a more inclusive and effective educational experience (Lallé et al., 2021; Luckin & Cukurova, 2019).

Otherwise, AI's role in enhancing educational quality is evident through its ability to facilitate collaborative learning and peer interaction. By integrating AI-powered tools and platforms, students can engage in interactive discussions, participate in group projects, and access various resources that enrich their learning journey. This not only enhances knowledge comprehension but also promotes critical thinking, creativity, and problem-solving skills among learners (Han & Ellis, 2021; Pinandito et al., 2021).

The positive impact of AI on educational quality is also reflected in the substantial improvements in administrative and instructional efficiency. AI algorithms can automate routine tasks, manage educational resources, and streamline administrative processes, allowing educators to focus more on teaching and less on administrative duties. This shift towards AI-enhanced operations translates into a more efficient and productive educational ecosystem, where resources are optimized and educators are empowered to deliver better educational services (Ouyang et al., 2023; Jiao et al., 2022).

Despite the promising advancements brought about by AI in education, it is imperative to acknowledge the challenges and ethical considerations involved in its application. Data privacy, algorithmic transparency, and equitable access to AI technologies must be addressed to ensure that the benefits of AI are realized ethically

and responsibly. As we continue to explore the positive impact of AI on educational quality, ongoing dialogue, research, and policy development are crucial to navigate the complexities and maximize the potential of AI in enriching educational experiences for all learners (Ali et al., 2021; Chang et al., 2017).

Put it in other words, the studies by Chen et al. (2020) and Chiu et al. (2022) provide compelling evidence of the positive impact of AI on educational quality, knowledge management, and student learning experiences. These findings contribute to a deeper understanding of the transformative potential of AI in education and its implications for enhancing educational practices. The advent of AI in academic spheres of activity has ushered in an era of unprecedented change, marked by the enhanced capability to tailor learning experiences to individual needs and preferences. Implementing AI-driven tools and methods in education has been instrumental in breaking down complex concepts into digestible, interactive modules, thereby simplifying the learning process and making education more accessible to a diverse range of learners.

All in all, the positive impact of AI on educational quality is multifaceted and far-reaching, offering significant benefits in terms of personalized learning, administrative efficiency, and enhanced learning outcomes. The studies by Chen et al. (2020) and Chiu et al. (2022), along with others in the field, provide a robust foundation for understanding the transformative role of AI in education. As we continue to harness the power of AI, it is essential to do so with a commitment to ethical principles, inclusivity, and continuous improvement to ensure that the future of education is shaped by the best that AI has to offer.

Integration of AI in knowledge management systems

Integrating artificial intelligence (AI) in knowledge management systems has revolutionized how organizations capture, store, and disseminate knowledge. Bencsik (2021) emphasizes the critical role of AI in knowledge management, particularly in streamlining knowledge-sharing processes and transforming knowledge workers' roles and processes in knowledge-sharing and learning. The study recommends tailored AI-enabled knowledge management systems for modern knowledge worker environments. Similarly, Yildirim-Erbasli (2023) advocates for integrating AI into knowledge management, highlighting the potential for AI to enhance self-regulated learning and learning analytics. The study addresses ethical considerations, challenges, and the need for interdisciplinary collaboration among educators, data scientists, and policymakers.

Further, Chatterjee et al. (2020) identify critical success factors for AI-integrated customer relationship management (CRM) systems to improve knowledge management in organizations and enhance business processes. The study highlights numerous factors critical for adopting AI-integrated CRM systems for efficient knowledge management. In addition, Delen et al. (2013) conducted a comparative analysis of machine learning systems for measuring the impact of knowledge management practices, shedding light on the potential of AI in evaluating and enhancing knowledge management initiatives.

On the other hand, Nemati et al. (2002) present the concept of a knowledge warehouse as an architectural integration of knowledge management, decision support, artificial intelligence, and data warehousing. The study emphasizes the practice of adding actionable value to

information by capturing tacit knowledge and converting it to explicit knowledge, thereby highlighting the potential of AI in knowledge management (Sundaresan & Zhang, 2021). Sundaresan & Zhang (2021) develop a framework for analyzing AI's role in different knowledge management activities, exploring the impact of AI in transforming knowledge workers' roles and processes in knowledge sharing and learning and presenting recommendations for tailored AI-enabled knowledge management systems for modern knowledge worker environments.

The critical role of AI in knowledge management is manifold. Firstly, AI facilitates the efficient capture and storage of knowledge. Through natural language processing and machine learning, AI systems can process vast amounts of unstructured data, extract relevant information, and organize it in a manner that is easily accessible and understandable. This not only saves time and resources but also ensures that valuable knowledge is preserved and utilized effectively.

Secondly, AI enhances knowledge dissemination and sharing. By personalizing content delivery and recommending relevant resources, AI enables knowledge workers to access the information they need when they need it. This tailored knowledge-sharing approach fosters a culture of continuous learning and collaboration, driving innovation and improvement across the organization.

Still more, the integration of AI in knowledge management extends to the branch of decision support. AI-powered analytics provide insights and foresight by processing complex data sets and identifying patterns and trends. This enables decision-makers to make informed, data-driven decisions, thereby improving the organization's overall strategic direction and performance.

In addition to these benefits, integrating AI into knowledge management also presents specific challenges and ethical considerations. Data privacy, algorithmic bias, and the digital divide must be addressed to ensure that AI is used responsibly and equitably. On the flipside, as AI continues to evolve, there is a growing need for interdisciplinary collaboration among various stakeholders to explore innovative applications of AI in knowledge management and address emerging challenges.

Definitivly, the integration of AI in knowledge management systems has been a pivotal subject of extensive research, marking a new era of efficiency and innovation in handling knowledge resources. Studies bring out the transformative potential of AI in streamlining knowledge-sharing processes, enhancing self-regulated learning, and evaluating knowledge management practices, thereby revolutionizing organizational knowledge practices. The advent of AI has enabled organizations to automate and optimize various knowledge-related processes, enhancing productivity and decision-making capabilities. Besides, the integration offers numerous benefits, including improved efficiency, enhanced decision-making, and personalized knowledge sharing. The research conducted by Bencsik (2021), Yildirim-Erbasli (2023), and others provides a solid foundation for understanding the transformative impact of AI on knowledge management practices. As we continue to explore and innovate in this field, it is crucial to consider both AI's potential and challenges in knowledge management to harness its full potential for organizational growth and development. These findings collectively highlight the critical role of AI in knowledge management, emphasizing its significant contribution to organizational success.

Case studies highlighting the transformative effects of AI in education

The transformative effects of artificial intelligence (AI) in education have been the subject of extensive research and case studies. Sapci & Sapci (2020) present a case study on the application of AI in medical education and tools for medical and health informatics students, highlighting the positive impact of AI on enhancing learning experiences. The study emphasizes using AI-enabled technologies to improve patient care, provide real-time data analytics, and enable continuous patient monitoring. Similarly, Kim and Shim (2022) focus on developing an augmented reality-based AI education app for non-majors, demonstrating the transformative effects of AI in engaging students and enhancing their learning experiences. The study showcases the potential of AI to simplify complex biological phenomena and connect biological processes with adaptive question-answering capabilities, thereby enriching the learning environment. Besides, Koc-Januchta et al. (2020) investigate the engagement with biology by asking questions, demonstrating the transformative effects of an AI-enriched textbook on students' interaction and learning. The study highlights the potential of AI to simplify complex and abstract biological phenomena, thereby enhancing students' learning experiences.

In parallel, Nemati et al. (2002) propose a knowledge warehouse as an architectural integration of knowledge management, decision support, artificial intelligence, and data warehousing, showcasing the transformative potential of AI in knowledge management. The study suggests a different direction for decision support systems in the next decade, emphasizing the potential of AI to revolutionize knowledge management practices.

In addition, Chatterjee et al. (2020) identify critical success factors for AI-integrated customer relationship management (CRM) systems to improve knowledge management in organizations and enhance business processes. The study points out the numerous factors critical for adopting AI-integrated CRM systems for efficient knowledge management. Similarly, Sundaresan & Zhang (2021) develop a framework for analyzing AI's role in different knowledge management activities, exploring the impact of AI in transforming knowledge workers' roles and processes in knowledge sharing and learning and presenting recommendations for tailored AI-enabled knowledge management systems for modern knowledge worker environments.

The individual case studies provide a nuanced understanding of how AI can be applied in different educational settings to achieve specific outcomes. For instance, the application of AI in medical education, as presented by Sapci & Sapci (2020), illustrates how AI can improve the efficiency of healthcare training, enable sophisticated simulations, and enhance the understanding of complex medical data. This not only improves the quality of education for medical students but also has the potential to impact patient care positively.

On the other hand, the development of an augmented reality-based AI education app, as discussed by Kim and Shim (2022), provides an example of how AI can make learning more interactive and engaging, particularly for subjects that benefit from visualization and immersive experiences. Such applications of AI in education open up new avenues for experiential learning and can significantly enhance students' understanding and retention of complex subjects.

Thereupon, the adoption of AI-enriched textbooks and resources, as explored by Koc-Januchta et al. (2020), demonstrates AI's role in making learning more personalized and adaptive. By incorporating AI into educational materials, educators can provide students with customized content that suits their learning pace and style, optimizing each individual's learning experience.

All considered, the collective insights from case studies and research findings point to the transformative effects of AI in education and knowledge management. These studies provide compelling evidence of AI's capacity to innovate and transform educational environments across various disciplines and contexts, highlighting its potential to enhance learning experiences, engage students, and revolutionize knowledge management practices. The diverse ways AI can be leveraged to improve educational quality and streamline knowledge management processes illustrate AI's practical applications and benefits in education. As the field of AI continues to evolve, it is anticipated that even more innovative applications will emerge, further transforming the educational landscape and opening up new possibilities for learners and educators alike. Therefore, it is crucial for ongoing research and collaboration among educators, technologists, and policymakers to continue exploring these possibilities and addressing the challenges associated with integrating AI into education and knowledge management systems, thereby contributing to a deeper understanding of the positive impact of AI in enriching educational experiences for all learners.

Innovating learning: how AI transforms educational management – a case study review

Artificial Intelligence (AI) is increasingly becoming a pivotal force in reshaping the landscape of educational management. This transformative technology brings forth a myriad of opportunities that enhance learning experiences, streamline administrative processes, and introduce innovative pedagogical strategies. However, these opportunities are not devoid of challenges, as they present new ethical considerations, demand changes in policy, and necessitate an ongoing dialogue about the role of technology in managerial education (Igbokwe et al., 2023; Kamalov et al., 2023; Maia et al., 2023; Moroianu et al., 2023).

Kamalov, Santandreu Calonge, and Gurrib's (2023) seminal work spotlight the revolutionary impact of AI on personalized learning, teacher-student collaboration, and the automation of administrative tasks. It brings to light the enhanced efficiency and learning outcomes AI provides, alongside cautioning against the potential ethical pitfalls, such as data privacy and algorithmic bias. This work sets the stage for understanding both the immense potential and the critical considerations of integrating AI into educational settings (Kamalov et al., 2023).

In terms of applications, the paper discusses how AI facilitates a range of innovative educational practices. Personalized learning, for instance, has been revolutionized by AI's ability to tailor educational content and pedagogical approaches to individual student needs. This personalization is not limited to academic content alone but extends to adaptively managing the pace and style of learning. Teacher-student collaboration is also enhanced through AI tools that provide real-time insights into stu-

dent performance, aiding teachers in delivering more effective and targeted instruction. Thereby, the automation of assessment tasks through AI reduces the administrative burden on educators, allowing for more efficient grading of assignments and tests and offering quick feedback to students. Intelligent Tutoring Systems (ITS), which simulate one-on-one interaction between students and tutors, have been significantly improved with AI, making high-quality, personalized education more accessible.

The advantages of AI in education are manifold. The study highlights improved learning outcomes as AI's personalized and adaptive learning models can cater to diverse learning styles, potentially leading to higher engagement and better understanding of the subject matter. Time and cost efficiency are other significant benefits. AI automates many time-consuming tasks, such as grading and lesson planning, freeing educators to focus on direct instruction and student support. Then, AI facilitates global access to quality education by providing scalable learning solutions that can reach students in remote or underserved regions, thus democratizing access to educational resources.

Despite these significant benefits, the article doesn't shy away from discussing the potential downsides and ethical implications of integrating AI in educational settings. Data privacy and security are important concerns, as personalized learning systems rely heavily on student data. The risk of bias and discrimination in AI algorithms, if not addressed, can lead to unfair or prejudiced educational outcomes. The paper also discusses the fear of diminishing human touch in education, as increasing reliance on AI might alter traditional teacher-student dynamics.

Moroianu, Iacob, and Constantin (2023) further build upon this narrative by highlighting the significant enhance-

ment of student understanding and the importance of AI in creating tailored learning experiences. Their systematic review emphasizes the necessity of a continuous and comprehensive research effort to fully understand and harness AI's capabilities across different educational levels and settings (Moroianu et al., 2023).

The study also discusses the methodological approach of a systematic review, adhering to PRISMA guidelines, and details the comprehensive process of identifying relevant literature. It categorizes the identified documents into empirical, proposal and prototype, and theoretical papers, each contributing different insights into the integration of AI in education. The findings from these papers suggest a strong presence of research on AI in education in countries like the United States, Taiwan, Japan, China, Singapore, the UK, Sweden, and Italy. These countries have been active in both systematic reviews and conceptual papers within the sphere of AI in education.

The study reveals a considerable focus on the beneficial functions of AI in essential educational areas like learning, teaching, assessment, and administration. It highlights the positive impact of AI tools in improving students' learning outcomes, supporting teachers' professional development, and enhancing the overall performance of educational units. However, it also throws into relief the importance of addressing the risks and potential biases associated with AI tools. It emphasizes the need for vigilance and critical assessment in their application. The study concludes that AI technologies in education are rapidly evolving and calls for further research to assess their integration at all educational levels.

In his exploration of AI in educational management, Igbokwe (2023) provides an in-depth look into the various applications of AI that are revolutionizing the field. From

personalizing learning to automating routine tasks, AI is a powerful tool for improving educational outcomes and operational efficiency. However, Igbokwe also highlights the need for a balanced and ethical approach to AI deployment, ensuring that technological advancements do not overshadow the human aspects of education or exacerbate existing inequalities (Igbokwe, 2023).

The research sheds light on the multifaceted applications of AI in educational management. One of the critical areas is the personalization of learning. By analyzing student data, AI systems can tailor learning experiences to individual needs, fostering greater engagement, motivation, and improved learning outcomes. In addition to this, AI has significantly enhanced tutoring systems. It does so by providing personalized and adaptive feedback, which promotes mastery learning and boosts learners' motivation. AI's impact extends beyond the classroom to administrative tasks as well. Routine tasks such as grading, scheduling, and record-keeping are now being automated by AI, freeing educators to focus more on impactful work that directly contributes to student learning and development. Lastly, AI plays a pivotal role in enhancing learning outcomes. Its ability to provide personalized feedback and analyze large amounts of data paves the way for improved student performance and targeted interventions. This comprehensive approach to education management underlines the transformative potential of AI in the educational landscape.

Nevertheless, the paper doesn't shy away from discussing the significant limitations and challenges of implementing AI in educational management. These include potential biases and discrimination, lack of transparency and interpretability, concerns about data privacy and security breaches, the risk of dehumanization and

loss of personal touch, lack of ethical and legal guide-lines, and the challenges related to technical expertise and interoperability.

Maia, Bueno, and Sato (2023) address a crucial gap in the literature by focusing on the underutilization of AI in practical educational settings, particularly in developing countries. They present a compelling argument for the potential of AI to provide deeper insights into educational dynamics and offer solutions for longstanding challenges. The call for adopting interpretability tools and robust data analysis methods supports the need for a responsible and informed approach to integrating AI in education (Maia et al., 2023).

The authors argue that despite advancements, educational systems, particularly in developing countries, still face challenges with academic performance not meeting expectations. They propose that Artificial Intelligence (AI) can be a potential solution for understanding educational dynamics and detecting patterns that could lead to improved outcomes. The study conducted a systematic review using the PRISMA methodology, exploring how AI has evaluated academic performance primarily in basic education across various countries. The review incorporated 19,114 works with 70 articles included. Key findings include the low adherence to AI methodology for practical actions in education, mainly due to its complexity and the "black box" nature of many AI systems. This complexity often makes understanding and implementing AI solutions challenging without a solid technical knowledge base. There is also a noted restriction in analyses to specific datasets, with many studies focusing more on computational methodology than the results' educational implications. The trend of utilizing AI in education is notably less in Latin America, which

already faces challenges with technology infrastructure and educational performance.

The study emphasizes the growing need to adapt to new methodologies and handle the increased volume of data. The authors highlight that while the use of AI in education is growing, the adoption is not uniform across the globe, with underrepresentation in regions like Oceania and significant parts of Asia and Africa. The application of AI in education faces hurdles, including the complexity of algorithms and the necessity of substantial technical knowledge for interpretation. The authors advocate for using tools like Local Interpretable Model-Agnostic Explanations (LIME) and SHapley Additive exPlanations (SHAP) to make AI models more interpretable and accessible.

The perspective of AI models enables analyses previously not feasible, which can lead to better understanding and improvement of student performance and more efficient resource allocation. AI's ability to process large, complex, and heterogeneous data makes it a potent tool for developing tailored educational policies and interventions. Jointly, the works above present a multifaceted view of AI's impact on educational management. They collectively advocate for a future where AI is seamlessly integrated into educational practices, enhancing learning experiences and operational efficiency while being cognizant of ethical implications and equity concerns. This future requires a collaborative effort from educators, policymakers, researchers, and technologists to ensure that AI is used as a force for good, augmenting human capabilities and providing equitable benefits to all learners.

As we move forward, we must continue exploring AI's potential in education, critically examining its impact, and developing frameworks that promote

ethical, equitable, and effective use. This exploration should be guided by a commitment to understanding the nuanced needs of various educational contexts, the diversity of learners, and the ever-evolving technological landscape. By doing so, we can ensure that AI acts as a catalyst for a more informed, inclusive, and innovative educational future.

AI and managerial strategies

Integrating artificial intelligence (AI) in managerial strategies is becoming increasingly pivotal in contemporary business practices. As highlighted by Davenport et al. (2019), AI's role is evolving from a mere operational tool to a strategic asset, fundamentally reshaping how decisions are made and how strategies are formed and implemented. By augmenting human capabilities, AI facilitates a more nuanced and informed approach to managerial decision-making. In alignment with these findings, Duan et al. (2019) observe that while the incorporation of expert systems in management has been gradual, it indicates an evolutionary shift in business processes and strategies, thus suggesting a broader research agenda to fully leverage AI in enhancing managerial functions.

Adding to this perspective, Wamba-Taguimdje et al. (2020) provide a comprehensive framework for managers to reconfigure organizational elements to harness AI's full potential. Their research points towards an AI-driven renaissance in business strategy formulation, particularly in marketing, enhancing both performance and competitive edge. Similarly, Rajagopal et al. (2022) delve into the specific impacts of AI on marketing strategies, offering nuanced insights into how these technologies

are reshaping the landscape of business strategy and academic research.

Kitsios and Kamariotou (2021) further elaborate on integrating AI into business strategies, especially in the context of digital transformation. They advocate for a multidimensional research agenda encompassing theoretical and practical aspects of AI application in management. Their work suggests an imminent evolution in management practices fueled by AI's ability to generate innovative methods and solutions. Chen and Biswas (2021) take this discussion into the crisis management domain, particularly examining the strategic use of AI and big data during the COVID-19 pandemic. Their research makes a point of the resilience and adaptability that AI can bring to business operations in times of crisis, enhancing not just recovery but also enabling organizations to seize new opportunities for growth and efficiency.

