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(REVIEW ARTICLE)

The use of artificial intelligence during the educational process for students with attention deficit and hyperactivity disorder

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Abstract

This research paper delves into the transformative potential of artificial intelligence (AI) in education, with a specific focus on students with Attention Deficit Hyperactivity Disorder (ADHD). It examines both the advantages and challenges associated with the integration of artificial intelligence into educational practices. Beginning with an overview of artificial intelligence's emerging role in education, the paper explores the characteristics and symptoms of ADHD, tracing its historical evolution. This sets the stage for an in-depth discussion of the signs and symptoms of ADHD and the need for tailored educational approaches. The study further deepens into the concept of artificial intelligence, elucidating its capacity to replicate human mental capabilities and its growing significance in education, particularly within the realm of special education. The legislative landscape within the European Union (EU) and Greece regarding AI integration in education is also outlined. After the literature overview, artificial intelligence's pivotal role in education is highlighted, encompassing personalized learning experiences, virtual tutors, and its positive impact on student engagement, critical thinking, and problem-solving skills. The challenges posed by artificial intelligence integration are meticulously explored, including ethical concerns, biases in automated assessments, and the importance of fostering stakeholder awareness and education. Additionally, the operational prerequisites for AI implementation are addressed, encompassing both technical infrastructure and human resources. Special emphasis is placed on the necessity for adequate training and support for students and teachers, alongside the challenge of ensuring access to essential technical resources. In conclusion, the paper underscores the substantial potential of artificial intelligence to reshape education while acknowledging the importance of addressing ethical concerns and ensuring equitable access to artificial intelligence technologies. This research underscores the pivotal role of artificial intelligence in adapting to the evolving demands of 21st-century education, with a strong emphasis on personalized learning and learner-centered approaches.

Keywords: Artificial intelligence; AI; Special education; Attention deficit and hyperactivity disorder; ADHD; Information and communications technologies; ICT

1. Introduction

The use of information and communication technologies in education in recent years has proven to be a powerful tool for effective and efficient learning while offering all the necessary means to create inclusive and accessible classrooms for all. Their use in special education has empowered teachers to provide personalized and high-quality services to their students. The benefits are even greater for the students themselves, who, with the use of technology, can overcome hearing and vision problems, enjoy a more creative lesson through the use of interactive whiteboards and projectors, and benefit from educational platforms (Drigas, Ioannidou, 2012).

One of the emerging technologies that can further enhance the educational process is artificial intelligence. UNESCO (2021) has issued a guidance manual for policymakers to support Member States in harnessing the potential of AI

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technologies to achieve the 2030 Agenda's sustainable development goals in education, while ensuring that their application in education is guided by the principles of inclusion and equity.

The use of such tools and platforms for students with ADHD could enhance their performance in school, help their self-control, and enhance their attention, reducing the gap between them and typical education students. This, apart from the learning outcomes, would also have emotional benefits for the student, as in this way their self-confidence would be improved, which could lead to the reduction of aggressive and delinquent behaviors that characterize the disorder and often stem from stigma and marginalization.

The purpose of this study is to investigate whether the use of artificial intelligence in the educational process can produce multiple benefits for students with Attention Deficit Hyperactivity Disorder, as well as the challenges that may accompany its use. Artificial intelligence is rapidly evolving in all sectors of society and is expected to play an important role in education in the near future (Carvalho et al., 2022).

2. Theoretical framework

2.1. Attention Deficit Hyperactivity Disorder (ADHD)

Attention deficit disorder with or without hyperactivity is a developmental disorder characterized by symptoms of deficit or exacerbation in the fields of attention span, impulsivity, and hyperactivity. It is one of the most common developmental disorders, usually appearing in infancy and continuing into adulthood. (Karabatzaki, 2010). This disorder is recorded in the DSM IV of 1963 (Nauebi, 2015) and to date has received several names, that reflect how the disorder and its causes have been perceived over the years. Some of the most characteristic terms are minimal brain damage, encephalopathy, hyperactivity syndrome, and psychomotor instability (Karabatzaki, 2010)

Nowadays, the Diagnostic Statistical Manual of Mental Disorders DSM-5 adopts the term Attention Deficit Disorder with or without Hyperactivity and locates the field of interest in attention problems, which occupy a central place in this disorder and not so much in hyperactivity problems, which may be absent. Due to the above restrictions, children with brain damage are excluded from the classification. The manual distinguishes three aspects of the disorder. Thus, attention deficit hyperactivity disorder, attention deficit hyperactivity disorder, and attention deficit/hyperactivity disorder not otherwise specified are identified (Karabatzaki, 2010).

