

INCLUSIVE EDUCATION IN THE ERA OF ARTIFICIAL INTELLIGENCE AND TECHNOLOGY

Kamelia Nusheva¹, & Boryana Yankova-Hadzhieva²

¹Chief Assist. Prof. Dr., ULSIT (Bulgaria)

²Assoc. Prof. Dr., ULSIT (Bulgaria)

Abstract

The report examines the key role of artificial intelligence (AI) and modern information technologies in the transformation of inclusive education, emphasizing the provision of equal access to quality education for all learners, regardless of their individual characteristics and needs. The report focuses on identifying the main challenges facing inclusive education, such as lack of accessibility, difficulties in personalizing the learning process and limited opportunities for adaptation to different needs. The methodology of the report includes an analysis of existing scientific research, practical applications of AI and technologies in education, as well as a study of successful international practices. The approach is based on combining theoretical research with real-world examples, which allows for an objective assessment of the impact of technologies on inclusion processes. The main tasks of the report are aimed at revealing the role and potential of artificial intelligence and modern technologies in the transformation of inclusive education. Identifying existing technological solutions that support inclusive education processes, focusing on their functionalities and application possibilities. The potential of artificial intelligence for personalizing the learning process is assessed, with the aim of adapting educational resources to the individual needs of learners and improving accessibility to learning materials. Adaptive technologies are analyzed that offer solutions to support learners with different individual needs, including those with physical, cognitive or sensory disabilities. The results achieved demonstrate the significant contribution of AI to improving the accessibility and effectiveness of inclusive education. By using adaptive systems, virtual assistants and applications that provide personalized learning, a more accessible learning environment is created for students with different abilities. The report highlights the successes of specific technological solutions that have proven their effectiveness in a real educational environment. It is concluded that artificial intelligence and modern technologies are not only catalysts for the transformation of inclusive education, but also tools for sustainable solutions to socially significant problems related to inequality in access to education. This paper was developed within the framework of a scientific research project “A model for evaluating the effectiveness and quality of inclusive education, training and lifelong learning” with contract № KII-06-H80/1, funded by National science fund of Bulgaria.

Keywords: *Inclusive education, Artificial Intelligence, technology, transformation.*

1. Introduction

Inclusive education is an educational model aimed at ensuring equal access to quality education for all students, regardless of their individual needs, abilities or socio-economic status. Its main goal is to remove barriers to learning and create conditions for the active participation of all learners in the educational process. This includes not only children with special educational needs (SEN), but also those from marginalized communities, migrants, students with different learning styles and individual challenges.

In the context of rapidly developing technologies, inclusive education plays a key role in reducing social inequalities by providing adapted solutions to the individual needs of learners. Through personalized learning resources, accessible digital platforms and innovative teaching methods, education systems can ensure that no student is left out of the learning process.

Artificial intelligence (AI) and modern technologies offer significant opportunities for the transformation of inclusive education. AI can provide personalized learning experiences by adapting content and teaching methods to the individual needs of students. Among the main benefits of technology in education are: **Personalized learning** – adaptive platforms and software solutions that analyze student progress and offer individualized learning materials; **Improved accessibility** – speech assistants, text and voice recognition technologies, as well as devices to assist people with visual, hearing or motor disabilities;

Automated feedback and assessment – intelligent systems that analyze student knowledge and provide recommendations for improvement; **Virtual teachers and chatbots** – AI-based platforms that provide real-time assistance and guidance to students; **Gamification and engaging methods** – using gamification and virtual reality to more effectively engage students.

Despite the significant potential of AI and technology, a number of challenges still face inclusive education:

- ✓ Lack of access to technology – the uneven distribution of digital resources can limit some students' access to quality education.
- ✓ Insufficient digital literacy of teachers and students – effective use of AI requires training and adaptation to new technologies.
- ✓ Challenges in personalizing the learning process – despite the progress of adaptive systems, many technologies are still unable to fully adapt to the diversity of educational needs.
- ✓ Ethical and social issues – including the protection of personal data, the possibility of bias in algorithms and the risk of addiction to technologies.
- ✓ Resistance to change – traditional educational institutions often encounter difficulties in integrating technological innovations into the learning process (UNESCO, 2023).

In view of these challenges, it is necessary to seek innovative and sustainable solutions that combine the potential of AI and technology with the principles of inclusive education. This report focuses on an analysis of existing technological solutions and their impact on inclusive education, offering practical guidelines for their effective implementation.

This report uses a methodological approach to systematically analyze the impact of artificial intelligence (AI) and modern technologies on inclusive education. The methodology includes three main aspects of the study: analysis of scientific research and existing practices, assessment of technological solutions in the field of education, and study of international good practices and the current state of integration of AI in education in Bulgaria.