Despite the promising potential of AI in revolutionizing managerial strategies, it is equally crucial to consider the ethical and practical challenges accompanying its widespread adoption. Issues surrounding data privacy, algorithmic bias, and equitable access to AI technologies are at the forefront of these challenges. To fully realize the benefits of AI in managerial strategies, a balanced approach that addresses these ethical considerations is essential. This includes ensuring transparency in AI algorithms, safeguarding personal and sensitive data, and fostering an equitable distribution of AI benefits.

In the long run, the synergy of AI with managerial strategies presents a transformative opportunity for businesses. The insights provided by Davenport et al. (2019), Duan et al. (2019), Wamba-Taguimdje et al. (2020), Rajagopal et al. (2022), Kitsios & Kamariotou (2021), and Chen & Biswas (2021) collectively emphasize the need for

an integrative approach that combines the technological prowess of AI with strategic business objectives. As we continue to explore the positive impacts and address the challenges of AI in management, ongoing research, policy development, and ethical consideration will be paramount in harnessing the full potential of AI to enhance organizational performance and strategy. This endeavor not only requires continual technological innovation but also a commitment to responsible and ethical management practices.

Utilization of AI for effective performance management

The exploration of AI in enhancing performance management attracts considerable scholarly attention, emphasizing AI's role in revolutionizing organizational processes, managerial strategies, and overall performance (Olan et al., 2022). AI is identified as a key driver of economic growth, optimizing supply networks and boosting organizational profitability. Olan et al. (2022) specifically point out the economic benefits and efficiency enhancements that AI brings to supply chain management, underlying its significant impact on organizational output and financial success.

Hosain (2019) highlights the importance of management's attitude toward AI adoption, particularly noting that supportive managerial attitudes can lead to successful AI integration in small and medium-sized enterprises (SMEs). This perspective highlights the critical role of leadership in fostering an environment conducive to technological innovation and steering organizations toward the effective utilization of AI for performance enhancement.

The influence of AI extends to the domain of accounting information systems (AIS), as outlined by Soudani (2012).

When coupled with AI, AIS becomes more potent in facilitating informed decision-making and enhancing operational performance, providing managers with timely and pertinent data. In marketing, Huang and Rust (2020) propose a strategic framework where AI is instrumental in refining marketing research, strategies, and actions, all contributing to improved organizational performance.

The scope of AI's impact is also evident in the financial services sector and marketing strategies. Riedel et al. (2022) delve into consumer psychology, examining how AI-infused financial services are perceived differently based on consumers' political ideologies, indicating AI's broad influence on consumer behavior and organizational outcomes. Busca and Bertrandias (2020) reflect on AI's transformative potential in digital marketing, advocating for intelligent systems that can acknowledge and adapt to consumer competence, thereby enhancing organizational performance and customer satisfaction.

While the contributions of AI to performance management and organizational strategy are profound and multifaceted, it is equally crucial to consider the challenges and ethical implications associated with AI deployment. Concerns about data privacy, the need for algorithmic transparency, and equitable access to AI technologies are paramount. Addressing these challenges is essential for ensuring that AI's integration into organizational processes is both ethical and effective. As the body of research grows and practical applications expand, continuous dialogue, further research, and thoughtful policy development are essential to navigate AI's intricacies and fully leverage its capabilities for improving and enriching organizational performance and management strategies. This ongoing effort will ensure that AI's integration is

technologically advanced, ethically grounded, and organizationally beneficial.

AI's role in decision-making processes

The role of artificial intelligence (AI) in decision-making processes has been a focal point of substantial academic inquiry, insisting on its transformative effect on how organizations make and implement decisions. Dietzmann and Duan (2022) accentuate the pivotal function of AI in augmenting managerial information processing, particularly in the context of the modern era's information surplus. This highlights AI's capacity to refine and streamline decision-making processes. Complementing this, Lee and See (2004) delve into the nature of decision-making, noting that skilled decision-makers seldom rely on extensive calculations or comparisons, thus positioning AI as a tool that can emulate and enhance this intuitive process.

Inclusively, Burrell (2016) addresses the inherent complexity and lack of transparency in machine learning algorithms, bringing to the fore the challenges and necessary policy considerations in understanding and governing AI's role in decision-making. This discussion is crucial as it points to the need for clarity and accountability in AI-driven decisions.

Zhang et al. (2020) contribute to this narrative by investigating how confidence and explanations in AI systems affect accuracy and trust calibration in AI-assisted decisions. Their findings indicate that appropriately calibrated trust enhances joint decision outcomes between humans and AI, emphasizing AI's potential to facilitate more effective decision-making collaborations. In human resources, Tambe et al. (2019) explore the challenges

and opportunities for AI, highlighting its capability to improve decision-making processes within knowledge management and HR operations.

On top of this, Guan et al. (2022) examine the ethical dimensions of AI in decision-making, focusing on risk factors and mechanisms. Their research sheds light on the need for ethical considerations and frameworks in deploying AI decision-making systems, ensuring that these technologies are used responsibly and effectively.

Briefly, the literature collectively stresses the significant impact of AI on decision-making processes across various domains. It highlights AI's role in enhancing managerial information processing, trust calibration, and the overall quality of decisions. Hence, it insists on the importance of addressing the ethical and transparency challenges associated with AI's integration into decision-making. As AI continues to evolve and its applications become more widespread, ongoing research, dialogue, and policy development must focus on harnessing its potential while navigating its complexities. This will ensure that AI's role in decision-making is not only technologically innovative but also ethically sound and organizationally advantageous.

Comparative assessment of AI education in different contexts

The comparative assessment of artificial intelligence (AI) in education across various contexts has garnered substantial scholarly interest, emphasizing its multifaceted applications and implications across diverse domains. A notable study by Peterson et al. (2021) offers an in-depth comparative analysis of AI education between China and the United States, shedding light on the variances

in system design, regulatory oversight, and strategic educational planning. This investigation into the cross-cultural differences in AI education elucidates the distinct approaches undertaken by different countries, thus contributing significantly to the broader understanding of AI's role and adaptation in the global education landscape.

Similarly, Song et al. (2022) provide a focused examination of AI's role in K-12 education in China, offering a comparative assessment of the pedagogical practices associated with AI education and their implications for enhancing computational thinking and learning outcomes. Their research delves into the specific challenges and prospects of integrating AI education into primary and secondary education systems, providing valuable insights into the varied methodologies and their impact in different educational contexts.

Expanding the discourse to marketing, Davenport et al. (2019) explore the future trajectory of AI in this field by providing a comprehensive comparative assessment of AI's influence on marketing strategies and existing classifications. Their study integrates various dimensions into a singular framework, offering a holistic view of AI's transformative potential in reshaping marketing practices and strategies. This assessment not only helps in understanding current AI applications but also in forecasting future trends and directions in AI-driven marketing.

Further contributing to the comparative narrative, Rajagopal et al. (2022) present an analytical comparison between conventional judgment and AI-driven automated judgment, demonstrating how these methods can bolster organizational judgment efficiency. Their study offers insightful reflections on the comparative merits and applications of human and artificial decision-making processes, highlighting AI's potential to enhance the

speed, accuracy, and overall efficiency of organizational decision-making.

Wamba-Taguimdje et al. (2020) investigate the influence of AI on firm performance through a comparative lens, focusing on AI-based transformation projects and their impact on business value across different industries. This study gives managers a nuanced understanding of AI as a diverse set of IT configurations applicable across various business areas. It offers insights into how different sectors can harness AI's potential according to their unique requirements and challenges.

Similarly, Riedel et al. (2022) delve into consumer behavior, providing a comparative assessment of consumer responses to AI in the financial services sector. Their study meticulously examines how consumers' political ideologies may shape their perceptions and reactions to AI-driven financial services. It offers a nuanced understanding of the diverse responses to AI across different consumer segments.

All considered, the comparative assessment of AI in education and its multifarious applications in organizational and educational contexts offers profound insights into the global landscape of AI adoption and its implications across various domains. Collectively, these studies contribute to a more comprehensive understanding of the diverse approaches to AI education and its impact on decision-making processes, marketing strategies, consumer behavior, and organizational performance. They point out the necessity of tailoring AI strategies to fit different sectors' specific needs and contexts, highlighting the importance of continuous innovation, ethical considerations, and policy development to leverage AI's potential fully. This endeavor requires a concerted effort from researchers, educators, policymakers, and industry practitioners to

ensure that AI's integration across different domains is not only technologically advanced and efficient but also ethically sound and universally beneficial.

Organizational performance and AI integration

Incorporating artificial intelligence (AI) into the fabric of organizational structures and processes has significantly enhanced performance metrics across various sectors. This assertion is well-supported by many studies examining the intricate relationship between AI integration and the consequent organizational outcomes. Soudani (2012) particularly emphasizes the vital role of accounting information systems in bolstering organizational performance. He points out the importance of efficient information flow and the interactive effects among various organizational functions, stressing AI's critical role in enhancing these aspects. By facilitating streamlined information dissemination and improved coordination, AI catalyzes organizational efficiency and effectiveness.

Chatterjee et al. (2021) delve into the attitudes and behaviors of organizational users toward AI-integrated Customer Relationship Management (CRM) systems. Their study is pivotal in demonstrating that the quality of CRM systems, coupled with user satisfaction, significantly influences employees' attitudes and intentions toward embracing AI-integrated systems. This research highlights the broader implications of AI integration in influencing employee attitudes and fostering a culture of innovation and technology adoption within organizations, which, in turn, positively impacts organizational performance.

Similarly, Alami et al. (2020) highlight the importance of AI in healthcare, specifically focusing on the organizational

readiness required for integrating AI into healthcare delivery systems. Their work points to the transformative potential of AI in healthcare, enhancing patient care and the operational efficiency of healthcare organizations. This emphasis on the healthcare sector reflects the broader recognition of AI's potential across different domains to improve service delivery and organizational outcomes substantially.

Adding a human-centric perspective to the discussion, Presbitero and Teng-Calleja (2022) examine how employees perceive AI integration in the workplace and its subsequent effect on their job attitudes and career behaviors. Their research contributes to the understanding that AI integration can significantly influence employee perceptions, morale, and career trajectories, indirectly impacting organizational culture and performance.

Complementing this people-oriented view, Herrmann and Pfeiffer (2022) propose the necessity for a socio-technical extension of human-centered artificial intelligence. They argue for a seamless integration of AI that aligns with and enhances existing organizational processes and work practices. This approach not only ensures that AI augments performance but also that it integrates ethically and effectively within the organizational ethos and culture, thereby ensuring sustained improvement and acceptance.

Collectively, these studies put under the limelight the significant and multifaceted impact of AI integration on various aspects of organizational performance. They highlight the influence of AI on internal processes, employee attitudes, technology adoption, service delivery, and overall organizational culture. These findings contribute to a nuanced understanding of the complex relationship between AI integration and organizational outcomes. As organizations continue to explore and adopt

AI, they must do so strategically and thoughtfully, ensuring alignment with organizational goals, employee well-being, and ethical standards. This ongoing endeavor requires a commitment to continuous learning, adaptation, and innovation to fully leverage AI's potential and ensure a positive, transformative impact on organizational performance.

Case studies demonstrating the influence of AI on organizational success

The investigation into the influence of artificial intelligence (AI) on organizational success has garnered extensive attention, with a myriad of case studies illustrating AI's wide-ranging applications and consequential implications in diverse organizational settings. Gong et al. (2019) embarked on a national survey to examine the effect of AI on Canadian medical students' inclination toward the radiology specialty. This study highlights AI's significant role in influencing medical students' career decisions, potentially shaping the future healthcare workforce. It brings out the transformative possibilities of AI in medical education and how it can lead to enhanced performance and innovation within the healthcare sector.

In a different fashion, Mikalef and Gupta (2021) explored the impact of AI capability on organizational creativity and firm performance. Their empirical study delves into the dynamic interaction between AI and organizational creativity, illuminating how AI fosters innovation and propels organizational outcomes. This investigation demonstrates that AI's influence extends beyond operational efficiencies, contributing significantly to creative processes and innovation, thereby enhancing overall firm performance.

What's more, Touretzky et al. (2019) presented a case study that envisions the application of AI in K-12 education. Their research offers insights into the successful implementation of AI education initiatives and their subsequent effects on educational outcomes. This study provides valuable perspectives on how AI can revolutionize educational practices, enhance learning experiences, and consequently improve organizational success within educational institutions.

In education, a particular focus has been placed on implementing web-based platforms for K-12 AI education in China. This case study provides insights into the successful deployment of AI in educational settings and its consequent impact on learning outcomes. It illustrates the positive influence of AI on educational practices and organizational success, particularly in the context of K-12 education, highlighting the potential for AI to revolutionize educational methodologies and outcomes.

Ibrada et al. (2020) delve into the terrain of accounting information systems, exploring the influence of organizational commitment and regulatory compliance on the successful implementation of these systems. Their research provides empirical evidence on how adherence to regulations and organizational commitment significantly affect the effectiveness of AIS, thereby contributing to an enhanced understanding of the critical factors that influence organizational success in this context. Similarly, Chen et al. (2020) investigate the critical success factors impacting AI adoption in China's telecom industry. Their study sheds light on the organizational and managerial factors that facilitate or hinder AI adoption, providing valuable insights into the dynamics of successful AI integration in the telecom sector.

Noordt and Misuraca (2020) offer exploratory insights into the adoption of AI in the public sector across Europe, emphasizing the unexpected challenges and opportunities that arise in governmental AI implementations. Their study provides a comprehensive view of the organizational, legal, and societal factors that influence AI adoption in public administration, contributing to a deeper understanding of AI's impact on organizational success in the public sector.

Furthermore, Chatterjee et al. (2022) assess the implementation of AI-integrated CRM systems for B2C relationship management, applying contingency theory and the dynamic capability view theory. Their research offers valuable perspectives on how AI-CRM technology implementation influences organizational success, providing a nuanced understanding of AI's impact on organizational performance, especially in the context of customer relationship management.

In essence, the collective insights from these case studies and research findings make a point about AI's significant and diverse influence on organizational success across various domains, including healthcare, education, accounting, telecommunications, public administration, and customer relationship management. Each study contributes to a profound understanding of how strategic AI integration can lead to enhanced performance, streamlined processes, and revolutionized outcomes across various sectors. These insights serve as a testament to the transformative power of AI, highlighting its broad potential not only to improve existing practices but also to introduce new paradigms in workforce development, creative problem-solving, and educational methodologies. As AI continues to evolve and integrate into different organizational contexts, its influential role in shaping the future of various sectors, from healthcare and education

to business innovation, becomes increasingly evident. This body of research puts under the limelight the need for continued exploration and understanding of AI's capabilities to ensure its optimal and ethical application. The potential of AI to drive significant improvements in performance and outcomes features the importance of its integration for achieving organizational excellence, innovation, and the overall benefit of organizations and society at large.

Synergies and future application

The role of artificial intelligence (AI) in fostering organizational success has captivated the attention of researchers and practitioners alike, leading to a proliferation of studies that delve into AI's diverse applications and transformative effects across different organizational settings. Chen et al. (2020) examined the critical success factors influencing AI adoption within China's telecom industry. Their study elucidates the various elements contributing to the effective implementation of AI in the telecom sector, thereby enhancing organizational performance. This research singularizes AI's capability to amplify operational efficiency and improve decision-making processes, significantly affecting the overall success of organizations within the telecom domain.

Analogously, Jöhnk et al. (2020) conducted an in-depth interview study to evaluate the readiness factors for organizational AI integration. Their findings illuminate the challenges and opportunities organizations face when incorporating AI, shedding light on the critical factors determining the success of AI integration. This case study identifies the necessity of organizational preparedness and strategic alignment for successful AI adoption,

highlighting its potential to propel organizations toward greater success.

Kar et al. (2021) approached AI adoption from a strategic management perspective, modeling the various drivers and barriers to AI implementation. Their comprehensive analysis categorizes the multifaceted factors influencing AI integration, providing valuable insights into how these elements shape organizational strategy and performance. This study demonstrates the complex nature of AI adoption and its significant potential to influence and enhance organizational success through strategic alignment and overcoming barriers.

Kashyap et al. (2021) also surveyed the organizational and computational setups required for deploying predictive models in health systems. The research identified various configurations for integrating AI into clinical workflows and examined their effects on organizational performance. This case study highlights AI's capability to revolutionize healthcare delivery and organizational success through advanced predictive modeling and clinical decision support systems, marking a significant step towards more effective and efficient healthcare services.

Okunlaya et al. (2022) introduced an innovative conceptual framework for the digital transformation of university education, utilizing AI in library services. The study explores the transformative potential of AI in redefining educational practices and enhancing organizational success within the context of digital library services. This case study exemplifies how AI can lead to revolutionary changes in educational methodologies and improve performance and outcomes in the education sector.

Put simply, these case studies collectively reinforce the significant impact of AI on organizational success, showcasing its potential to drive operational efficiencies,

enhance strategic decision-making, and catalyze transformative changes across various sectors. The insights gleaned from these studies highlight the multifaceted nature of AI adoption, emphasizing the importance of strategic integration, readiness, and overcoming barriers to harness AI's full potential. As organizations continue to explore and implement AI, these case studies serve as valuable references, illustrating the broad possibilities for AI to contribute to organizational excellence, innovation, and sustained success in an increasingly digital and competitive landscape.

Synergies and future applications

Artificial intelligence (AI) intersection in education, managerial strategies, and organizational performance forms a triad of symbiotic relationships, drawing significant scholarly attention and yielding many studies that illuminate AI's diverse applications and implications in organizational contexts. Particular research delves into the influence of AI on educational practices, examining how the incorporation of AI in educational initiatives can profoundly impact learning outcomes and organizational success. This research stresses the transformative role of AI in enhancing educational methodologies, thereby contributing to the overall improvement in organizational performance, especially in K-12 education systems.

Another study explores the ramifications of AI on managerial strategies and overall organizational performance. It provides insights into how AI initiatives can refine managerial decision-making, streamline strategic planning, and bolster organizational outcomes. This case study exemplifies AI's capacity to augment strategic

decision-making processes, thereby driving organizational efficiency and effectiveness.

Brock and Wangenheim (2019) focus on the realistic applications of AI in driving digital transformation. Their research provides pragmatic insights for organizational leaders on the implementation and implications of AI, highlighting AI's potential to catalyze transformative learning and foster an environment conducive to improved organizational performance. In a similar investigative vein, Wamba-Taguimdje et al. (2020) assess the impact of AI on firm performance, particularly examining AI-based transformation projects and their contribution to business value. Their study illuminates the significant potential of AI in boosting organizational performance and profitability, demonstrating the value-added value of AI in enhancing operational efficiencies and strategic capabilities.

Further contributing to the discourse, Mikalef and Gupta (2021) empirically analyzed AI's influence on organizational creativity and firm performance. Their findings shed light on the dynamic role of AI in fostering an environment of innovation and creativity while also improving firm performance metrics. This study elucidates the multifaceted nature of AI's impact, emphasizing its potential to streamline operations and inspire creativity and innovation within organizations.