2.2. Signs and symptoms of ADHD disorder

People suffering from this disorder experience strong impulsivity, decreased concentration of attention, and intense motor activity, although the latter is not always present. A child with ADHD often finds it difficult to sit for a long time in a position or even when sitting, shows constant movement in a part of his body (eg., nervous movement in the leg), is overly talkative and noisy, acts without having thought about his actions and their consequences, is inattentive, ignores danger and shows a lack of fear.

- More specifically, characteristic symptoms of the disorder can be:
- Constant body movement and preference for running rather than walking
- Frequent moaning with outbursts
- Destructive tendencies
- Violent and delinquent behavior – aggression
- Easily jumps from one activity to another
- Instability – clumsiness
- Auditory and visual memory impairment
- Orientation difficulty
- Dyslexia
- Speech problems

For the diagnosis of the disorder, it is not necessary to have all of the above. According to studies, the average age of occurrence is 3 and a half years old and its effects are evident in many areas of life, such as the family, school, and social life of the child (Karabatzaki, 2010).

2.3. Artificial intelligence

According to the Merriam-Webster dictionary, artificial intelligence is the ability of a machine to mimic a human's mental capacity. Alternatively, it could be described as the study and development of intelligent agents who can perceive their environment and act in a way that increases the chances of success (Drigas, Ioannidou, 2012). It is used for tasks that require the utilization of human intelligence through a computer application (Hopcan et al, 2022). This technology can take either physical form (e.g. humanoid robots) or software (e.g. virtual assistants). According to Stone et al. (2016), artificial intelligence draws inspiration from how human beings use their neural networks to understand, learn, evaluate, and behave appropriately. Artificial intelligence imitates all of the above. Its foundation was the idea that intelligence could be described so accurately that a machine could reproduce it. This is precisely what distinguishes it from other computer programs, namely its ability to self-learn in a developed form. This is because AI can develop competencies comparable to human learning, such as situational understanding, problem-solving, and language communication (Kok et al., 2009).

In recent years, this innovative technology has been introduced in special education, producing benefits for students with various special educational needs. The advantages of its utilization lie in the creation of powerful learning environments that promote interaction with students and create a pleasant learning environment (Drigas, Ioannidou, 2012).

2.4. Legislative framework in the EU

Defending users' fundamental rights and safety, as well as ensuring trust in the development and acceptance of AI, is at the heart of the European Commission's proposal for a regulatory framework for Europe.

The Commission proposes a risk-based approach, with four levels of risk:

- Unacceptable risk: ban a very limited set of particularly harmful uses of AI that contravene EU values because they violate fundamental rights
- High risk: a limited number of AI systems identified in the proposal that have a negative impact on people's safety or fundamental rights (as protected by the EU Charter of Fundamental Rights) are considered high-risk. The list of high-risk AI systems is attached to the proposal.

Mandatory requirements are proposed for all high-risk AI systems on:

- Quality of datasets used
- Technical files and record-keeping
- Transparency and information for users
- Human oversight
- Robustness, accuracy, and cybersecurity

In the event of a violation, national authorities will be able, under the requirements, to access the information needed to investigate compliance with the legislation. The proposed framework is in line with the Charter of Fundamental Rights of the European Union and with the EU's international trade commitments.

- Limited risk: For certain AI systems specific transparency requirements are imposed, for example where there is a clear risk of manipulation (e. g. through the use of interactive robots). Users should be aware that they are interacting with a machine.
- Minimal risk: All other AI systems can be developed and used subject to existing legislation without additional legal obligations. Most AI systems currently used in the EU fall into this category. Optionally, providers of such systems may choose to apply the requirements for trustworthy AI and adhere to voluntary codes of conduct.

2.5. Legislative framework in Greece

Law 4961/2022 - Emerging information and communication technologies, strengthening digital governance and other provisions

- Putting in place the necessary safeguards to enable public sector bodies to reap the benefits of AI technologies
- Ensuring that AI technologies do not lead to undesirable ethical consequences in the workplace
- Establishing a regulatory framework for the implementation of the national strategy for the development of artificial intelligence in Greece

- Establishing an Observatory on Artificial Intelligence

3. Literature Review

3.1. Utilization of Artificial Intelligence in children with ADHD

According to the review by Dringa and Ioannidou (2012), creating AI-based tools could empower students with ADHD by providing them with personalized and data-tailored guidance, real-time feedback through virtual assistants, and opportunities for self-monitoring and limiting distraction. The authors study some smart systems, that are already used in the diagnostic or educational process. One of them is the smart teaching system designed by Aguilar and others (2010), which adapts to the individual characteristics and preferences of each student and offers targeted support and guidance to students using audiovisual media so that on the one hand they remain committed to the subject of learning and on the other hand they are psychologically empowered through rewarding their achievements (Drigas, Ioannidou, 2012).