In sum, these studies collectively highlight AI's profound influence across educational practices, managerial strategies, and organizational performance. They single out AI's potential to drive transformative learning, enhance strategic decision-making, inspire innovation, and significantly improve organizational outcomes. This body of research emphasizes the symbiotic relationship between AI and various organizational facets, advocating for strategic and thoughtful integration of AI to harness

its full potential. As organizations navigate the digital age, understanding and leveraging the synergistic relationships between AI, education, and managerial strategies will be pivotal in achieving sustained organizational success and staying competitive in an increasingly complex and dynamic environment.

Addressing challenges and opportunities for future applications

Exploring the intersection between artificial intelligence (AI) in education, managerial strategies, and organizational performance continues to be a rich field of study, revealing numerous opportunities and challenges for future applications. Research into the influence of AI on educational practices demonstrates its profound impact on organizational success. Studies provide insights into the successful implementation of AI in education, particularly in K-12 systems, revealing how AI can augment educational outcomes and thereby contribute to enhanced organizational performance. Further investigations into the dimension of managerial strategies show how AI is revolutionizing decision-making processes and overall organizational outcomes. Such studies illuminate the potential of AI to bolster strategic decision-making, enhancing organizations' agility, efficiency, and effectiveness. These insights suggest a future where AI becomes integral to managerial processes, driving innovation and performance.

Davenport et al. (2019) specifically discuss the future of marketing in the context of AI, suggesting a significant transformation in marketing strategies driven by AI's capabilities. This study stresses the revolutionary potential of AI to redefine marketing practices, predicting a future

where AI-driven insights and strategy lead to superior organizational performance and market edge.

Systematic reviews of AI applications in higher education highlight the transformative potential of AI in this sector. These studies shed light on how AI can revolutionize educational methodologies, contribute to adaptive learning environments, and enhance the overall educational ecosystem, thus positively impacting organizational performance in higher education.

In the healthcare sector, Fenech and Buston (2020) delve into the impact of AI on cardiac imaging, presenting a case where AI's precision and efficiency can significantly enhance diagnostic processes. This case study exemplifies AI's potential to revolutionize healthcare practices, leading to improved outcomes, enhanced patient care, and overall organizational success in medical settings.

Collectively, these studies point towards a future where the integration of AI across different sectors—educational, managerial, healthcare, and beyond—will not only transform existing practices but also create new opportunities for innovation, efficiency, and enhanced performance. However, as we venture into this AI-driven future, addressing the challenges of ethical considerations, data privacy, algorithmic transparency, and equitable access becomes paramount. It is critical to navigate these issues with a focus on creating AI solutions that are not only effective but also ethical and accessible to all. This will ensure that the future applications of AI contribute positively to society, paving the way for a future where AI and human endeavor work in concert for the greater good of all organizational and societal spheres.

Conclusion

Investigating the synergistic relationship between artificial intelligence (AI) in education, managerial strategies, and organizational performance concludes a substantial area of academic inquiry. Numerous studies have illuminated AI's varied applications and profound implications across different organizational settings, providing invaluable insights into how AI can catalyze transformative learning, enhance strategic decision-making, and ultimately lead to improved organizational outcomes. A particular focus has been placed on the influence of AI in educational practices. Research, such as that conducted by Song et al. (2022), offers a window into the effective deployment of AI in education, showcasing its impact on learning processes and outcomes. These studies demonstrate AI's capacity to elevate educational methodologies, thereby contributing to a more robust and effective organizational performance within educational institutions, particularly in K-12 education.

In the field of managerial strategies, the impact of AI has been equally profound. Research exemplified by Shrestha et al. (2019) delves into the successful integration of AI in managerial functions and its subsequent effect on organizational decision-making and outcomes. These investigations reveal AI's potential to refine strategic decision-making processes, thereby enhancing organizational efficiency, adaptability, and overall performance.

The discourse around AI also extends to understanding the challenges and seizing the opportunities for future applications within various organizational contexts. Groundbreaking studies by Andrews et al. (2006) and Novlina and Indriani (2020) have explored AI's role in driving organizational innovation and performance.

These insights are critical in charting the path forward for AI applications, highlighting the need for continued innovation, ethical considerations, and strategic alignment with organizational goals.

Concisely, the body of research reviewed in this discussion accentuates AI's significant and diverse influence across educational practices, managerial strategies, and overall organizational performance. It points to a future where AI is seamlessly integrated into various facets of organizational life, driving innovation, efficiency, and transformation. However, as we move forward, addressing the ethical, technical, and strategic challenges of AI integration is crucial. Ensuring responsible, equitable, and effective use of AI will be paramount in realizing its full potential for enhancing organizational success. This will involve a continued commitment to research, a nuanced understanding of AI's capabilities, and a strategic approach to its implementation, all aimed at harnessing AI's transformative power for the greater good of organizations and society.

Summary of key findings

The literature review illuminates the synergy of AI in education, managerial strategies, and organizational performance, revealing its capacity to enhance learning, streamline knowledge management, and revolutionize managerial decision-making. It encapsulates the growing body of research on AI's role in personalized learning, administrative efficiency, and strategic business transformation. It also acknowledges the challenges and ethical considerations inherent in AI adoption. The findings advocate for a balanced integration of AI, emphasizing augmentation over replacement, ethical deployment,

and continual research to navigate its complexities and maximize its potential across various domains.

AI in Education: Studies indicate that AI significantly enhances educational practices, improving organizational performance, particularly in K-12 education systems. AI's integration in educational settings revolutionizes learning experiences by offering adaptive, personalized instruction and identifying individual learning gaps. This advancement contributes to the overall quality of education, increases student engagement, and elevates academic performance.

Area of Impact	Key Findings
AI in Education	AI enhances educational practices by providing adaptive, personalized instruction and identifying learning gaps. It contributes to improved quality of education, student engagement, and academic performance.
AI in Managerial Strategies	AI influences managerial strategies and decision-making. It aids in refining strategic decision-making, enhancing operational efficiency, and promoting innovative practices within organizations.
Organizational Performance and AI Integration	AI's integration into organizational practices drives significant improvements in overall performance. It enhances productivity and profitability across various sectors, including healthcare and marketing.
Challenges and Opportunities for Future Applications	Future applications of AI present challenges such as ethical considerations, data privacy, and equitable access. However, these are accompanied by opportunities for innovation and improved human-machine collaboration.
Implications for Educational and Organizational Practices	AI has multifaceted implications for both educational and organizational practices. It promises to revolutionize traditional pedagogical methods and impact employee well-being, organizational health, and strategic decision-making.

All considered, the key findings from this exploration into the synergy of AI in education, managerial strategies, and organizational performance highlight the transformative potential of AI across various domains. The studies discussed provide a comprehensive understanding of AI's diverse applications and implications, emphasizing its role in driving innovation, enhancing efficiency, and improving outcomes in educational and organizational contexts. As AI continues to evolve, it presents both challenges and opportunities, dwelling on the need for continuous research, ethical consideration, and strategic implementation to fully realize its potential for the betterment of society.

Implications for educational and organizational practices

The ramifications of artificial intelligence (AI) for educational and organizational practices are extensive, presenting opportunities to fundamentally alter approaches to learning, work, and organizational management. The adoption of AI in both educational and organizational contexts promises to revolutionize traditional processes, augment decision-making capabilities, and yield improved outcomes across various dimensions. This symbiotic relationship between AI, education, and organizational practices carries significant implications for operational aspects, including employee well-being, organizational health, and overall performance metrics.

The relationship between employee well-being and organizational health is particularly pivotal in AI integration. As posited by Singh and Jha (2021), the welfare of employees is intricately linked to the overall vitality of the organization. Introducing AI into organizational practices

can substantially influence employee engagement, job satisfaction, and mental well-being, thereby impacting the broader health of the organization. This interdependence highlights the critical need to consider the human aspect of AI integration, ensuring that adopting such technologies enhances rather than diminishes employee welfare and, by extension, the organization's health.

In the area of education, the implications of AI are equally profound. AI's integration into educational frameworks promises to enrich learning experiences, personalize educational journeys, and foster innovation in pedagogical methodologies. AI's capability to offer adaptive learning experiences, identify and address individual learning gaps, and tailor instruction to match each student's unique needs promises to revolutionize the educational landscape. These advancements have far-reaching implications for the quality of education, student engagement levels, and overall academic achievement.

Withal, the influence of AI on organizational practices extends into critical areas such as decision-making, operational efficiency, and strategic planning. AI significantly enhances strategic decision-making, streamers operational processes, and catalyzes innovation within organizations. The symbiotic relationship between AI and organizational practices thus necessitates a thoughtful consideration of how AI integration affects overall organizational strategy, health, and employee well-being.

More specifically, the implications of AI for educational and organizational practices are comprehensive and transformative. This technology has the potential to redefine how learning and work are conducted, influencing everything from individual student experiences to the overarching health and success of organizations. As such, there is a pressing need for educational institutions

and organizations to thoughtfully consider the broader implications of AI integration, ensuring that it enhances human welfare, promotes organizational health, and drives performance in an ethical, equitable, and effective manner. As we move forward, the continued exploration of AI's potential alongside a commitment to addressing its challenges will be crucial in harnessing its full power to benefit individuals, organizations, and society.

Recommendations for future research

Based on the findings and discussions presented in the previous chapters, several recommendations can be made for future research in AI, education, managerial strategies, and organizational performance. Nevertheless, as AI continues to evolve, so too should the research that seeks to understand its myriad applications and implications. For that very reason, the following recommendations aim to address existing gaps, explore potential opportunities, and guide the future trajectory of AI application and study:

Recommendation	Description
Ethical and Equitable AI Development	Focus on mitigating biases, ensuring data privacy, and developing ethical guidelines for AI. Explore strategies for equitable access to prevent a digital divide.
AI in Education – Beyond K-12	Expand research to include AI's impact on higher education, vocational training, and lifelong learning, focusing on curriculum development and personalized learning.
Longitudinal Studies on AI's Impact	Conduct long-term studies to understand the sustained impact of AI on organizational performance and employee well-being over time.
Cross-Cultural and Cross-Sectoral Studies	Examine AI's impact across different cultures and sectors to understand diverse applications and implications.

Recommendation	Description
AI and Managerial Decision-Making	Investigate how AI can support and enhance managerial decision-making in strategic planning, risk management, and crisis response.
Integration of AI with Emerging Technologies	Explore the integration of AI with technologies like blockchain, IoT, and augmented reality for innovative applications.
AI's Impact on Job Roles and Skills	Research how AI advancement is changing job roles and skills requirements, identifying new skills and strategies for workforce development.
Measuring the Success of AI Integration	Develop metrics and evaluation frameworks to measure the success and impact of AI integration in educational and organizational settings.
Case Studies of AI Failures and Successes	Document and analyze successful and unsuccessful AI integration case studies to provide valuable lessons and insights.
Policy Implications and Regulation of AI	Focus on the policy implications of AI, including the need for regulations and standards to manage its development and integration effectively.

Building on the comprehensive insights garnered from the interplay of AI in education, managerial strategies, and organizational performance, future research is poised to forge deeper into AI's ethical, educational, and managerial frontiers. Key recommendations call for initiatives to mitigate biases, enhance data privacy, and establish ethical AI frameworks to foster equitable access and bridge the digital divide. Emphasis on extending AI's educational influence beyond K-12, understanding its long-term organizational impact, and bolstering managerial decision-making is paramount. Further investigations should include AI's integration with emerging technologies, its redefinition of job roles, and the development of robust metrics to measure AI integration success. Documenting case studies of AI's failures and successes, alongside policy

and regulatory implications, will provide invaluable guidance for AI's future trajectory in various sectors and cultural contexts.

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Lifelong Learning (LLL) & Prompt Engineering Skills in the Age of AI.
The Future of the Communication Profession

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Raluca Ciochină

Abstract

The integration of AI-based technologies into strategic communication work practices presents both opportunities as well as challenges for adult learners. This paper examines the understanding of *prompt engineering skills* and the vision for Lifelong Learning (LLL) in the age of AI, particularly for communication professionals. The use of AI in decision-making and complex problem-solving can benefit communication professionals, but it requires more than just access to AI tools. Learning how to use AI and develop and refine AI-generated text prompts that meet the needs of clients and users has become a new skill. Workplace learning with new technologies is intertwined with social practices and individual learning. AI's increasing presence, including Chat GPT and other generative AI systems, has sparked concerns about its potential impacts on education and communication. While AI technologies offer personalized learning and interactivity benefits, they raise incorrect information generation, biases, and privacy concerns. In this context, communication professionals must learn how to develop and harness the digital skills that allow them to use AI-based tools effectively and responsibly.

Context

With the advancements in modern information and communication technologies, many fueled by artificial intelligence (AI) capabilities, the communication profession currently faces opportunities and challenges it has never met. Organizations are increasingly looking for ways to integrate and take advantage of AI technologies for various reasons. Recent studies show AI technologies started to be employed for strategic marketing purposes, communication management, and customer relationship management (Ledro, Nosella, & Vinelli, 2022; Zerfass, Hagelstein, & Tench, 2020), with almost 6,000 AI tools being available to public relations professionals, according to the Chartered Institute of Public Relations report released in 2023 (Smith & Waddington, 2023). Additionally, despite the pessimistic economic outlook, the communication budget spent on technology will likely increase, being one of the largest areas of investment for 34% of agencies and the 2nd largest for in-house communication teams (Bruce & Bailey, 2023). Zerfass et al. (2022) showed that the most challenging aspects of adopting communication technologies are related to organizations not being prepared for digitalization. While only 6.2% established an advanced use of communication technologies, the rest of the organizations still face challenges such as tasks and processes not being prepared for digitalization, inflexible structures and cultures, lack of IT support, and other structural barriers. Technological issues or lack of digital competencies are not seen as the most significant challenges. However, investment in AI, particularly in generative AI, could further impact agencies reliant on content creation fees. In this context, communication professionals face the challenge of understanding and

integrating AI technologies in their work processes and developing the needed skills to deal with these changes to leverage the opportunities they offer.

AI technologies. Opportunities and challenges for communication professionals

The benefits of using AI-based technologies from a communication standpoint mainly refer to time efficiency and cost efficiency, with most uses for media and social monitoring, collaboration, content creation, and media databases (Gregory, Valin, & Virmani, 2023). However, practitioners lack an understanding of the sort of added value these technologies bring, including for analytics and data. While communication professionals still perceive AI tools as instrumental in achieving various tasks, *humans are still needed* to make strategic choices (Gregory, Valin, & Virmani, 2023).

Gregory, Valin, and Virmani (2023) also showcase throughout extensive research that the public relations profession is now *assisted by AI* in doing repetitive tasks and, thus, improving efficiency, *and augmented by AI*, in aiding to perform previously difficult tasks, like identifying patterns in data or completing research. The authors note that even though the integration of AI and automation tools is increasing, human roles are not yet to be replaced, as tasks requiring human judgment, empathy, and ethical considerations still play an essential role. PR professionals perceive AI tools as helpful for decision making, for "work that requires judgement, a consideration of context, human empathy and nuanced ethical judgement is neither reducible to defined tasks, nor amendable to AI" (p.5). So, a good understanding of strategy and AI-based technology's ethical implications is highly needed. Amongst other

barriers to using communication technology refer to the ability to use it effectively, followed by the difficulty in integrating different systems and the ability to identify and choose technologies. The main issues typically refer to resistance to change, the need to audit existing technology, and the need to evaluate team skills to maximize current resources (Bruce & Bailey, 2023).

As a Large Language Model (LLM), OpenAI`s ChatGPT is used for generating content based on the input of data from the Internet (without being connected to it), being optimized for dialogue by using Reinforcement Learning with Human Feedback (RLHF) (OpenAI, 2023). According to the "Artificial Intelligence (AI) and the impact on public relations (PR) practice" report (Smith & Waddington, 2023), public relations professionals are divided, with some viewing it as a threat and others as an opportunity for growth and augmentation the role of professionals. Considering that ChatGPT can generate human-like text, including PR materials like press releases, email pitches, messaging, social media content, etc., critics suggest that the content is average, as the output results are simplistic, "cliched, or downright wrong."

Even though emerging artificial intelligence technologies, such as ChatGPT, provide opportunities in content creation specifically, there are still many questions related to developing skills needed to take advantage of the strengths of these types of tools efficiently. Skills such as "prompt engineering" may become invaluable for communication practitioners because they are collaborating with the tool to refine content and generate more nuanced versions of what they seek to obtain (Smith & Waddington, 2023, p. 12).

The Global Alliance Global Body of Knowledge (GBOK) outlines over 50 skills needed in PR, many of which AI

could impact (Gregory & Fawkes, 2019). Beyond writing, AI can assist in research, planning, and analysis. Other generative AI technologies like Midjourney and Synthesia are expanding the range of AI capabilities to include image and video generation. In general, the landscape of AI tools and their applications in PR is proliferating, suggesting that AI will play a complementary role in the industry, aiding professionals in creating more valuable content and possibly redefining skill sets.

Nonetheless, the advancements in modern digital communication technologies present significant ethical dilemmas for communication experts. According to the European Communication Monitor report for 2020 (Zerfass, Verhoeven, Moreno, Tench, & Verčič, 2020), nearly half of all practitioners encounter various ethical issues in their daily professional activities. The results specifically show that 46% of communication practitioners experienced ethical challenges in their daily work, such as using bots to generate feedback and followers on social media, applying big data analysis, and paying social media influencers for communication purposes (Zerfass, Hagelstein, & Tench, 2020).

The opportunities, as well as challenges posed by AI technologies, can lead to changing job roles for communication professionals, both at the entry and mid-level, as well as the senior level. Changing job profiles and modifying existing workflows based on collaboration between humans and AI technologies (Zerfass et al., 2023) may come with various possibilities. As Adi (2023) highlights, while communication professionals show enthusiasm for something they possess limited knowledge and experience in, heightened demand for improved measurement and increasing client expectations make the current landscape quite challenging. With AI`s

responsiveness to the environment making it more than just a technology performing a task, the future of the communication profession seems exciting, especially if ethical standards and transparency are addressed.

Capabilities development for communication professionals

Given the current evolution of the communication technology landscape, communication professionals are expected to develop themselves and others through continuous professional learning, according to the first globally applicable and internationally recognized *Capability Framework* conceived by Gregory and Fawkes (2019), adopted by professional associations worldwide. The framework was designed to describe the scope and role of the public relations profession, assisting practitioners, employers, and academic communities in identifying individual and team capabilities with both gaps and strengths, assessing training and development needs, and providing opportunities for practical career planning in the public relations profession. On a more positive note, based on the framework, the CIPR 2023 report (Gregory, Valin, & Virmani, 2023) highlights that there are broader capabilities within the profession that cannot be replaced by AI-based technologies, such as advising, ethical analysis, strategy development and judgment, reputation management, relationship development, and so on. As far as academic institutions are concerned, they must adapt their curricula to equip future communication professionals with AI competencies. However, successfully integrating AI requires a structured approach (Gaule, 2023), including identifying relevant AI applications, aligning learning outcomes with industry needs, and

focusing on faculty development through training and recruitment. The curriculum should blend theoretical AI knowledge with practical skills.

However, with communication professionals not feeling very confident using communication technologies effectively, some questions still arise regarding the best performance in achieving human-centered tasks. For instance, Bruce and Bailey (2023) revealed different perspectives between agency and in-house professionals when self-assessing their competency in adopting new communication technology. While only 52% of in-house respondents considered themselves competent, 67% of agency respondents did so, showing a difference in how professionals perceive their skill levels according to workplace experience and the need for improvement. The report emphasized the importance of including tech updates in one's Continuous Professional Development (CPD) efforts at least annually.

Furthermore, one of the communication trends for 2023 highlighted the role technology plays in the future of work, particularly in how humans and AI collaborate, aiding the former in accomplishing organizational tasks (Zerfass et al., 2023). Specifically, AI technologies hold the "promise to improve productivity by performing routine tasks, to reduce human error, and to generate insights that improve decision-making" (p. 5). Some of the challenges highlighted in the report refer to the outputs and how they change when AI makes suggestions, as well as accountability issues regarding the final output and how job satisfaction and skills will change for communication practitioners in the context of AI taking over more tasks. Drawing from the centaur chess idea, where human chess masters team up with AI, Kwame (2023) suggests that "the best communicators of the future will likely be centaurs,

a perfect blend of human expertise, AI computing power, and exceptional communication skills."

Lifelong learning: an opportunity for communication professionals in the AI era

By 2030, technological advances will significantly impact the demand for skills, with jobs requiring originality and creative problem-solving being less likely to be replaced by AI (OECD, 2019). The OECD report suggests that employees and future earners should focus on acquiring skills that complement AI capabilities and are less likely to be automated. In this fast-paced technological world dealing with an aging workforce, the importance of lifelong learning is becoming increasingly discussed (Martin, 2018). Results from the Programme for the International Assessment of Adult Competencies (PIAAC) show that those with more education and skills get more opportunities for further learning (Martin, 2018). According to UNESCO, lifelong learning refers to the process of learning that continues throughout life to address the individual`s learning needs, and it is used widely when referring to adult education programs (UNESCO, 2006). The UNESCO Institute for Lifelong Learning defines it as the "integration of learning and living, covering learning activities for people of all ages (...), in all life contexts (family, school, the community, the workplace, and so on), and through a variety of modalities (formal, non-formal and informal)" (UNESCO Institute for Lifelong Learning).

Lifelong learning involves various forms of learning. Cedefop Glossary defines both formal and non-formal learning as intentional (Colardyn & Bjornavold, 2004; Cedefop Glossary). While the former implies an organized

and structured manner of learning, resulting in obtaining a certification or diploma, non-formal learning involves learning during planned activities. The third type of learning, informal learning, known as experiential learning, consists of activities related to the contexts experienced by the individual, either personal related or professional related (Colardyn & Bjornavold, 2004). According to Fischer (2000), lifelong learning refers to more than continuous adult education or training opportunities, planned or not, involving a variety of learning experiences, from conceptual to practical knowledge, therefore encompassing the three types of learning experiences mentioned above (formal, non-formal and informal). Fischer (2000) suggests that integrating working and learning is useful so individuals "learn within the context of their work on real-world problems" (p. 6), thus integrated into the work process. Therefore, during this process, individuals look for solutions to the problems they are dealing with at work and are more inclined to learn when they see immediate benefits in their work rather than just potential long-term gains. Lifelong learning is necessary for shaping the future of communication professionals and their skill enhancement process. With current requirements discussing the need to develop prompt engineering skills, communication professionals must invest time in self-directed learning and learning on demand to cope with the current AI technology-based tasks at work.

Increasing participation in lifelong learning is crucial for leveraging technologies and improving ICT literacy skills. As a key component of learning, metacognitive skills and critical thinking remain essential in lifelong learning, especially as the labor market evolves and the ability to continually learn and adapt becomes increasingly

important (OECD, 2019). However, according to the PIAAC data, factors such as costs and time constraints can affect the decision to invest in learning. Investing resources in learning can be challenging for mid-career employees and those approaching retirement. Considering the restraining factors and the challenges employees face in the current economic landscape, a wide diversity of stakeholders like employers, governments, and employees is essential to promote lifelong learning.

With the rapid advancement of AI-based technologies, a focus on lifelong learning activities and practices becomes necessary to stay relevant in the job market, especially for communication professionals. Whether it`s formal, informal, or non-formal learning experiences, professionals should be exposed to opportunities that allow them to extract value from the technologies that serve different roles, mostly for increasing productivity and decreasing time spent on more tedious tasks. Self-driven individuals will probably be able to manage their learning journey by themselves. In contrast, others will need support from the educational system, their employers, or colleagues or will turn to specialized training, hoping to deal with the challenges and survive in a competitive marketplace.

In this sense, supporting personalized and contextual learning is relevant for any adult learning needs. For instance, Personalized Language Learning methods based on adaptive learning technologies have proven to be effective ways to implement precision education and to deal with the variety of individual language learning needs and preferences, helping with student engagement, satisfaction, and increase in self-efficacy and confidence (Chen et al., 2021). As an AI-based technology, ChatGPT can identify the user's learning style by analyzing the

interactions and the responses in real-time, "allowing for a conversational experience that feels natural and intuitive" (Biswas, 2023). This way, users can engage with the technology at their own pace and give the contexts where they need to apply the knowledge rather than respond to a predefined learning experience. ChatGPT can work like a virtual teaching assistant, and help enhance critical thinking and communication abilities, work as a research tool (Javaid et al., 2023) while keeping in mind that inaccurate information and data bias are still crucial ethical concerns, besides the potential issues about privacy, data security and intellectual property that also need to be taken into account.

What are prompt engineering skills, and why do they matter for communication professionals?

Prompt engineering refers to the "practice of designing, refining, and implementing prompts or instructions that guide the output of LLMs to help in various tasks" (Mesko, 2023). To take the most advantages from the interaction with AI-based technology, prompt engineering is a practice that allows users to optimize these systems to aid in decision-making, administrative tasks, research, training, and others (Meskó, 2023).

A new paradigm called *pre-train, prompt, and predict* is emerging in language models, mainly focused on using textual prompts to guide the model`s behavior in achieving a specific task (Liu et al., 2023). Since learning language models can resolve multiple tasks simultaneously, finding the most appropriate prompt or textual input for each task becomes essential. The prompt works as "a set of instructions provided to an LLM that programs the

LLM by customizing it and/or enhancing or refining its capabilities" (White et al., 2023).

Baskara (2023) suggests that ChatGPT has the potential to support self-determined learning through personalized tools and resources. However, ethical concerns regarding data privacy, security, and algorithmic bias can interfere with developing and implementing ChatGPT strategies for self-guided learning. A similar perspective is emphasized by Mhlanga (2023), who studied both the opportunities and the challenges of using ChatGPT in higher education, observing that there may be resistance to changing the traditional methods of evaluation of students, primarily written assignments. While ChatGPT can be problematic regarding accuracy, developing policies for its use may come too late. The author also signals the risk of reinforcing existing biases and discrimination, leading to unequal learning experiences. Additionally, even though ChatGPT has the potential to offer personalized support in lifelong learning, there is a risk that students become reliant on using this instrument and less invested in developing critical thinking skills (Mhlanga, 2023).

According to Oppenlaender, Linder, and Silvennoinen (2023), prompt engineering might be a learned or even a specialist skill requiring deep subject-matter expertise like a specific knowledge of keywords, understanding of system configuration settings, and training data. After conducting experiments with a paid crowd on Amazon Mechanical Turk, the authors found that prompt engineering training is needed to understand better prompt style modifiers (from the AI art community), even though users could use creative prompts written in descriptive language. This could suggest that only communication professionals with extensive knowledge of their profession and experiences, or those who undergo specialized, extensive training,

could be the ones who will take the most advantage of LLMs and their outputs.

Conclusions

The discussions about the impact of AI technologies in the communication profession are complex. Further research is needed to understand better the challenges regarding access, relevance, and benefits. However, integrating AI in communication needs, first of all, a process for evaluating professionals' skills, competencies, and capabilities in the current landscape. Besides the imperative of further studying prompt engineering skills and their place in the communication domain, the social, cultural, technical, and ethical concerns about integrating these technologies into daily or strategic activities are valid and require a deeper understanding. Lifelong learning activities and programs emerge as critical pathways for professionals looking to keep up to date and stay relevant in a dynamic and continuously evolving environment. The challenge will be to balance all the above into designated learning programs that develop professional`s ability to adapt and engage in problem-solving activities in which AI will probably take a considerable role.

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The Uses and Abuses of ChatGPT in the Work Processes. A Romanian Employees' Perspective on Training for New Skills

Camelia Crişan, Mihaela Boicu

Abstract
This chapter aimed to uncover the advantages and disadvantages perceived by Romanian professionals when using ChatGPT and the impact of its usage on productivity and gaining new skills. For this purpose, we have conducted two focus groups. Regarding productivity, respondents brought up aspects such as speeding up the thinking process, avoiding dead times, or even skipping stages. About half of those who participated in the two focus groups mentioned using ChatGPT to write different types of texts, such as emails, speeches, product descriptions, and social media posts. They believe no new skills need to be acquired to use ChatGPT. Based on the answers, however, prior education and experience in a specific field are necessary to trust, use, and discern if the information provided is accurate and can be used. While the first result is consistent with previous literature, the second one needs more exploration of different types of professionals and industries.

Introduction

Studying the impact of artificial intelligence (AI) on work and the work environment is of significant

importance in the organizational context because, by understanding the effects, it becomes possible to integrate and use this revolutionary technology efficiently (Kılınç, 2023). According to a 2020 report by the World Economic Forum, about 85 million jobs are expected to be replaced by artificial intelligence by 2025. But at the same time, about 97 million new jobs will be created thanks to artificial intelligence. This statistic highlights that technology generates more employment opportunities than the number of jobs eliminated, adding increased value to human existence (Abdulgafar, 2023).

Research by Deloitte (2020) shows that AI is generally used to make processes more efficient, enhance existing products and services, improve decision-making, and lower costs. However, despite significant concerns that super-intelligent machines will replace humans, only in recent years, due to machine learning, big data, and the use of the neural networks model, has AI begun to flourish as practitioners started to integrate statistics and probability in their applications (Benbya, Davenport, & Pachidi, 2020).

About AI – ChatGPT

Artificial intelligence is expected to impact the economy significantly, bringing potential improvements in economic growth and transforming how people engage in work and leisure activities. AI's influence on the workforce is likely to be multifaceted. On the one hand, AI can replace tasks previously performed by humans, while on the other hand, it can complement human work.

ChatGPT is a new AI technology that has rapidly gained popularity and has the potential to revolutionize various aspects of our lives, including education and

research. With its Natural Language Processing (NLP) capabilities, ChatGPT manages to understand and interpret human language innovatively. It can create human-like conversations by mimicking human abilities such as reasoning, problem-solving, and creativity. The technology uses techniques such as sentiment analysis, natural language processing, and machine learning to understand the context of the conversation and provide appropriate responses (Jaiswal, Arun, & Varma, 2022; Zhu et al., 2023).

We decided to research the impact that using ChatGPT can have on work. Initially viewed as an advanced chatbot, ChatGPT proved to be a much more sophisticated application. It can assist users with various answers to their questions and in creative works, contributes to math tutoring, language translation, and writing, creates other chatbots, and has applications in the medical field, social sciences, philosophy, or financial sciences. It is used by a plethora of professionals, including students and teachers, doctors, engineers, lawyers and judges, farmers, businesspeople, but also poets, and writers (Singh, Kumar, & Mehra, 2023). This technological revolution will affect the employment balance, generating changes and restructuring in all industries, as technology is ubiquitous in most sectors today (Jaiswal, Arun, & Varma, 2022).

AI and the labor market

Implementing ChatGPT and other artificial intelligence services can produce significant changes in various labor market sectors due to the automation of many tasks. Automation can cause considerable disruptions in the labor market, making some jobs obsolete but also creating new employment opportunities (Zarifhonarvar, 2023). In

addition to supporting existing professions, ChatGPT has also generated new occupations or increased demand for specific roles in the IT sector (Chen et al., 2023). The impact of AI on employment is expected to differ by industry and field. (Felten, Raj, & Seamans, 2023).

According to Cardon et al. (20023), it has long been predicted that artificial intelligence will significantly impact the nature of work in the future. Recently, the attention given to ChatGPT has led to the suggestion that a significant transformation in the workplace is inevitable. However, generative artificial intelligence is expected to change how most professionals work. This has the potential to significantly transform the future of work, as some of the major software companies have already begun to integrate these technologies into their products, millions of users have rapidly adopted these tools in just a few months, and people continue to discover new ways of using generative AI in various sectors of activity. In education, chatbots are used to help students with course materials and answer general questions, allowing them to focus on other important matters, such as research or teaching activities (George & George, 2023).

Developing skills related to artificial intelligence and its applications is paramount to helping employees remain relevant in the labor market. According to Hancock, Lazaroff-Puck, and Rutherford (2020), between 30% and 40% of employees in developed countries will need to improve their skills significantly in the next decade or even change their occupations. As the adoption of ChatGPT and other AI technologies continues to grow, job seekers need to develop relevant skills to remain competitive in the job market. It is increasingly essential for workers across industries to be proficient in ChatGPT and other AI technologies as they continue to redefine the nature of

work. Adaptation and development of skills in the field of ChatGPT become essential to keep pace with technological evolution and to adapt to the demands of the labor market in a constantly changing environment (Chen et al., 2023).

AI is also changing how work is organized, bringing profound transformations and new and innovative management models. In a company, AI can be used in various tasks, from managing data and automating functions such as finance and internal accounting to managing production, supply chain, and recruitment, including using machine learning to analyze business intelligence and ensure security. The implementation of AI requires an essential reorganization of the internal structure of the company and involves a profound reflection on the place of this new technology (Ponce, 2018). For instance, about a third of workers used ChatGPT for communication tasks, as well as writing emails and reports. The use of ChatGPT is more common among managers and executives, and most of the respondents believe that this generative artificial intelligence helps them work more efficiently, generate ideas for their work, improve the quality of work, and facilitate more effective communication (Cardon et al., 2023).

Collaboration between people and ChatGPT can contribute to employee skills development and will not significantly affect employment opportunities. Improving the quality of office workflow not only reflects business growth but also ensures a sustainable approach. ChatGPT is not limited to providing suggestions on processes, policies, and methods but also provides recommendations that stimulate creativity and innovation, benefiting employees, especially in industries that require creative skills (Zukic et al., 2023). It can have significant implications in the field of work; this technology can completely replace certain

categories of writers, such as those involved in writing projects or marketing activities, by automating the process of creating these materials (Noy & Zhang, 2023).

ChatGPT and productivity

ChatGPT has the potential to disrupt the productivity of employees tasked with problem-solving. Generative AI can create new content and not just analyze existing data, which makes ChatGPT an important tool for increasing employee productivity (Dwivedi et al., 2023). At the same time, using ChatGPT and other similar tools significantly increases the productivity of writers by automating routine and time-consuming tasks (Noy & Zhang, 2023). Through complementary and responsible use, artificial intelligence tools such as ChatGPT can positively impact increasing efficiency in time management and facilitating collaboration (Fauzi et al., 2023).

ChatGPT can bring various benefits to researchers, such as rapid generation of search strings and acceleration of keyword selection, thereby helping to reduce the time, effort, and number of researchers needed to conduct record reviews (Nguyen-Trung, Saeri, & Kaufman, 2023; Singh, Kumar, & Mehra, 2023).

According to Noy and Zhang's 2023 study, access to ChatGPT has significant productivity benefits for employees performing professional writing tasks. The application improves the quality of texts delivered by workers with reduced skills and simultaneously reduces the time required to complete tasks. High-skilled employees have their quality standards maintained and become significantly faster at completing work tasks. Dwivedi et al. (2023) argue that by saving the time and effort needed to write initial drafts, ChatGPT can help

increase the efficiency and effectiveness of workers, giving them a solid foundation for further development of final products. Noy and Zhang (2023) suggest that ChatGPT technology largely replaces workers' efforts rather than complementing their skills, which may decrease labor demand.

Since ChatGPT technology can take over repetitive and time-consuming tasks in the accounting field, for example, specialists can focus on solving tasks of greater complexity. Automation can also improve the accuracy of these routine tasks, reducing the risk of errors and saving time in the proofreading process. This leads to increased productivity and efficiency in accounting. The ChatGPT chatbot can also help prepare financial statements, balance sheets, and other reports by quickly accessing and organizing data. This reduces the risk of human error and saves time compared to manual processes. In addition, ChatGPT's ability to understand and interpret natural language commands can improve the speed and accuracy of data extraction and analysis, leading to more accurate and efficient financial reports (Alshurafat, 2023). Moreover, when put in situations where it needs to provide answers to social problems, the prisoner's dilemma, the ultimatum game, or the trust game, the answers of ChatGPT show cognitive biases, and its responses are more similar to humans than to fully rational agents (Azaria, 2023)

Research design

Considering the context set above, this chapter intends to identify the benefits and challenges that ChatGPT brings for a series of Romanian professionals so that it is possible to maximize the advantages and minimize the associated disadvantages. To achieve this objective, we

have developed two research questions. The first question aims to look at the benefits and weaknesses perceived by employees when using ChatGPT technology. The second question is related to ChatGPT's impact on employees' work productivity, as well as their education and training. Data was collected via two focus groups. Employees who use ChatGPT at work have been invited to attend. We then use content analysis to discover the answers to our research questions.

The primary goal of this study is to comprehend how using ChatGPT affects workplace activities and duties from the workers' viewpoint. We aimed to understand how this technology is integrated into the employees' workflow and the work contexts in which it is utilized. To achieve the previously stated objective, we developed two research questions to answer the goal. These are:

1. What are the advantages and disadvantages perceived by employees when using ChatGPT?
2. What impact does using ChatGPT have on work productivity, particularly concerning education and training?

To achieve the objectives mentioned above and answer the research questions, we used a qualitative research method, the focus group. We created a grid of nine open questions that examined productivity, trust, innovation, and creativity to learn as much as possible about the subject. Nine people participated in two focus group meetings where the grid was discussed. Both focus group sessions were conducted online through the Google Meets app. The participants were selected based on two aspects:

a. to be active in the labor market, and
b. to use ChatGPT in work tasks.

They were informed at the beginning of the focus group about data confidentiality and the purpose of the meeting.

All nine participants answered all the questions asked. Their age was between 25 and 45 years. The composition and details of the participants are presented in Table 1.

Table 1. Details of the participants who attended the focus groups

Focus Group	Participant	Age	Gender	Profession
I.	C.A.	33	m	Technical Director
	A.P.	25	m	Specialist in public relations
	A.C.	28	f	Graphic designer
	E.A.	30	m	Commercial Director
II.	M.T.	38	m	Project manager
	A.B.	30	m	Software system engineer
	R.C.	45	f	Editor
	M.A.	32	f	Marketing specialist
	D.C.	27	f	Small business manager

There were four participants in the first group—three men and one woman. They work in design, sales, public relations, and maintenance industries. The second group comprised three women and two men, with participants from journalism, IT, marketing, and entrepreneurship. The respondents' varied professional backgrounds guarantee the groupings' representativeness. Both focus groups have accomplished their stated goals, considering the amount and quality of the responses so the data may be analyzed and interpreted.

Results and analysis

While performing content analysis on the answers that have been provided, we have identified the presence of eight main themes that the respondents mentioned, namely: productivity; creativity; reliance on responses

received from ChatGPT; innovation, new ideas, and solutions; quality of work; maintaining a balance between using ChatGPT and own knowledge; ethics and the fear of automation.