The benefits of personalized learning that can be organized using artificial intelligence have also been noticed by Sinan Hopcan, Elif Polat, Mehmet Emin Ozturk, and Lutfi Ozturk (2022). More specifically, they say that the use of AI tools can help ensure that each individual is assessed according to his or her cognitive level and interests. In this way, students will have the opportunity to learn each subject in depth. In addition, these tools enable each student to learn at their own pace, while guiding teachers towards a more personalized approach. Personalization can even apply to homework, which is structured to meet the learning needs of each student, taking into account their learning profile (Hopcan et al., 2022). At the same time, these technologies can provide useful metadata about the way the human brain works and the mental functions involved in learning, allowing researchers to create an effective and efficient learning system that integrates traditional teaching practices, enriched with the necessary innovative elements that will make teaching more enjoyable for the learner and more efficient for the teacher (Becker, 2017). Unlike the traditional system, which treats and approaches all students in the same way, AI can offer an alternative and more efficient approach for each student, which is designed around their personality, strengths, and skills (Chen et al., 2020). For example, chatbot-type software applications are considered programs that run on artificial intelligence and can detect and understand speech and then respond correctly. Such applications can provide personalized learning support using a variety of tools, including computers, mobile devices, and speakers. According to Topal et al (2021), cooperation between chatbots and students in a classroom can encourage learning by laying the foundation for an innovative approach to teaching.

Mhlanga (2023) and Qadir (2022) argued that students could use AI tools as virtual tutors, receiving feedback and personalized responses at any time and place, for any subject, since they are capable of discussing a multitude of topics, both educational and non-educational. This approach can allow students to gain greater autonomy and motivate them to delve into subjects beyond their schoolwork that fall within their interests, promoting not only academic progress but also personal development. Furthermore, the questions and prompts generated by chatbots, such as ChatGPT, potentially encourage the participation of students with different levels of knowledge and skills in the educational process, as well as stimulate problem-solving and critical thinking skills (Kasneci et al., 2023), which are vital for 21st-century education. The learner is engaged in a synthetic approach to learning, as they are challenged to answer a set of questions tailored to their level (Cotton et al., 2023). Through their ability to act as intelligent conversationalists, they can provide students with valuable opportunities to improve both their social and argumentation skills (Bayat et al., 2022). Students can engage virtually in a discussion with the chat, examining the weaknesses of both their own and the opposing position. Through this, students practice evaluating other views, while also understanding how they can strengthen their own. In addition, through the personalized instructions and comments they provide to students on their assignments, they can help them organize and plan their time.

The use of AI, as stated by Zhao et al. (2019), has a favorable effect on students both in gaining new knowledge and retaining already acquired knowledge. This can provide continuous upgrading and improvement to the educational process, arouse students' enthusiasm and interest, and promote their ingenuity and creativity (Huang et al., 2021). At the same time, it offers a wide range of standardized programs for self-learning and teacher support, providing an opportunity to modernize the education system in general (Tulasi, 2023). As a result, AI applications can update curriculum, educational strategies, and scheduling, all of which contribute to the educational process.

3.2. Challenges in the use of Artificial Intelligence

In the discussion on the use of AI in special education, some concerns are raised about the challenges that need to be addressed in its implementation. One concern is its appropriate and ethical use and the bias of its algorithms (Holstein et al., 2019). Many researchers have mentioned that artificial intelligence, due to its inherent characteristics,

incorporates discriminations and prejudices of society, which may be related to stereotypes about gender, nation, preferences, etc. (Madaio et al., 2021).

Shum and Luckin (2019) argue that in order to achieve a happy outcome in the effort to integrate AI into education, stakeholders - teachers, students, parents, and policymakers - need to be informed and educated about the benefits of AI in the educational process, but also the potential risks that may arise. In this way, not only will they be ready to accept and deal with the new technology as a tool and not as a substitute for their effort, but at the same time it will establish its acceptance by all stakeholders, ensuring rational and efficient management of the resources that will be allocated to it.

Chounta et al. (2021) in their study of the concepts of fairness, accountability, transparency, and ethics of AI systems, reviewed Aiken and Epstein's discussion of principles for designing such systems (Aiken and Epstein, 2000). The latter argue that the adoption of AI in education should be motivated by the satisfaction and facilitation of human needs (human-centered perspective) and not by a technocratic perspective. Thus, they proposed the establishment of a set of system design principles based on six fundamental 'aspects' of human existence: physical, intellectual, psychological, moral, social, and aesthetic.

Another challenge that needs to be addressed is the coexistence of humans and artificial intelligence, and particularly the prevention of the former's prevalence in the workplace, creating social and economic problems. Manyika et al (2017) observed that due to human emotional intelligence, creativity, and communication skills, having teachers as guides during the educational process is considered essential. The coexistence of the two in a complementary relationship will be able to yield the best possible results for both the student and the teacher (Kim et al. 2018), who will now have more time and resources to personalize teaching and differentiate the teaching approach according to the needs of each individual. To distinguish between the two types of teaching, the authors described the contribution of AI to the educational process as a more formalized approach to learning and assessment, machine learning.

There are also concerns about the bias of automatic assessment programs, which could create rankings that do not reflect the true potential of each student, with an impact on their emotional state and self-confidence. Thus, the focus is on the need to ensure transparent and explanatory assessments in order to uphold fairness for both teachers and students and to build trust between AI and humans (Holstein et al. 2019). The themes of the UNESCO (2021) handbook highlight the institutional concerns for a fair and safe transition to the new educational standards, ensuring privacy and accessibility. In particular, it highlights the need to regulate the issues of data ethics and algorithmic biases, gender equality, monitoring, evaluation, and research on the use of AI and transform the role of teachers and students in the educational process.

Last but not least, for the tools to be used universally and based on the principles of justice and equity, the operational requirements for their implementation in education must be met. These include both technical infrastructure and human resources. For the latter, provision should be made for appropriate training and support for students and teachers to prepare them for the integration of the new tool. The change will not only concern the physical infrastructure but also the shift of the entire education system to more innovative and modern models of learning and teaching. In terms of technical infrastructure, high-speed internet connections, computing resources, and the necessary specialized software should be provided, which can be a challenge for some schools and students (Božić & Poola, 2023).

4. Discussion

Finally, we stress the significance of all digital technologies in the field of education and in ADHD training, which is highly effective and productive and facilitates and improves assessment, intervention, and educational procedures via mobile devices that bring educational activities everywhere [33-36], various ICT applications that are the main supporters of education [37-53], and AI, STEM, Games and ROBOTICS that elevate educational procedures to new performance levers [54-61]. Additionally, the development and blending of ICTs with theories and models of metacognition, mindfulness, meditation, and emotional intelligence cultivation [62-87], accelerates and improves more than educational practices and results, particularly in students with ADHD, treating domain and its practices like assessment and intervention.

5. Conclusions

Artificial intelligence will soon affect all aspects of life and education is one of them. The existing education system will have to adapt to the changes in order to meet the new needs of the times and to deliver the best for students. Artificial

intelligence offers a range of benefits, including personalized learning experiences tailored to individual cognitive levels and interests, empowering students to learn at their own pace while guiding educators toward more personalized teaching approaches. This innovative approach promotes engagement, encourages critical thinking skills, and fosters problem-solving abilities. Virtual tutors in the form of chatbot-type AI applications provide personalized feedback and responses, enhancing autonomy and motivation, and driving personal development. These tools also encourage students to explore topics beyond their immediate academic curriculum. AI's positive impact extends to knowledge acquisition, retention, enthusiasm, and creativity, contributing to continuous educational improvement. It offers standardized self-learning programs and modernizes the education system. Besides, according to the conclusions of the researches on samples of Greek teachers, investigating their intention of using artificial intelligence in their teaching, they maintain a positive attitude towards it. However, challenges in artificial intelligence integration persist. Ethical concerns, algorithmic bias, and societal prejudices must be addressed to ensure a fair and equitable learning environment. Stakeholder awareness is essential for harnessing artificial intelligence's benefits while mitigating potential risks. Fairness, accountability, transparency, and ethics in AI systems are paramount, with a focus on a human-centered perspective in their adoption. The coexistence of humans and artificial intelligence in educational settings leverages the strengths of both parties, enhancing the learning process. To ensure universal access and equitable AI implementation, addressing technical infrastructure and human resource needs is crucial. Adequate training and support for students and teachers, along with robust technical infrastructure, are vital components of successful AI integration. This integration holds immense promise for creating more inclusive, equitable, and effective learning environments.

The present literature study sought to shed light on the aspects of the use of AI in the educational process of students with Attention Deficit Hyperactivity Disorder and the risks that may be involved in its application. The literature highlights the multiple benefits that AI can bring to education by creating visual aids, such as slides or worksheets that clearly describe the learning objectives and success criteria for a subject. Also, the interactive tools offered through it can encourage the participation of students with different levels of knowledge and skills in the educational process, as well as stimulate problem-solving and critical thinking skills, which are vital for 21st century education. In this way, the learner is now put at the center and is no longer a mere listener, but an active actor, exploring information and data using tools promoted by the teacher and not requiring his/her involvement. By responsibly addressing challenges and balancing innovation with ethical considerations, we can pave the way for a transformative educational landscape that empowers students, supports educators, and fosters a lifelong love of learning.

Compliance with ethical standards

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Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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