The first theme addressed by the participants was productivity, and for this chapter, we will focus solely on this one. The respondents believe that ChatGPT has increased their productivity; thus, A.C. (F, 28) claims, "I am a little more productive than before and can finish more jobs in a shorter period of time." Users have noticed increased productivity in their work departments because of using ChatGPT, claiming that "productivity, in the case of the department I work in, has increased" (C.A., M, 33). With the help of ChatGPT, users have been able to complete more projects in less time and avoid repetitive tasks, thus gaining more time to focus on the more complex aspects of their work and providing more time for creativity. "You have a base from which you start, and if you can skip these mechanical processes and have more time to think, it proves extremely useful." (A.C., F, 28). ChatGPT has also helped reduce the time needed to search for information by providing quick answers; in this regard, E.A. (M, 30) claims that ChatGPT is "a good tool that helps to reduce the times of searching for information." Users also noted that ChatGPT allowed them to make more informed decisions and solve problems more efficiently: "It helps me a lot at work, it saves me many hours of searching in other sources, I get almost instant answers to questions" (M.A., F, 32). Through ChatGPT, more effective solutions and quality results were obtained in a shorter time, as can be seen from those reported by R.C. (F, 45): "Obviously, it increases productivity. It can write in a few seconds what it would take me hours". In addition, A.C. (F, 28) claims that ChaGPT "can only speed up the thinking

process, and then it can help me move more easily from one project to another so that I can change my focus from one direction to another more quickly," therefore, it facilitated moving attention of employees faster from one task to another, thus increasing efficiency. In addition, ChatGPT provided multiple perspectives and contributed to continuous development in professional areas. Users experienced a significant increase in productivity and achieved fast and detailed results, saving considerable time and effort, as indicated by the responses provided by M.T. (M, 38): "It delivers the final result with a high degree of detail in seconds, instead of a few hours of work previously invested by me or by a person in general."

The second theme identified following discussions with the nine participants was creativity. Thus, ChatGPT was appreciated by users for its multiple benefits in the creative process and idea generation; moreover, A.P. (M, 25) mentioned that "ChatGPT gives you the feeling of when the light turns on, and a new idea comes to you. ChatGPT is considered a source of ideas and solutions without replacing the users' own thinking and ideas. In this sense, A.C. (F, 28) states: "It won't ever be a substitute for our thinking or our ideas, but it can provide inspiration and solutions when you're stuck and would otherwise find them more slowly."

The third theme found in the responses provided by the participants was their trust in the answers provided by ChatGPT. Thus, we found that some employees express high confidence in the information received, as shown by the responses from C.A. (M, 33): "I generally have a high level of trust in the information received from ChatGPT." Some respondents are more cautious about the level of trust given to the information received. M.T. (M, 38) wonders, "How can we trust that the answer provided

is correct if we do not master that subject?" but he was not the only one. A.C. (F, 28) considers that "It's critical that you possess the knowledge that is required to use it"; this respondent also claims that "I wouldn't use it for something that I don't know very well, nor do I know if it has reached or been developed enough so far to be able to offer me a solution to something that I am not already knowledgeable enough about." The level of confidence on ChatGPT and the information transmitted may vary depending on the user's area of expertise and his degree of knowledge in that area. A.B. (M, 30) states that "because we're not talking about an unknown field and because I'm good at what I'm doing, I trust the answers because I filter them before I take them for granted," so the trust in ChatGPT and the information provided it depends mainly on the user's personal judgment and assessment.

Another theme expressed by the respondents focuses on the importance of balancing using ChatGPT and applying one's knowledge. After the analysis, it appears that ChatGPT can be considered "a tool to help us in work processes and simplify our mechanical work and help us synthesize information" (A.C., F, 28) and that it "should not be used in excess that is, it is only a matter of ideas" (E.A., M, 30). These statements are also supported by A.P. (M, 25), who believes that "it's a pretty good tool, and I think it should be used more as a little help rather than letting it do most of our work."

During the discussions, we noticed that at least one respondent was concerned with the ethical aspect of using ChatGPT. A.C. (F, 28) claims that "all these artificial intelligence software are somehow taking the information that is already online, taking other artists' works and mixing them together, and it's inappropriate."

Another theme present in our analysis is related to the fear of automation. Thus, there are concerns about the possibility that certain jobs will be replaced by automation; according to A.E. (M, 30), who sees this as an issue for the medical field, "basic doctors will disappear, the family doctors who refer you to the specialist doctor. That's what ChatGPT does, what could ChatGPT do", this is being also supported by A.C. (F, 28) who says that "in my sphere, this kind of discussion has also appeared, especially on this part of the design, because in addition to ChatGPT all kinds of platforms have appeared that generate content for you directly from posts and everything." In the same vein, A.P., (M, 25) states that ChatGPT "has also created something else, which is the discussion of the artificial and how it will evolve or how it can replace our work."

Discussion

The most frequent topic during the discussions was the productivity that the employees have at work. Respondents brought up aspects such as speeding up the thinking process, avoiding dead times, or even skipping stages. These are consistent with Dwivedi et al. (2023), according to which ChatGPT can increase employee efficiency by saving time and effort in the process of writing a project. It provides a solid foundation, suggesting ideas and providing relevant information, allowing employees to focus more on further developing final products.

Without exception, each of the participants finds ChatGPT to be a good tool in terms of their productivity at work and that they can focus much more easily on several tasks simultaneously, a fact that is demonstrated by Dwivedi et al. (2023), who state that by eliminating repetitive and time-consuming work, ChatGPT helps

increase employee productivity and overall efficiency. The implementation of solutions offered by ChatGPT in the maintenance department brings multiple benefits to the production process, this being consistent with those stated by Ponce Del Castillo (2018) and Rathore (2023), who claim that artificial intelligence can have a significant impact on the processes of production and maintenance, thanks to its ability to analyze and process large volumes of data, being able to identify relevant patterns and trends to optimize production processes. ChatGPT can easily give people access to ideas and knowledge and is used to improve the productivity of software developers, writers, and other professionals (Dwivedi et al., 2023); this is also unequivocally evident from the responses received during the research.

About half of those who participated in the two focus groups mentioned using ChatGPT to write different types of texts, such as emails, speeches, product descriptions, and social media posts. According to Huang and Tan (2023), using artificial intelligence technologies such as ChatGPT offers great help in speeding up the writing and idea-generation process. At the same time, it was shown that more than half of the employees involved in a study use ChatGPT in writing activities (Cardon et al., 2023).

Returning to our research questions, we see various uses for AI-generated apps. At the same time, we also see several professions where ChatGPT is of significant use. It does not need new specific skills, so no further training or education is necessary in this respect. No new skills need be acquired to be able to use it. Based on the answers, however, prior instruction and experience in a certain field are needed to trust, use, and discern if the information provided is accurate and can be used. Much more reluctance is advised when one is looking for an

answer in a new field of knowledge, where one lacks the suitable filters based on which they can judge the data provided. Further education and training may be needed to evaluate ChatGPT's answers on critical thinking, information triangulation and connecting them with the proper experience.

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Empowering Organizational Success: The Imperative for AI Education to Enhance Human Capital Proficiency in Daily Activities

Mădălina-Elena Stratone, Victor-Emanuel Ciuciuc, Laura Andreea Oprea

Abstract

This study emphasizes how vital AI education is for organizations and how important it is to improve human capital proficiency. The study argues that employees should possess technical skills, subject-specific expertise, and ethical awareness in the fast-growing field of artificial intelligence. It strongly emphasizes strategic planning and dedication to a learning-centric environment to overcome implementation obstacles. The research demonstrates through case studies that thorough AI education imparts necessary skills and cultivates an innovative and adaptable company culture, leading to higher employee engagement, job satisfaction, and effective AI adoption. Overall, the research contends that investing in AI education is not just a competitive advantage but a tactical necessity for organizational success and future workforce preparedness.

Introduction

The incorporation of artificial intelligence (AI) has emerged as a revolutionary force in today's fast-paced and constantly changing business landscape, transforming

industries and reinventing how businesses work. The importance of human capital in properly utilizing AI's potential cannot be emphasized as organizations work to remain ahead of the competition and optimize their operations (Alnamrouti, Rjoub, & Ozgit, 2022). The ability of personnel to comprehend, use, and adapt to AI technology has turned into a strategic requirement for company success (Jarrahi et al., 2021).

Providing the skills and information they need is very important for workers to navigate the AI-driven environment successfully. This paper explores the fundamental relevance of giving AI education to the workforce and underlines that companies must strategically invest in AI education programs since AI technology is developing at a fast pace (Samoilovych et al., 2022). By doing this, businesses can create a workforce prepared for the future and capable of working in unison with AI tools and apps to promote creativity, efficiency, and improved performance (Lee, 2023; Rusminingsih, Harnani, & Damayanti, 2022).

Businesses need to focus on the fundamentals of AI education to empower employees in an AI-powered world. A complete AI education program is built on three pillars: the development of technical abilities, the acquisition of domain-specific knowledge, and the promotion of an understanding of AI's ethical implications (Ma et al., 2022). Thus, effectively implementing AI education is difficult, as with any transformational project. Organizations may face obstacles such as resistance to change, a lack of teachers with the necessary credentials, and the necessity for ongoing education (Bottrill, 2022). Strategic planning, stakeholder participation, and a dedication to fostering a culture that values learning and growth are necessary for addressing these difficulties (Limna et al., 2022).

This chapter will also examine several eye-catching case studies of companies that have effectively incorporated AI education initiatives. These real-world instances demonstrate the benefits of equipping staff with AI expertise. These case studies show positive advantages such as higher organizational performance, employee engagement and job satisfaction, and AI adoption rates (Palos-Sánchez et al., 2022).

Literature review

The rise of AI

This literature review delves into the exigency of AI education in elevating proficiency in human capital within daily behavior. It examines the present state of AI education, its latent advantages, and the challenges necessitating resolution. The influence of Artificial Intelligence (AI) is already significantly reshaping society (Floridi & Cowls, 2022). In recent years, the impact of algorithms and artificial intelligence (AI) has sparked intense discussions across media, business, and the social sciences, often portraying artificial intelligence and machine learning (ML) systems as capable of rendering more intelligent, efficient, and potentially impartial decisions (Stypinska, 2023).

Artificial intelligence (AI) is a branch of computer science and engineering that focuses on constructing and advancing intelligent entities capable of perception, reasoning, experience-based learning, and situational adaptation. Using algorithms, computational models, and data analysis techniques, they mimic human cognitive abilities such as problem-solving, decision-making, language understanding, and sensing (Jaiswal, Arun, & Varma,

2022). Despite the uncertain origins of the AI concept, its development is prominently associated with two authors: A.M. Turing, renowned for his role in modern computation and the introduction of algorithms, and J. McCarthy, credited as the father of AI, who coined the term "artificial intelligence" and laid the foundation for the field during the Dartmouth conference (Palos-Sánchez et al., 2022).

Driven by rapid technological progress, the synchronization of information systems, and the wave of industrialization, corporate managers are progressively integrating AI into innovation, prompting scholarly interest in delineating and mapping the nexus of AI within corporate innovation and leading to a substantial body of literature over recent decades (Bahoo, Cucculelli, & Qamar, 2023). Progressively, machines imbued with artificial intelligence assume control over monotonous, mechanized, and routine human activities, encompassing duties like documentation, scheduling, equipment inspection, data collection, and initial analyses (Huang, Rust, & Maksimovic, 2019). Thus, artificial Intelligence stands as one of the foremost transformative technologies reshaping the labor market landscape as well (Pan & Froese, 2023). Currently, multinational corporations (MNCs) invest significantly in AI tools grounded in logic and knowledge, powered by extensive data, information, and rules (Jaiswal, Arun, & Varma, 2022).

AI in educating human capital

As stated by J. A. Comenius (1967), the pioneer of pedagogy, all individuals possess the potential for knowledge, virtue, and piety within them. However, these potentials do not develop independently and require the nurturing influence of education (Ning-xue, 2019).

'Tabula Rasa,' the foundational perspective of John Locke on education, posits that the human mind is comparable to a blank slate at birth, with experience and knowledge acquired through interactions with the environment after that (Kadizade, 2016). In his 1916 work, Dewey defines education as the mechanism for the ongoing social continuity of life, with its purpose being the growth and survival of individuals within society (Takyi Mensah et al., 2023).

Enhancing the quality of human resources based on job demands involves offering education and training, which, in turn, is connected to the specific nature of education and training provided within each work unit or project (Kurniawan et al., 2022). Companies that endorse workplace education and training initiatives benefit from a workforce that is more diligent, innovative, devoted, and reliable (Mikołajczyk, 2022).

Artificial intelligence (AI) has the most significant potential to increase intellectual capital through the generation of "green" innovations (Kukushkina et al., 2022). Intellectual capital represents a fundamental organizational asset that can be utilized to achieve a competitive advantage (Vătămănescu et al., 2019). It encompasses talent, skills, technical knowledge, relationships, and machinery that can be transformed into value, constituting the collective knowledge within the organization that grants a competitive advantage in the market (Niwash, Cek, & Eyupoglu, 2022; Stratone, 2023a). Intellectual capital is frequently categorized into three components: human capital, structural capital, and relational capital (Brătianu, 2018).

In a continuously changing business environment, successful organizations aspire to accomplish business success by guiding the knowledge contained within a

range of intellectual capital components through their tactical organizational strategies (Dinu et al., 2023; Stratone, 2023b). In this way, Piontek and Piontek (2019) establish that science and education constitute strategic domains influencing the quality of human capital. Human capital is acknowledged as the foremost wellspring of innovation, augmenting individuals' ability to instigate technical transformations and to embrace and conform to them adeptly (Blundell et al., 1999), and it constitutes a vital competitive resource in the modern global market (Samoilovych et al., 2022).

The synergy between Artificial Intelligence and human capital plays a pivotal role in enhancing the efficiency of the transition towards robotics (Ballestar et al., 2022). Artificial intelligence has a favorable correlation with an increasing amount of trained human capital in firms, which has a notable and increasing impact on productivity growth (5%) (Ballestar et al., 2020). Thus, the desire to comprehend and enhance the utilization of AI techniques for educational aims is currently more substantial than ever, extending beyond educational institutions to encompass government sectors (Chen et al., 2020).

Case studies

While AI is often associated with automation, it also catalyzes human creativity and innovation (Bouschery, Blazevic, & Piller, 2023). By handling routine and repetitive tasks, AI allows employees to focus on higher-order thinking and problem-solving endeavors as AI can read, summarize, translate, engage in natural language communication, and create content (Pan & Nishant, 2023).

By adopting AI in educating and nurturing human capital, organizations can provide personalized learning

experiences, efficient training, data-driven insights, and opportunities for creative expression (Almaiah et al., 2022). The synergy between AI and human capital is not about replacing humans but rather augmenting their capabilities and enabling them to thrive in an ever-evolving landscape as organizations continue to embrace AI to unlock the full potential of their most valuable asset – their people (Kaur & Gandolfi, 2023). Using AI in human capital education challenges balancing personalization and privacy, adapting to technological shifts, maintaining content quality and trust, and ensuring meaningful human interaction within learning experiences (Cain, 2023). Moreover, ethical considerations, data biases, and safety-related matters are included (Ray, 2023). To tackle these challenges, businesses and organizations must formulate strategies and frameworks that advocate for data quality, quantity, diversity, and privacy, which could entail enacting data cleaning and validation procedures to ensure data quality, gathering and managing substantial amounts of varied data, and establishing data privacy protocols and measures to safeguard sensitive information (Aldoseri, Al-Khalifa, & Hamouda, 2023).

As AI gradually replaces tasks currently performed by humans, the nature of work is changing, requiring employees to adapt and learn new skills, highlighting the value of individuals who take advantage of new opportunities, the importance of lifelong learning, and adaptability to the new AI tools (Kaplan & Haenlein, 2019). Widespread use of AI is thought to be essential for company expansion, and the sharp rise in demand for AI professionals has revealed a severe skills and talent gap that prevents them from realizing their full economic potential (Johnson et al., 2021). For organizations, it is not only important to focus on cultivating non-technical

assets like human skills, leadership, teamwork, culture, innovation, and governance but also to find strategies for integrating AI with employees to fully leverage AI adoption in daily activity (Chowdhury et al., 2023). Companies that adopt AI will venture into diverse avenues, including management and governance frameworks, democratization of data science and AI, continuous model enhancement, transparency and comprehensibility of AI, and diminished data prerequisites (Benbya, Davenport, & Pachidi, 2020). The following cases were analyzed for this paper: PwC (Paradise, 2023; Wang, Xiong, & Olya, 2020) and KPMG (Gartner, 2023; Paradise, 2023; Zhang et al., 2020).

PwC is one of the companies that implemented AI practices within its work with employees and included AI training. PwC is a major accounting and consulting firm that launched AI training for 75,000 employees in the US and Mexico. It aims to explore AI integration in their work, beginning with foundational AI knowledge and progressing to personalized training for specific teams (Paradise, 2023). The move reflects the growing significance of AI, particularly generative AI, in the business world, with monthly online lessons, interactive elements, and AI experts within the company sharing knowledge to assist colleagues in mastering AI skills. At the same time, the human capital training approach aims to bring all employees up to speed with AI technology and its potential applications (Wang et al., 2020).

Another company that recognized how crucial it is to implement AI training to fasten the organization's development and its adaptability to the fast-changing business world is KPMG. The company has a $2 billion investment in a five-year collaboration with Microsoft. It aims to systematically integrate AI, analytics, and emerging

technologies into their environment and services, focusing on efficiency and quality in delivering AI-generated knowledge and recommendations (Paradise, 2023). KPMG prepares its workforce for the AI era through a combination of in-house and external training programs, covering AI basics, practical usage, and certifications, enabling employees to incorporate AI tools into their tasks adeptly (Zhang et al., 2020). This way, KPMG can increase productivity as Microsoft includes OpenAI's generative AI components into its product suite. However, educating the workforce about responsible AI use is critical to ensure moral and efficient implementation, including safeguarding sensitive data (Gartner, 2023).

Final considerations

The success of enterprises (SMEs and multinational companies) significantly depends on talented and informed human capital, especially when AI quickly changes sectors and all company departments. This article discusses how important it is to provide workers with detailed AI training so they can use it well during their daily activities. Moreover, this paper establishes AI education as a tactical requirement for organizational success by evaluating the revolutionary potential of AI, the critical components of AI education, the problems faced in implementation, and the practical advantages for enterprises. Education in AI can foster an inventive and adaptive culture within enterprises beyond only offering technical training. This paper underlines the significance of lifelong learning and upskilling and demonstrates how funding AI education fosters a learning-centric environment (Campanella et al., 2023). Such a setting increases employee satisfaction

and engagement and makes the company adaptable to technological changes.

This literature review study concludes that AI education for human capital is a strategic imperative for the future of businesses rather than just a way to achieve a competitive advantage (Samoilovych et al., 2022). Companies may fully utilize AI's potential while preserving a positive interaction between human intelligence and artificial intelligence by bridging the knowledge gap and promoting a culture of constant learning. The organizations that embrace the revolutionary power of AI education will emerge as trailblazers as we go deeper into the AI age, laying the foundation for a new paradigm of organizational excellence and success.

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Educating Retail Employees for the AI Era

Adina Săniuță, Valentin Stoica

Abstract
One of the largest economic sectors is the retail industry, with millions of employees worldwide and big companies like Walmart or Alibaba. This study investigates the development of artificial intelligence in retail using bibliometric analysis based on VOSviewer software. It also provides a guideline for education programs for retail employees to leverage the benefits of AI. The bibliometric study, which examined 888 papers extracted from the Web of Science, shows a significant increase in interest in artificial intelligence and retail since COVID-19 started. It maps keyword clusters, such as loyalty, innovation, big data, eCommerce, and machine learning, that clarify the effects of artificial intelligence on retail. This bibliometric research of the literature review provides valuable insights highlighting retailers' need to prioritize employee education while integrating AI.

Introduction

Retail is among the world's largest and most diverse industries, and many retailers are part of the world's top enterprises (Dekimpe, 2020). Retailers such as Walmart, Amazon, The Home Depot, and Alibaba are, as per Statista (2023), among the top companies in the world by market capitalization (STATISTA, 2023). In this sector, millions

of people are working in each of the world's leading economies (STATISTA, 2023). For example, US retailers employed over 15.7 million people in February 2022; in Germany, one of the world's leading retail markets (with important players such as Kaufland and Lidl), almost 1.2 million inhabitants were working in the retail sector in 2020, this data refers only to those working full-time in the German retail industry; three million people were employed in 2019 in UK retail sector.

When it comes to technology adoption, according to GfK Retail (R) evolution Report (GFK, 2023) retailers' top 2 focus areas are: 59% of the omnichannel retailers will focus on AI and Machine Learning and 34% on Blockchain, those acting in online focus more on AI and Machine Learning – 81% and 44% of them on Robotics, 55% of offline retailers concentrate as well on AI and Machine Learning and 34% on AR/VR. One of the reasons retailers use AI and will use it more intensively is that with its help, they will enhance the shopper experience and ensure growth.

To remain competitive in one of the most dynamic sectors, retailers should invest in AI technology and educate their employees to use the tools accordingly. In this regard, the paper aims to identify the evolution of AI-powered tools in retail by conducting a bibliometric analysis of the existing literature with the help of VOSviewer software and proposing a set of recommendations for educating employees for the AI era.

Literature review

Recent years have seen a notable transition in the retail industry, fueled by changes in consumer preferences, global economic conditions, and technological improvements.

Loh Li Har et al. (2022) describe the evolution from Retail 1.0 to Retail 4.0. Retail 1.0 department shops started to appear at the same time that the engines with steam produced the first mass-made goods (Har, Rashid, Chuan, & Seah, 2022). Due to the advancement of technology during Retail 2.0, customers benefited from goods, which led to more malls opening. Retail 3.0 appeared with the rise of eCommerce, and consumers began to like shopping online anywhere in the world. Their buying habits changed as they could buy anything without leaving the house. Retail 4.0 makes our lives easier and better, which is possible due to technologies such as Artificial Intelligence, the Internet of Things, Cloud Computing, Big Data, and Augmented and Virtual Reality.

Dekimpe (2020) states that the retail industry is almost, by definition, a big data one, as thousands of stores sell millions of products to millions of customers through billions of transactions. Only Walmart serves more than 35 million customers daily in its 11000 stores in more than 25 countries. We as individuals become data generators who leave data marks each time we purchase and pay with our credit card, use loyalty cards/apps, and search the web/social media (Muller, 2014). When we think about Big Data, not only the technology has to be considered, but we should also relate to the ability to make changes at the strategic level, which leads the business acting in the retail industry to sustainable competitive advantages (Săniuţă et al., 2021). Kostakis and Kargas (2021) define big-data management as a mixture of old and new data management practices, skills, teams, data types, and functionalities. Further in the same paper, the two authors state that there are five areas of interest when it comes to making the change from a traditional volume of data to the management of big data; these are as follows:

- **Leadership:** the role of the leadership, besides the classic ones, is to guide the company towards an efficient management of big data. Evaluating information and extracting the knowledge that can lead to business decisions is a science itself and requires visionary leadership.
- **Talent management**: managing big data is a complex task, requiring both technological and process management skills; this requires, therefore, selecting and recruiting specialized professionals and data scientists.
- **Technology**: Nowadays, IT departments have a variety of solutions to integrate big data management systems within those organizations. The IT professional, in particular, and others in general, must also acquire and constantly develop skills to manage new technologies and report the data needed for business decisions.
- **Decision-making:** As information and decision-making are interrelated, it is crucial for the employees handling and processing data to work together with those responsible for planning and making decisions.
- **Company culture:** a company that is sensitive to the result of extensive data management (big data transformed into valuable information) requires significant changes in terms of culture. One of them can be the necessity to act agile, especially in industries with highly competitive levels, such as retail.

Mastering big data management is a must for companies – no matter the industries they are acting in – and those who want to lead the market and are forward-thinkers are implementing and applying machine learning solutions as an advanced form of big data analytics; this assures them to extract more value from the information (Walch, 2023).

When using personalized AI tools, it is mandatory to have good data, which is why companies should first have competitive big data management (Maryville University, 2017). Artificial Intelligence (AI) can be applied as software, such in search engines, data analytics, speech and facial recognition systems, and virtual assistants, or as "embodied" AI, as in autonomous vehicles or robots. It enables businesses to grow workers' productivity, spur innovation, improve customer experience, and boost efficiency, all leading to more effective resource allocation and a nearly 60% rise in profit (Săniuță & Filip, 2021). Regarding retail, AI can revolutionize retail marketing, retailing, and business operations (Williams, 2023). To be in front of the revolution, retailers must understand what skills the employees need to understand AI technology and invest in training programs to develop or enhance those skills.

As it's been known, the workplace is being transformed by Artificial Intelligence (AI), the COVID-19 pandemic, and the latest technological disruptions are increasing the pace. According to some studies, employees are willing to pay higher wages to employees with AI skills and expertise, and these processes have the advantage of improving operational efficiency, worker productivity, and decision-making (Amazon Staff, 2023). Consequently, workers also show increased interest in developing AI skills to advance their careers. However, this interest is also found in older generations, not only in younger workers who are naturally oriented towards new technologies and work optimization with the help of AI. Recognizing the potential advantages of AI, 73% of employers surveyed in a report prioritize recruiting individuals with AI expertise. However, an overwhelming 75% of these employers struggle to find the requisite talent. Additionally, the survey indicates that

employers aren't exclusively concentrating on technical skills like coding; instead, critical and creative thinking hold even greater importance in their hiring criteria (Amazon Staff, 2023).

However, in some industries or for some roles, AI will simply be complementary and will replace *hard skills* that require repetitive tasks or little to no human input. That's why the so-called *soft skills* are rising to the surface and gaining more popularity (Abelli, 2023). Among them, some are considered to be very important:

- **Social interaction skills:** In the era of AI, numerous professions will still demand highly developed social abilities. Social skills remain pivotal in the contemporary work environment, whether it involves managing emotions effectively, actively engaging in meetings, or cooperating with colleagues during high-pressure situations. Studies indicate that employing AI tools diminishes the performance divide between employees with varying levels of expertise and seniority. This reduction accentuates any disparities in social skills, underscoring the significance of interpersonal communication, teamwork, and emotional intelligence in today's professional landscape.
- **Creativity:** Individuals utilizing AI will probably supplant those who don't. A recent study revealed that knowledge workers using Chat GPT 4.0 accomplished tasks 12.2% more efficiently, 25.1% faster, and 40% higher quality than those who didn't employ AI in their work. This data is remarkable, particularly regarding the notable increase in the quality of work output. Human workers who harness AI, coupled with robust creativity and critical thinking skills, will excel the most.

- **Critical thinking skills:** The assessment of AI responses demands applying critical thinking. Not all generated responses are guaranteed to be valid, impartial, factually accurate, or error-free. The scrutiny of prompts requires human logical reasoning, reflective contemplation, rational analysis, and impartial assessment. Despite the rapid generation of copious data, analyses, and potential solutions by AI, the credibility and relevance of its responses aren't assured. These sophisticated technologies derive their outputs from patterns extracted from extensive datasets, which might hide inherent biases and inaccuracies. This is precisely where the irreplaceable human capability for critical thinking becomes essential. Logical reasoning empowers humans to dissect AI-generated outputs, identifying potential inconsistencies or flaws. Reflective contemplation prompts employees to ponder the broader implications and contexts of the presented information. Rational analysis allows for assessing evidence, distinguishing between what's pertinent and extraneous. The unbiased assessment ensures vigilance against potential biases stemming from both the AI and our predispositions.
- **Curiosity:** Natural curiosity drives us to explore, comprehend, and seek knowledge about the world surrounding us. A keen desire to uncover information motivates employees to pose inquiries, challenge assumptions, and look deeper into subjects. Curiosity prompts individuals to step beyond their comfort zones and engage with unfamiliar concepts, ideas, and experiences. In the era of AI, where algorithms and machines swiftly process vast data volumes, curiosity assumes heightened significance. While AI excels at recognizing patterns, forecasting outcomes,

and automating intricate tasks, it lacks the profound understanding rooted in genuine human curiosity. The value of an employee shifts from mere possession of knowledge to the application of curiosity: the capacity to question, interpret, and reimagine that knowledge. By consistently asking "why" or "how," curious individuals seek innovative solutions and groundbreaking ideas essential for companies navigating the age of AI.

- **Unbiased, ethical decision-making**: In the era of AI, where algorithms increasingly inform or even dictate decisions, impartial and ethical decision-making becomes pivotal. AI systems operate on vast datasets, basing decisions on patterns extracted from this information. However, these datasets often reflect societal biases, causing AI to make biased and unjust judgments. Unchecked AI biases perpetuate existing inequalities and may even generate new forms of discrimination within organizations. The repercussions can be significant, influencing everything from an organization's hiring practices to people's access to products or services. It's solely through the uniquely human ability for impartial decision-making that we can serve as a barrier against unchecked algorithmic injustices, acting as the final defense in preventing harm.

As the retail industry is transitioning towards a digitally inclined, instant-access consumer base, AI emerges as a crucial tool for retailers to comprehend this evolving consumer behavior. The surge in personalized online shopping, direct-to-consumer models, and delivery services creates opportunities for generative AI to unlock multiple advantages, enhancing retailers' customer care, talent development, and application performance. Generative AI

showcases its strength in handling a myriad of unstructured data sources like emails, images, videos, audio files, and social media content. This diverse data forms the foundation for constructing models and continually training generative AI, ensuring its sustained effectiveness. Utilizing this unstructured data extends across various facets of retail operations, including improving customer service via chatbots and streamlining email management. This practical application translates to guiding users toward relevant resources, be it connecting them with the right agent or directing them to user guides and FAQs.

Recognizing the pivotal role of AI, retailers are strategically integrating it into multiple operational dimensions. IBM's recent study indicates a growing focus among industry leaders on AI technologies to drive revenue growth, with 42% of surveyed retail CEOs banking on technologies like generative AI, deep learning, and machine learning to yield results in the next three years. This aligns closely with a recent IDC Europe study reporting that 40% of global retailers and brands are in the experimentation phase of generative AI, while 21% have already invested in generative AI implementations (Niazi, 2023).

According to a survey, 37% of companies using AI say that the technology replaced workers in 2023, 44% say AI will lead to layoffs in 2024, and 83% say skills will help current employees retain their jobs (Resume Builder, 2023). From 2023 to 2028, the retail AI market is projected to surge from $7.3 billion to over $29.45 billion—an increase exceeding 400% (Lim, 2023). However, when envisioning how these innovations will reshape the retail landscape, one's focus typically centers solely on consumer advantages. However, integrating AI within both independent and chain retail establishments

is also meant to enhance the lives of store employees. Despite concerns regarding job displacement, human labor remains integral for the foreseeable future. Employees serve as the cornerstone of any successful retail enterprise. Armed with a deeper comprehension of the customer base, these employees can offer proactive solutions, deliver personalized recommendations, and attentively monitor feedback. However, this merely scratches the surface of AI's potential. AI can contribute to attracting and retaining talent, aligning training programs with a company's standards, and predicting and meeting customer needs before they articulate them.

Bibliometric analysis

The elaboration of the bibliometric analysis implies selecting papers indexed in the databases available on the Web of Science, considering them sufficient and complete to cover the subject. Initially, articles available in Scopus were also considered, but it was observed that most of the materials available in Scopus are also available in Web of Science. The bibliometric analysis was developed using the VOSviewer tool, version 1.6.19, released on January 23, 2023. The principal analysis was done on the degree of co-occurrence of different terms in the articles' titles, keywords, or abstracts. The mapping function of the VOSviewer tool generates a two-dimensional map that shows the correlation between 2 terms by the distance between them. The terms used to search the content were „retail" and "artificial intelligence," which were present in the title and keywords of each article. Articles written in English were selected from all Web of Science categories. The search returned 888 results, exported on 20 December 2023 and imported into the VOSviewer tool.

The first step of the analysis was to compare the number of papers published by year. From a total of 888 papers selected, 438 (49.3%) were published between 2021 and 2023, showing increased interest regarding this topic since the beginning of the COVID pandemic and the disruption caused by newly launched AI tools.
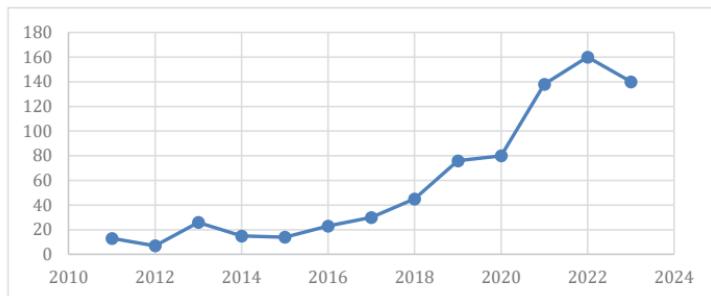
Figure 1. Number of published AI and retail papers by year.
Source: authors' contribution, based on WoS data analysis

Most articles were published in the Computer Science Artificial Intelligence Web of Science category (310), followed by Business (171) and Computer Science Information Systems (160).

Figure 2. Distribution of papers by Web of Science category.
Source: authors' contribution based on WoS data analysis

The countries with the largest number of digitalization papers published are the People's Republic of China (194) and the USA (150), followed by India (73) and England (65).

Figure 3 Distribution of papers by country.
Source: authors' contribution based on WoS data analysis

To better analyze and visualize the connection between digitalization and other keywords, a keyword map was created with the help of the VOSviewer tool by grouping keywords into clusters with the clustering technique described by van Eck and Waltman (2011). This technique uses keywords as nodes, showing co-occurrence and link strength by drawing lines of different weights between them. Figure 4 shows the map generated by VOSviewer, containing 32 keywords related to artificial intelligence and retail with at least three co-occurrences, divided into five clusters.
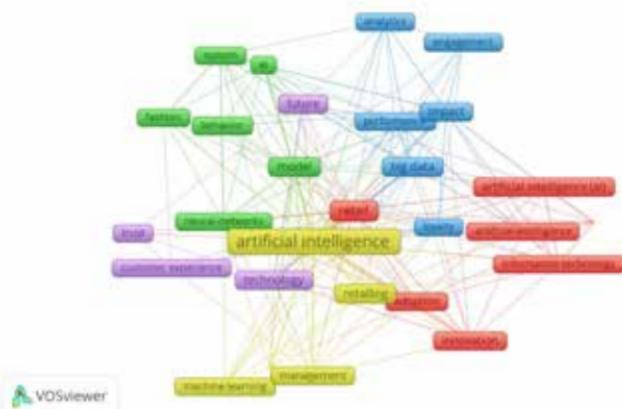
Figure 4. Keyword with at least three co-occurrences
Source: authors' contribution based on WoS data analysis

The subjects and number of items in each of the 5 clusters are different. Cluster 1 (red) has seven items, including artificial intelligence, innovation technology, innovation, and retail. Cluster 2 (green) has six items, among them being behavior, model and system. Cluster 3 (blue) contains six items, among them counting analytics, big data, loyalty, and performance. Cluster 4 (yellow) includes five items, such as machine learning and prediction. Cluster 5 (purple) has four items: customer experience, future, technology, and trust.

To assess the evolution of AI in retail in the academic literature, a visual representation of keywords by average publication year was developed, showing how different topics have been studied in recent years.
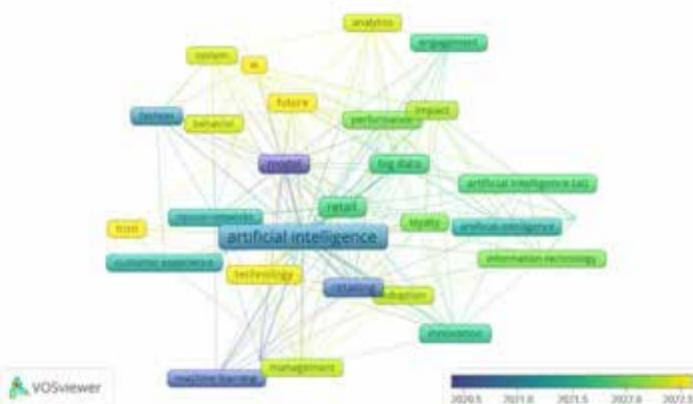
Figure 5 Evolution of keywords in the last three years.
Source: authors' contribution based on WoS data analysis

Keywords such as „future," „trust, "technology," „AI," "behavior," and „analytics" were found in papers published since 2020, showing a high level of interest in this subject once the restrictions caused by the COVID-19 pandemic were imposed and multiple tools based on AI began to develop.

The gathered data can provide a good starting point for researchers analyzing the changes produced by the COVID-19 pandemic, showing trends, topics, and research gaps that can be analyzed.

Conclusions

There is a rise of AI in retail and its impact. During the decades, the retail industry has witnessed big changes. New technologies like Artificial Intelligence, Big Data, Machine Learning, and IoT are reshaping retail operations, marketing, and customer experiences. Those retailers that will ride the wave of AI will have significant opportuni-

ties to grow their revenue, make their operations more efficient, and loyalize their clients through enhanced customer service and personalized products.

Insights from bibliometric analysis. The bibliometric study highlights the increased interest in AI and retail from the start of the COVID-19 epidemic. Clusters of terms linked to the use of AI in retail are revealed by the research landscape, with particular emphasis on customer interaction, loyalty, innovation, Big Data, eCommerce, and machine learning.

Global perspectives on AI in retail: Most scholarly writing on artificial intelligence in retail comes from countries like China, the US, India, and the UK. This suggests a general focus and interest in comprehending and applying AI technologies in retail settings across different regions worldwide.

Education for employees has additional elements to consider. As AI becomes business as usual in retail, retailers must invest in training programs to educate and upskill their employees. The training programs should be based on technical knowledge and soft skills like ethical decision-making, creativity, and critical thinking. For example, Amazon already has an initiative through which the company aims to provide free AI skills training to 2 million people globally by 2025 (Sivasubramanian, 2023). On the Amazon website (https://www.aboutamazon.com), it is stated that it offers eight free AI and generative AI courses, access on Udacity to a new generative course for more than 50,000 high school and university students globally, and a new collaboration with Code.org to help students learn about generative AI.

Platforms such as Udacity or Coursera are among the most popular for those who are looking for a course in AI for business; a ranking developed by mltut.com shows

6 out of 10 recommendations coming from these two platforms and only two coming from universities (ML Tut, 2023). In the following lines, the authors selected five of them and disseminated them and their offerings:

- **AI for Business Specialization – University of Pennsylvania:** This program is oriented towards those professionals who are technology-oriented, online marketers, statisticians, automation innovators, or data professionals. It starts by teaching the ethics and risks of AI, designing governance frameworks to apply AI fairly, and also has a component of marketing strategies with the help of AI.

- **AI, Business & the Future of Work – Lund University:** The other program from a university in this ranking is a free-to-audit course, meaning that one can access the course for free, but s/he has to pay to receive a certificate. It is oriented towards decision-making with the help of AI so that one will understand how AI analyses data to provide valuable insights, automates repetitive tasks, and understand the implications of AI in any industry. It is intended for anyone, including beginners, with little to no experience with AI.

- **AI for Business Leaders – Udacity:** It is intended for those with a previous understanding of statistics, probability, and algebra; this exhaustive program takes 4 to 8 weeks to complete. It starts by teaching the fundamentals of machine learning, AI, and basic terms (models, training, machine learning, algorithms). It also goes behind the scenes, explaining the mathematics behind machine learning models and helping those who follow them better differentiate between different types of AI models. It ends with an implementation of AI use cases through small learning experiments.

- **IBM AI Foundations for Business Specialization – Coursera:** This program has three different courses, and it's designed for beginners. It goes through the foundations of AI and its applications in various fields. It then explains the potential societal impact of AI and the ethical perspectives and ends with a mini project that has the role of showing AI in action.
- **Artificial Intelligence in Marketing – The University of Virginia:** Designed for beginners, this course takes only 10 hours and explains the fundamental concepts of AI and its practical applications, including Google Images and IBM Watson. It shows the importance of AI in gaining and maintaining competitive advantage, focusing on marketing strategies and how to drive them effectively with the help of algorithms, networks, and data.

All these courses have in common the technical approach, aiming at explaining AI and algorithms from a mathematical and statistical point of view. There is little to no focus on soft skills development, although according to the literature, this is a critical factor that will develop in the following years.

New opportunities for employees are emerging. Managers should recognize that AI complements human tasks and have to make use of it to improve employees' productivity and their decision-making capabilities.

In conclusion, integrating AI into retail requires that both technology adoption and staff training to become a priority. To succeed in the AI-driven retail environment, retailers must embrace AI while ensuring their workforce has the proper knowledge and skills to embrace the change brought by the ever-evolving technology.

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How XR and AI Technologies are Transforming Museum Education. A Journey through the Romanian Museums

Monica Bîră, Alexandra Zbuchea

Abstract

In the past few decades, museums have changed their role in society and how they relate to and address the public. Nevertheless, the educational role of museums is not only stronger than ever, it has also increased. New technologies brought new tools to reach their educational mission. This chapter mainly discusses how XR and AI enhance the museum experience and the educational value of museum visits. Although different technologies, the two tools could support each other in any way. Integrating AI in XR would enhance the impact on visitors. They both could boost the efficiency of educational endeavors for all museums. The study also highlights some applications of these technologies in museums. It also maps Romanian museums' XR and AI initiatives, highlighting their educational value.

Argument

Contemporary museums are extremely dynamic organizations, playing a significant role not only in terms of their impact on visitors but also on communities. The recent definitions of museums tend to stress the complex

role museums could play in society. In contrast, the older ones tended to favor the functional aspects of collection preservation, study, and management (discussions are included in various articles, e.g., Gurian, 2006; Brown & Mairesse, 2018; Mairesse, 2019; Zbuchea, 2022).

We note that certain museums have always been complex organizations, offering more than a showcase window presenting artistic, ethnographic, or historical artifacts. Prominent museums have emphasized the educational dimension of their collections within the context of interaction with their visitors. Stressing some of the inconvenient effects of this approach, G. K. Chesterton, an English writer, philosopher, and art critic from the early 20th century, is credited with observing that: "The Museum is not meant either for the wanderer to see by accident or for the pilgrim to see with awe. It is meant for the mere slave of a routine of self-education to stuff himself with every sort of incongruous intellectual food in one indigestible meal." However, over the past decades, museums evolved towards being new types of educators. Museums no longer embody the old-fashioned, dusty, severe, and inflexible teacher; instead, they have become dynamic, interactive partners for those seeking a learning experience by exploring the intricate ways collections are now exhibited and explained.

This change in the educational profile of the museum should be credited to a shift in mentalities and behaviors (encompassing both museum educators and their visitors). Additionally, the integration of new technologies into the many facets of museum activities determined numerous benefits spanning from organizing data about artifacts to engaging with visitors.

As data worldwide point out, using new technologies to enhance the museum experience is a solid trend. However,

it has not yet become mainstream for many museums and organizations dedicated to cultural heritage as they are usually slower adopters of these emerging technologies. A 2019 survey focused on the use of digital technology among museums in England indicated that almost 70% of them are involved in digitizing collections (an essential step to protect and share data but also to get materials for further applications into XR and AI). Meanwhile, a third offer digital experiences used simultaneously as the artwork, 20% provide online interactive tours for real-world exhibitions/spaces, and a little over 10% provide AR or VR experiences (Statista, 2019). Another study shows that, in 2020, a similar situation related to the usage of VR technology was also registered in Italy: 11% of museums, galleries, and similar cultural institutions provided VR technologies to visitors, with half of them planning to implement this technology in the future (Statista, 2020). However, with the recent surge of interest in research on technology and museum visitors' experiences, more work is needed to investigate how different forms and types of technology used impact the way museums perform their role in society and, more specifically, museum education. Steps have been made to explore the evolution of technology research designed to enhance museum visitors' experiences, with a four-stage model being elaborated (Se et al., 2023). Grounded in the historical evolution of technology adoption into museum settings, this model consists of four stages, suggestively named ICT incubation, smart technology adoption, ICT transformation, and futuristic innovation. More research rooted in museum studies, particularly in approaches that emphasize perspectives outside the simple historical evolution, such as heritage mediation, the impact on user experiences (Verhulst et al., 2021) and on different

generations of visitors (Traboulsi et al., 2018), would bring new light upon how the employed emerging technologies are shaping museum activities.

XR, AI, and museums

As museums step into the digital age, understanding the current landscape and emerging trends in AR and AI implementation is central to exploring how they shape museum visitors' experiences. To this end, a closer examination of key concepts and definitions concerning Augmented Reality (AR) and Artificial Intelligence (AI), as well as their applications within the realm of museums, will be discussed to offer a broader landscape of this new reality.

Extended Reality (XR) is an umbrella term encompassing a range of technologies designed to integrate the physical world with the virtual or digital world (Marr, 2019). It includes Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). VR creates an entirely immersive digital environment that users can interact with using specialized hardware, such as VR headsets. AR overlays digital content onto the real-world environment, enhancing the user's perception of reality, using apps on devices like smartphones or tablets, and allowing users to see the physical world and digital information simultaneously. MR combines elements of both VR and AR, allowing digital and physical objects to coexist and interact in real time, involving devices like smart glasses or headsets that can seamlessly merge digital and physical environments. As a broad term that acknowledges the continuum between the purely physical world and the strictly digital one, Extended Reality (XR) is employed to denote all the variations and combinations in between.

It also has applications in various fields, including gaming, education, healthcare, manufacturing, and more. As technology continues to advance, XR is expected to play an increasingly significant role in shaping how we interact with and perceive our surroundings.

AR holds many valuable applications within museum settings (Keil et al., 2013; Hammady, Ma, & Temple, 2016; Ding, 2017; Moorhouse, tom Dieck, & Jung, 2019; Loureiro, 2021; Jiang et al., 2022). Most of them are centered on visitors, allowing them to discover multiple information layers and improve museum experiences. Therefore, AR is a powerful and engaging educational tool. Similarly, VR contributes to enhancing the museum experience, personalizing the learning process within exhibitions, and creating certain levels of expectation – all of which ensure rewards for the museums' visits (Zhou, Chen, & Wang, 2022; Shahab et al., 2023).

Artificial Intelligence (AI) refers to machines that demonstrate behavior indicative of intelligence. These machines operate within the digital realm and are characterized by logic, understanding, critical thinking facilitated by Natural Language Processing (NLP), planning capabilities, awareness, and development (potentially including emotional aspects), creativity, and the ability to learn (Vidu, Zbuchea, & Pinzaru, 2021). One of the distinguishing features of AI is its planning capability. AI systems can devise strategies and organize tasks, demonstrating a capacity for foresight and deliberate action. This planning ability contributes to the adaptability of AI in various domains, from problem-solving to decision-making.

Furthermore, AI systems showcase awareness and development, prompting discussions about the potential for emotional intelligence. While the extent of emotional understanding in AI is a subject of ongoing research and

debate, some AI models exhibit rudimentary forms of emotional responsiveness. Creativity is another facet of AI, as these systems can generate novel solutions, designs, or artworks. AI's creative capabilities are harnessed in fields such as art, music, and design, where algorithms produce outputs that can rival human creations. Crucially, AI possesses the ability to learn from data. Machine learning algorithms enable AI systems to improve their performance over time through experience, making them adept at recognizing patterns, adapting to changing circumstances, and refining their decision-making processes.

According to Kaplan and Haenlein (2019), there are two types of AI: AGI and ANI. Artificial General Intelligence (AGI) refers to intelligence capable of influencing and understanding a range of situations and environments in a broad sense. It can perform at an intellectual level comparable to at least average human performance. Artificial Narrow Intelligence (ANI) can only fulfill functions designed for it to perform, translating into a minimal range of capabilities. While there is a broad skepticism about the possibility of developing AGI, there are many ANI applications in various fields.

Research and publications on AI have bloomed during the past few years, which may also related to the increased popularity of ChatGPT and other AI tools. The literature points out numerous advantages and disadvantages of AI (Khanzode & Sarode, 2020). Somewhat surprisingly, the first literature review was published in 2008 (Oke, 2008). Most studies discuss AI's applications and impact on medicine (Secinaro et al., 2021). Considering the academic interest in how AI is used in museums, the interest is in its infancy. Most studies seem to assess the influence of AI on museum experiences (Recuero Virto & López, 2019). But many more studies investigate other types of technology-

empowered museum experiences, which predate AI's adoption in museums, such as various digital applications, VR, AR, etc. (Chella & Macaluso, 2009; Center for the Future of Museums, 2015; Choi & Kim, 2016; Solima, Della Peruta, & Maggionni, 2016; The Conversation, 2018; Kang & Yang, 2020; Torres-Ruiz et al., 2020; Longo & Faraci, 2023).

Extended Reality (XR) and Artificial Intelligence (AI) are two distinct technologies, but they often intersect and complement each other in various ways (Reiners et al., 2021). Integrating AI with XR can elevate user experience overall, improve interaction, and enable more intelligent and adaptive applications. XR and AI are related in many ways, with the creation of smart content and interaction among them. AI algorithms can generate realistic and dynamic content in XR environments, creating more immersive and engaging experiences. Another vital facet is enhanced personalization and adaptation. AI can analyze user behavior within XR environments to understand preferences, optimize content delivery, and personalize experiences based on individual preferences. AI algorithms can predict user actions and preferences, enabling XR applications to anticipate user needs and provide more proactive and personalized experiences. AI algorithms can adapt XR content based on the user's learning style, progress, and feedback, making educational experiences more compelling. AI-powered computer vision can enhance object recognition within XR environments, allowing for more realistic and contextually aware interactions. Also, AI algorithms can help XR systems understand and interpret the physical environment, enabling better integration of virtual elements into the real world in AR and MR applications. The combination of XR and AI can potentially create robust and adaptive immersive experiences, whether for entertainment,

education, training, or various other applications. As both technologies continue to advance, their integration is likely to become more sophisticated and impactful. For a literature review of the academic studies on the relationships between the two technologies, one might consult Hirzle et al. (2023).

Also, in museums, as in many other fields, XR and AI can boost efficiency and find a wide array of applications, both in the management of collections and the public-oriented activity of museums. Combining AI with Augmented Reality (AR) and Virtual Reality (VR) has opened up new possibilities for immersive museum experiences (Waern & Løvlie, 2022). AR applications can overlay digital information onto the physical exhibits, providing additional context, while VR allows visitors to explore virtual galleries or even step into historical settings. The role of AI is to deepen the experiences, make them more accurate and realistic, and better personalize and enhance museum (educational) experiences. AR and VR present certain benefits for museum visitors but also have limits. An important aspect is related to their maintenance and permanent updating. Logistics is also an important aspect, especially for VR. AR depends mainly on visitors' digital devices, primarily smartphones. In the case of VR, museums have to invest in various equipment to ensure they are working and are safe for museum visitors to use.

Transformative applications can be found at the intersection of AI and museums (Vidu, Zbuchea, & Pinzaru, 2021). Traditionally regarded as repositories of cultural and historical artifacts, museums have embraced AI applications to enhance visitor experiences and bring a new dimension to how we engage with art and knowledge. Chatbots and improved customer services are maybe the aspects that come to mind when thinking about this

topic. Museums consider the integration of chatbots, both online and within the museum premises (some examples and discussions are included in Maniscalco, Minutolo, Storniolo, & Esposito, 2024). Whether encountered on a museum's website or embodied in a physical form like Pepper, these interactive bots serve as informative guides, providing visitors instant information about exhibits, artists, and historical contexts. Pepper is a social humanoid robot with a friendly face developed by SoftBank Robotics in 2014 and is credited as being the first one able to recognize faces and emotions (CAN, 2021), being also able to estimate the age and gender of visitors (Castellano, De Carolis, Macchiarulo, & Vessio, 2020). Until now, it is used mainly as museum guide in several museums around the world, as in the case of the European Museum of Modern Art in Barcelona (Spain), the Smithsonian Institutions in Washington, DC (US), Hydropolis in Wroclaw (Poland), Cité des Sciences & de l'Industrie in Paris (France), Heinz Nixdorf Museum (Germany), the Museum from the Ancient Site of Herculaneum (Italy), Palazzo Madama e Gamor in Torino (Italy), and temporarily, at MUBA in Milano (Italy). In each museum mentioned, Pepper interacts differently with visitors, sometimes as a general guide to the museums but mainly as a specialized educator and facilitator (CAN, 2021; Dafoe, 2018; Tyagi, 2021; Walch, 2020; Weiler, 2018). Other robot-like museum guides and facilitators have been used in various museums, especially in Europe and the US (see Maniscalco, Minutolo, Storniolo, & Esposito, 2024; Vidu, Zbuchea, & Pinzaru, 2021). Although such social robots present various limits, visitors, especially younger ones, prefer to interact with them in many ways (Maniscalco, Minutolo, Storniolo, & Esposito, 2024). Also, Asian museums have their robot guides, as in the case of Asimo at the National Museum

of Emerging Science and Innovation in Tokyo and the Honda Motor Museum (Japan), Aibo at Ohara Museum of Art in Kurashiki (Japan), Temi at the National Gallery and the Changi Chapel and Museum (Singapore), or Jinny at the National Science Museum in Seul (Korea). (Kim et al., 2005; Pitsch et al., 2009; Atewill, 2013; Kageyama, 2013; Sheam, 2015; NDTV, 2018; Iio et al., 2020; Govtech Singarore, 2022).

AI has also revolutionized the conventional audio guide. Interactive audio guides, driven by AI algorithms, can adapt to user preferences, offering personalized narratives and additional insights based on the visitor's interests. This tailored approach enriches the museum visit by catering to individual curiosities. AI's capabilities extend to the creative realm by generating images and films. Museums can utilize AI algorithms to create visually stunning artwork, offering a contemporary twist to the traditional art landscape. Additionally, AI can bring historical figures to life through film generation, offering an innovative way to engage visitors with the past. From producing unique artworks to reconstructing historical events through multimedia, AI fosters a dynamic and evolving museum environment. This infusion of technology adds a layer of innovation to the traditional museum setting, attracting a diverse audience.

The impact might be profound, including the following aspects: improved museum experience, improved accessibility, better collection management and security, exhibition curation and creation, etc. Also, it can enhance museum education and visitor experiences in museums and online. The integration of AI in museums represents a paradigm shift in how we perceive and interact with cultural institutions. From chatbots facilitating real-time engagement to immersive AR and VR experiences, AI

has become a catalyst for redefining museum visits. As technology continues to advance, the synergy between AI and museums is poised to create even more captivating and enriching experiences for visitors, ensuring that these cultural institutions remain vibrant and relevant in the digital age.

AI has numerous applications in museums (Ciecko, 2017; Ioannakis, Bampis, & Koutsoudis, 2020; Pisoni et al., 2021; Wang, 2021; Gustke, 2023). In the past years, there has been an enhanced interest of museum professionals in this field, as pointed out by various studies and opinions expressed by the Center for the Future of Museums (2015, 2017, 2018, 2023) and the AAM (Alliance Blog, 2018) or other professional groups such as Museum Next (Richardson, 2017; Charr, 2021; Styx, 2023). Also, the Museum Innovation Barometer by Museum Booster (2023) periodically checks this field's state of the art. The Network of European Museum Organisations (NEMO, 2022) also issued a report on digital education in museums. The academic literature in this field is not yet so extended, especially if we consider the educational applications of AI in museums (Aslan, 2021; Aso et al., 2021; Ilhan & Aslan, 2021; Yang & Wang, 2023).

Lastly, ethical concerns must be addressed when adopting another new technology into museum operations, including using AI-generated materials in museums and ensuring multiple voices when reusing historical information to make compelling VR and AR exhibitions that are likely to enhance representations of the past further. Including scientific research and fresh perspectives on past realities when designing educational materials and exhibitions that use emerging technologies is an important feature to remember and not overlook in favor of focusing solely on the new technology usage. Since

AI-supported digital environments are likely to become a significant medium to inform the next generations' representations of heritage artifacts and past societies, ensuring the accuracy of information and a science-based approach are of particular concern.

Visitors' experiences through the lens of emerging technologies. An overview

Exploring the current usage of AR and VR in museums from Romania reveals a transformative landscape that has gained momentum during the last ten years. Although less addressed, artificial intelligence is central to several new museum experiences. Several particular features of how technological advancements intersect with cultural and educational experiences are noted when exploring how AR and VR applications in museums and heritage have evolved beyond novelty into integral tools for enriching visitors' engagement and learning. Partnership and cooperation, as well as additional grants and funds, are critical to such projects, and most of the examples presented within this chapter are, in fact, the results of such collaborations and additional sources needed to cover various costs.

The novelty of AI, as well as the AR and VR technologies used in educational materials, is enhanced by being promoted as exceptional events by the media and museums through online communication tools (blogs, websites, social media platforms, etc.). More often than not, VR or AR are associated with specific insertions in museums' permanent exhibitions, short-term exhibitions, and events that are either hosted during a local festival or at the inauguration of an exhibition. The oldest examples we could reveal consist of two AR applications. One is in the National Museum of Art of Romania (MNAR) –

the country's leading art museum–and another is in the Grigore Antipa National Museum of Natural History (Antipa Museum) – probably the most famous museum with children and not only. In 2013, MNAR implemented three complex projects financed by the Orange Foundation and the Administration of the National Cultural Fund (AFCN). These projects were probably the first and one of the few consistent attempts in Romania to make art accessible to people with special needs. An AR application was among the educational and exploration tools designed at the time (MNAR, 2013, pp. 41–42), which allowed for a unique exploration of the *Flower Bouquet* by Jan Breugel the Elder. Thus, when scanning the painting with their phones, visitors had access to a digital 3D model of the flower bouquet, while information about the different species of flowers and insects present in the painting was overlayed on the 3D model. Moreover, the app offered visitors additional information about the painter's life, allowing for a better understanding of the context in which the painting was made and its symbolism. The AR application was accompanied by a leaflet designed as a map, allowing further exploration of the artwork and the museum's European art collection. Unfortunately, the museum could not secure additional funding for updating the app and its maintenance; therefore, it stopped working within a few years of its launch. The previous year, in 2012, at Antipa Museum, visitors could actually see two of the museum's most important artifacts through AR applications: *Mammut americanum* and *Deinotherium gigantissimum* (Cerban& Mironescu, 2012). Smaller-scale initiatives are sometimes encountered in museums across the country, such as the County Museum in Buzău, whose permanent exhibition includes several smart showcases that enable the visitor to interact with exhibited objects

through touch screens and rotative devices. Also, by collaborating with local enterprises, VR experiences are sometimes proposed to younger visitors (Muzeul Județean Buzău, Facebook, 2022).

Considering the new technologies, more recent and consistent examples include unraveling the Museum of Abandonment. This museum is one of Romania's newest and most special museums. It is a digital and participatory museum-forum based on an independent project that has undertaken the mapping of the culture of abandonment and the rendering of a historical narrative of the phenomenon of child abandonment in Romania. The Abandonment Museum was awarded in 2022 at the Awards Gala of the National Cultural Fund Administration (AFCN) with the Prize for Social Inclusion and Intercultural Dialogue and at the Civil Society Gala with three First Prizes in the sections Art and Culture, Social Impact, Communication Campaigns on Social Issues (Muzeul Abandonului, 2023b). This museum stands out, among other aspects, through live events labeled "Unboxing Muzeul Abandonului" and short-term exhibitions and events that present glimpses into past realities. In this way, museums incorporate AR to provide context, additional information, and interactive elements, creating a dynamic and immersive environment. VR, on the other hand, transports visitors to virtual realms, offering simulations, reconstructions, and experiences not possible within the physical confines of the museum. A three-day event exhibition took place in the emblematic building of the former St. Catherine's Children's Home (Leagănul de copii), which also included unpublished documents from the institution's archives from 1903 to 1948.

However, with the extension of emerging technology and the opportunities offered by VR headsets to be used

outside museum spaces, the prospects of encountering a VR experience proposed by a museum or an organization related to heritage, history, or memory have enlarged. Thus, children are exposed to such experiences during educational activities at school due to an extensive range of partnerships and projects. Of particular concern seem to be rural areas, with a recent example including a larger itinerant educational project run by Zalău County Museum of History and Arts, with children having mediated access, via VR headsets to 3D archaeologically investigated objectives from the Roman Castrum of Buciumi (Muzeul Zalău, 2023a, b). Also, in the line of interest for rural areas and the best way in which museums situated in villages across Romania might be promoted to larger audiences, another recent project draws attention. Based on digital technology, the platform Museums from Villages (muzeedelasat.ro), launched in 2021, has so far included 73 virtual tours of 68 museums in 60 villages. It provides a virtual tour of each cultural site as an interactive 3D projection integrated into Google Street View, Google Maps, and Google Earth (Muzee de la sat, 2023).

In terms of integrating the physical world with the digital world, this approach has been widely implemented in many larger museums in Romania. Each major museum can boast virtual tours for various segments of their permanent exhibition, with direct access from their websites. It is important to keep in mind that online virtual tours (usually a 3D panorama of the permanent exhibition) are often encountered on museum websites in Romania: the national museum register includes 189 such tours out of more than 840 museums and collections included in this register (Cimec, 2023).

However, rendering collections from museums in rural areas accessible online contributes to improved awareness

of their potential and an increased familiarization of larger (and newer) audiences with a modern way of engaging with museum artifacts and exhibitions. Together with the nonprofit organization Teach for Romania, Museums from Villages is also developing a project through which around 1.000 pupils from disadvantaged schools can access the museums on the platform through VR glasses (Popovici, 2023).

Larger cultural events like festivals also allow larger audiences to engage with VR experiences proposed by museums or in a museum setting. Recent examples include electro arts festivals in Cluj (Clujotronic, 2020) and the Transylvania International Film Festival (Tiff, 2022), both involving the Art Museum in Cluj. During these events, various AR and VR experiences were proposed to the public, thus rendering interaction with heritage via emerging technologies a regular experience associated with other forms of cultural consumption. Street Art Delivery, another well-known significant (cultural) event organized in Bucharest, has been a good opportunity for museums to step outside their traditional settings and to interact with larger audiences, offering them various interactive exhibitions, including technology-mediated experiences (Dicționar pe sărite, 2021). Art Safari, self-branded as the „museum of temporary exhibitions," is another extremely popular cultural event organized in Bucharest, offering out-of-the-box exhibitions and experiences to its visitors. Amongst them, several VR experiences stand out, such as the 2018 VR and AR experiences that have featured in "50 de tablouri impresioniste" (IQAds, 2018) or the recent 2023/24 experience organized around the anniversary of 60 years activity of Madrigal Choir (IQAds).

The Night of the Museums, which is probably the most popular cultural event in Romania in the past years,

is also cooperating with Samsung for unique cultural experiences. For instance, during the last edition of the Museum Night, the audience could visit the AwesoME Gallery, including AI portraits created with Galaxy A series mobile phones (Samsung, 2023). However, this is not the first partnership involving AI or other new technologies. In 2018, participants at the Night of the Museums in Bucharest could explore the live artistic experience of Raluca Bararu in a VR universe (IQads, 2018). In 2019, Samsung implemented the dARe project in partnership with the Museum of Recent Art and Odeon Theater, allowing the public to bring art to life using AR and digital technologies (IQads, 2019). Unsurprisingly, most projects of this kind took place in large cities. Another example is the 2019 event developed by the Art Museum of the Moldova Museum Complex and the artist Dorin Baba (BZI, 2019). meanwhile, one of the most recent examples of VR experience used in exploring art comes from Bucharest, where at the exhibition "The Universe of Salvador Dalí" (2023/2024) had the opportunity to discover hidden details of the Spanish artist's creations in a new dimension, and will turn the visit into an interactive journey into the surrealist imagination of Salvador Dali (Arcub, 2023).

Last but not least, AR, VR, and AI have occasioned a strengthening of partnerships between museums and for-profit organizations, as well as opportunities for museums to grow closer to academic domains that are not traditionally associated with them, such as ICT and human-computer interactions. In this line, we will briefly highlight two examples that illustrate how diverse organizational objectives can be unified under the broader umbrella of public outreach.

AI usage – museum education and (private) corporate social responsibility

A commercial bank has developed one such example of AI usage within the framework of a long-time CSR initiative aiming to improve the financial education of the general public, including children. Partnering with the Museum of Immersive New Art (MINA), the largest new media art center in Romania, inaugurated in 2023 (https://www.minamuseum.com/), a well-known commercial bank in Romania has put together an innovative financial education project. Developed by artists, the project showcases Vivi, the intelligent avatar of financial education based on artificial intelligence algorithms, trained to learn the entire financial education curriculum of existing courses dedicated to preschool, primary, and secondary school children. The avatar's face is animated when it speaks, providing the most authentic interaction possible. It can adapt its answers in real-time and to the children's questions. The avatar has interaction mechanics designed to keep children interested and convey educational information in fun ways, while there is no limited number of questions children can ask (EduPedu, 2023).

A groundbreaking project of AI usage in museums was also developed within a partnership framework between Casa Mureșenilor (Brașov) and the Transilvania University in Brasov in 2019. A female avatar-like presence, called IA – which is also the Romanian acronym for artificial intelligence – is the first virtual assistant to greet museum visitors in Romania right at the museum entrance. She is based on a computer program and visualized on a TV screen. The AI can provide on-demand information about the Casa Mureșenilor museum, its exhibitions, and exhibits in Romania. In doing this, it increased social interaction

with visitors through dialogue and non-verbal actions (gestures, facial expressions) in a friendly way. Besides the novelty of this initiative, the project also reveals the challenges encountered by researchers (historians and IT developers) and educators in introducing new technology designed to enhance visitors' experiences. Amongst them, one can name the organization of the required information and the selection of available tools and software components (text-to-speech tools, natural language processing software, and display solutions), with additional challenges generated at that time by pronunciation in Romanian. With the gradual development of technology, at least some of these challenges will be easily surpassed. However, historians and museum educators alike are poised to explore new facets of using AI in museum settings, such as dynamic storytelling and offering personalized and immersive experiences in accord with diverse interests and learning styles (Seitz, 2019).

XR – from classical usage in heritage education and preservation to sharing collective memory and trauma

An increased number of research projects developed by museums aim to enable more extensive access to heritage items by preserving and conserving them and making them available in new environments – e.g., digital environment. Besides obvious advantages related to an increased number of potential visitors by virtual means, these methods also ensure that relevant details (color, shape, dimensions, textures, etc.) are registered for further references. In this line, VR enables visitors to explore previously inaccessible details: museum objects previously displayed under a protective glass can now be explored at leisure from different perspectives. Using VR headsets

that can be easily moved from one place to another may, in time, decrease mechanical damage to heritage objects since they may require less manipulation for itinerant exhibitions and also have the potential to increase the number of "visitors." The Ethnographic Museum of Transylvania in Cluj has recently been involved in two such projects. The open-air section within the Ethnographic Museum of Transylvania in Cluj harbors several wooden constructions, amongst which a wooden church built by Horea (Vasile Ursu Nicola, 1731–1785, a well-known figure animating social and national movements in the second half of the 18th century Transylvania). Recently, the church has been restored and made an object of a virtual reality exhibition organized around the original inventory of the museum. VR headsets enabled people to visualize several items related to liturgical service. Another project was dedicated to a relevant collection of glass-painted icons from the museum collection – over 60 such items are now available to larger audiences via VR (Muzeul Etnografic al Transilvaniei, 2023).

A pronounced component of education and interactivity is to be encountered at the National Museum of Maps and Old Books [Muzeul Național al Hărților și Cărții Vechi] in Bucharest, within an innovative project suggestively named "Hands on the map!". A mobile app dedicated to children aged 10–14 was created for children to meet and greet Nora, a girl their age. Passionate about maps and extremely curious, Nora comes from the future, and her role is to lead young visitors through the museum in a fast-paced and highly engaging manner. Formal and non-formal education elements are included within this experience that merges AR and gamification to render curriculum content from various school disciplines, such as history and geography, more appealing to children

and, at the same time, to familiarize them with museum collections and concepts related to cartography (National Museum of Maps and Old Books, 2023). This is not the first exploration of this museum's collections. Previously, some of the museum's graphics have been brought to life through AR technology within the framework of a project developed with students (IQads, 2021). However, in this case, the added value was not related to educational aspects but to the enhanced experience of the visitors and is mainly connected to the involvement of students and stakeholders in co-creating this experience.

Mixing state-of-the-art technology (augmented reality), unconventional exhibition spaces (pop-up museums and virtual exhibitions), and heritage items (images, song recordings, etc.) has proved to be a successful combination. This strategy effectively serves the dual purpose of enhancing the museum experience (via educational projects) and bridging generational and demographic gaps among museum visitors, as through their versatility, pop-up museums can be placed anywhere from street festivals, schools, museums, and cultural centers within rural areas. "De la Tilincă la Opincă. Dicționar pe sărite" has been such a project that via its activities (six pop-up museums, an outdoor exhibition, and a virtual exhibition) and using augmented reality as a link with the new generation attracted an audience that would otherwise not be interested in a project promoting a "rural vocabulary." For six months (in 2021), a team of ethnologists, museum educators, visual artists, and two animators translated 22 old terms into 2D and 3D augmented animations, which were unveiled in six "pop-up museums" (Nicolescu, 2021; National Peasant Museum, 2021).

For reasons about visibility, but not only, most examples presented within this article revolve around

larger museums that have considerable resources to pour into ambitious technology projects. However, smaller museums have also developed notable initiatives in this direction, such as Zalău County Museum of History and Art, which boasts not only itinerant educational projects using VR and AR but also on-site exhibitions using these technologies. Visitors can explore Roman-era items retrieved from archeological surveys organized in the nearby area. Five such virtual items can be visualized in AR mode: some smaller-scale items, such as statues and vases, and larger items, like funerary monuments and colossal statues. In addition, an architectural ensemble, namely a temple, has been virtually reconstructed and is presented in AR mode. On the other hand, VR is employed to engage the visitor into experiencing two different historical eras – a virtual tour of a street in the Roman city of Porolissum as well as a virtual tour of the city center of Zalău from the beginning of the XXth century – are available for exploration. They are accompanied by voice-recorded information on day-to-day life, society, and architecture. Other examples of new technology applications available to a general audience within the same museum are an interactive book dedicated to the life and works of a national political figure whose family hails from the region, a virtual assistant (the emperor Caracalla) tasked with greeting visitors and shortly presenting the museums and the surrounding archeological areas. Last but not least, a VR application is used for temporary VR exhibitions: its functioning is relatively simple: 3D models of heritage items are uploaded within the application, with users being able to rotate the objects and observe them from different angles. The same usage can also be employed for 3D models of buildings that have previously been scanned and digitally processed through photogrammetry.

Last but not least, emerging technologies prove to be a suitable answer when bringing past social causes into the current conversation and themes of interest, especially for younger generations. The Museum of Abandonment, which aims to document and get public attention on a highly sensitive topic belonging to the recent past, is such an example. This large project is based on museum content and mixed methods of documentation ranging from archival research, interviews, testimonials, photo-video documentation, 360 photography, and 3D scanning that are exposed to the public in a three-dimensional and interactive format that borrows specific languages of new media, video games, and virtual reality. The project started under a multi-disciplinary team comprising communicators, historians, architects, psychologists, archivists, and museographers, with VR experience produced and developed by the Augmented Space Agency. Among their recent public events are the above exhibition at St. Catherine's Children's Home and several workshops dedicated to teenagers. However, the main project to date that has been constructed around „classical" items is a virtual reality exhibition – *Sighet. Cămin Spital* –, available via VR stations but also online, through a comprehensive and interactive website (https://muzeulabandonului. ro/experienta-digitala/; Museum of Abandonment, 2022a, b). This particular initiative revolves around the building of the Hospital Home in Sighet – the origin of worldwide-circulated images in the early 1990s – that was abandoned twenty years ago. The building has been digitally preserved through 3D scanning and is now the symbolic home of the Museum of Abandonment. Being „a cloud of dots," this museum can be accessed worldwide, and the stories it houses can be listened to at the virtual visitor's own pace. At the same time, it also retains the

essential components of a modern museum: it brings forward a relevant (and sensitive) topic, it allows for multiple voices, it aims to educate not only to entertain, is based on items traditionally associated with cultural heritage (pictures, archives, oral history, a building) and employs scientific methods when researching its central theme.

Discussion and further research

As can be easily observed from the examples above, many initiatives aim to introduce AR and VR technologies in museum environments. In most cases, they are the results of different partnerships and depend either on extended, long-term collaborations with technology developers (see MINA, Museum of Abandonment) or on platforms and technologies that are publicly available and free of charge or that are used under various other research licenses (see Casa Mureşenilor, Muzeul Hărţilor). Access to technology is, therefore, an important characteristic that influences the capacity of a museum to implement such projects. Meanwhile, the skills and abilities its employees must acquire are yet another feature influencing the pace of technology adoption. Last but not least, the costs of such initiatives are easily overlooked; however, most of them depend on contextual factors, opportunities, and networks since a significant part of presented projects were based on grant competitions such as EEA grants (issued by Iceland, Lichtenstein, Norway) or AFCN grants (a competition organized by the Ministry of Culture in Romania). With these two features in mind, it is important to remember that visibility may also be an issue: limited funds affect not only the number of projects or their coverage but also their public visibility since most efforts are usually employed

into bringing the project about, and less attention (and funds) are allocated to public communication and visibility. Most of the initiatives included in this study are based in Bucharest or bigger cities. However, notable projects are based on emerging technology in smaller localities (see County Museum Zalău). This is yet another reminder of the dependency between technology adoption in museums and resources required but, at the same time, a strong argument for investing in such projects that, as we have seen in examples pertaining to smaller museums or museums in rural areas, are consistently contributing to the collection being accessible to larger audiences from different locations across the country (See Muzee de la sat, 2023; Muzeul Zalău, 2023 c).

The list below, by no means complete, is a first attempt to map the most visible initiatives recently developed by museums in Romania that further included new technology in their operations, most notably in visitor experiences and museum education.

Augmented reality

Museum	Examples
Grigore Antipa National Museum of Natural History (Bucharest)	Carban & Mironescu (2012)
National Museum of Art of Romania (Bucharest)	MNAR (2013)
National Museum of Maps and Old Books (Bucharest)	National Museum of Maps and Old Books (2023)
National Museum of the Romanian Literature (Bucharest)	Gorunescu (2017)
Art Museum of Arad	Arad Obiectiv (2023)
Moldova Museum Complex (Iasi)	BZI (2019)
Night of the Museums	IQads (2018), IQads (2019)

Virtual reality and extended reality

Museum	Examples
Zalău County Museum of History and Art (Zalau)	Muzeul Judeţean de Istorie şi Artă Zalău (2023a) Muzeul Judeţean de Istorie şi Artă Zalău (2023b) Muzeul Judeţean de Istorie şi Artă Zalău (2023c)
Museum of Abandonment	Muzeul Abandonului [Museum of Abandonment] (2023a) Muzeul Abandonului [Museum of Abandonment] (2023b)
Museums from Villages (online platform)	Muzee de la sat [Museums from villages] (2023)
ASTRA Museum (Sibiu),	Muzeul ASTRA [ASTRA Museum] (2022)
Ethnographic Museum of Transylvania (Cluj)	Muzeul Etnografic al Transilvaniei [Ethnographic Museum of Transylvania] (2023a) Muzeul Etnografic al Transilvaniei [Ethnographic Museum of Transylvania] (2023b)
County Museum Buzău	Muzeul Judeţean Buzău [Buzău County Museum] Facebook, (2022)
National History Museum of Transylvania (Cluj)	Via Cluj, TV (2018)
Art Safari	ArtSafari (2023)
National Museum of Romanian Peasant	Muzeul Naţional al Ţăranului Român [National Museum of Romanian Peasant] (2020) Dicţionar pe sărite (2021)

Artificial Intelligence

Museum	Examples
Casa Muresenilor Museum	Seitz (2019)
MINA	EduPedu (2023)
Museum of the A.I. Cuza University Iaşi	Euronews (2022)

As with any new technology employed to inform, educate, and entertain larger audiences, one of the main

challenges revolves around providing consistent and valuable educational input via engaging experiences without giving way to superficiality and easy entertainment. Yet another aspect essential in introducing and using new technologies in the short and medium term is related to costs generated by devices and know-how as to how to use and service them when needed (repairs, cleaning, etc.). Additionally, adopting new technological devices implies considerable effort in adapting museum space for storage, the actual usage of those devices, and finding transport solutions when outdoor activities are organized. All these challenges are reflected by the need to identify alternative funding solutions. The fact that most examples provided within this article are based on projects funded by various grand competitions or for-profit organizations is telling. An additional factor influencing the success of adopting new technologies to be used in the visitor experience is the ease of usage for all the parties involved: visitors and museum educators/personnel. Therefore, a technology based on mobile phone usage might be preferred to a complicated mix of different headsets.

While VR and AR are not in their beginnings in terms of being successfully integrated with museum experiences, they are still marking a pivotal juncture in the relationship between these institutions and their audiences, as well as between them and their traditional partners, ranging from for-profit organization to academic and research facilities. Transcending conventional museum boundaries by reaching larger audiences and enabling more in-depth exploration of societal causes, multiple voices, and perspectives is another opportunity for museums to explore. The potential for AI to enrich experience through personalized interactions, content creation, and educational engagement has also been

tapped into. However, its usage is less encountered than AR and VR. Nevertheless, more research is needed to assess how these new technologies transform the relationship between museums and their visitors and between visitors and how they are provided with access to information about valuable cultural heritage items.

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