2. Technological solutions for inclusive education

The rise of artificial intelligence (AI) and modern technologies is transforming the educational process by facilitating personalized learning, increasing accessibility, and optimizing assessment methods. In these conditions of real change in the learning process, the next change is also taking place: the emergence of the need for a new type of literacy – digital literacy, which is related to new technologies, the way they are used and applied in life. [Evgenieva, 2020]

Artificial intelligence plays a key role in personalizing the educational process by ensuring the adaptation of educational material to the individual needs of students, which is a fundamental element of inclusive education. Through the use of adaptive learning systems, AI analyzes the progress of students and automatically adjusts the content to meet their specific needs. These intelligent platforms allow for dynamic adjustment of the difficulty of tasks according to the student's skills, offer personalized recommendations for learning resources, and help identify knowledge weaknesses by providing targeted support. In this way, artificial intelligence facilitates individual learning and contributes to more effective learning.

Example: Platforms such as Knewton, Smart Sparrow, and DreamBox offer adaptive learning by using data analysis to optimize the learning process.

Personalized content powered by AI significantly improves the learning process by creating interactive and engaging materials tailored to the individual needs of students. By automatically generating text explanations, audiovisual materials, and interactive simulations, AI supports better learning and facilitates learning. It also provides the ability to translate learning resources into different languages or convert them into alternative formats, such as audio versions for students with dyslexia, making education more accessible. In addition, AI enables the creation of virtual tutors who guide students through individualized strategies, offering personalized guidance and support in real time.

Example: IBM Watson Education and Squirrel AI use algorithms to analyze each student's learning style and offer appropriate content.

Digital technologies facilitate access to education for students with physical, cognitive, and sensory disabilities. Many technological solutions have been developed to ensure equal access to education through:

- ✓ Screen readers (e.g., JAWS and NVDA) – software that converts text into speech, assisting people with visual impairments.
- ✓ Speech-to-text programs – such as Dragon NaturallySpeaking, which help students with motor disabilities or dyslexia.
- ✓ Specialized keyboards and alternative interfaces – for students with physical disabilities.

Example: Microsoft Learning Tools includes tools to improve reading and writing by automatically recognizing errors and customizing the interface.

AI-based virtual assistants can provide personalized support by: Answering questions in real time; Directing students to appropriate learning materials; Providing emotional support and encouraging motivation to learn.

Example: Google Assistant, Siri, and Amazon Alexa can be integrated into the educational process, helping students with dyslexia, visual impairments, or language barriers.

Automated feedback and assessment using artificial intelligence provide new opportunities for analyzing and improving the learning process, offering personalized and adaptive assessment methods. Intelligent learning progress analysis systems allow tracking the progress of students and provide detailed analyses of their strengths and weaknesses in knowledge, while suggesting strategies for improving results. In addition, through the collected data, AI can generate individual recommendations for teachers and parents, supporting a personalized approach to learning and increasing the effectiveness of the learning process.

Example: GradeScope and Coursera AI Grader use algorithms to grade essays and tests, providing fast and objective feedback.

Examples of successful practices: Edmentum – an adaptive learning platform that analyzes individual student needs and provides personalized learning paths. Carnegie Learning – uses AI to automatically detect weaknesses in math knowledge and offer personalized exercises. Turnitin – a text analysis tool that helps identify plagiarism and offers guidance for improving writing skills.

3. Analysis of the impact of technology on inclusive education

The introduction of innovative technologies in education leads to significant changes in the way students interact with the learning process. The main improvements include:

Increased accessibility

- ✓ Technologies provide greater access to learning resources through digital platforms that offer alternative formats of content (e.g. audio files, sign language translation, adapted text).
- ✓ Automated assistive technologies such as screen readers, speech assistants and adaptive interfaces support students with visual, hearing and motor disabilities.
- ✓ Online learning systems allow students from remote or underdeveloped areas to receive quality education without physical presence.

Improved learning efficiency

- ✓ Adaptive platforms such as AI-based systems analyze student progress and offer personalized content that reduces learning difficulties.
- ✓ Gamification and virtual reality increase student engagement and facilitate understanding of complex concepts through interactive methods.

Automated assessment tools provide immediate feedback and guidance for improvement, making it easier for teachers and accelerating the assessment process.

Technology can reduce social inequalities by providing equal access to knowledge and educational opportunities.

Reducing educational segregation

- ✓ Online platforms bridge geographical and socio-economic gaps by providing educational resources to students from different social backgrounds.
- ✓ Access to learning in a native or foreign language through automatic translations and voice recognition technologies improves the integration of students from different cultural backgrounds.

Social and emotional support

- ✓ Virtual assistants and chatbots offer emotional support to students who feel isolated or anxious during their studies.
- ✓ Online communities and collaboration platforms (e.g. Google Classroom, Microsoft Teams) encourage communication between students with different abilities and interests, thus building a more inclusive learning environment.

Despite the benefits, there are a number of challenges associated with the implementation of artificial intelligence in inclusive education:

Technological challenges

- ✓ Lack of digital infrastructure – some regions lack the necessary resources to implement advanced technologies.
- ✓ Quality of algorithms – AI may contain bias in algorithms, which can lead to discrimination in the provision of learning resources.

- ✓ Limited personalization – although AI systems offer adaptability, they cannot yet fully replace the human factor in learning.
- Social and ethical challenges**
- ✓ Data privacy concerns – the collection and processing of students’ personal data raises questions about the protection of personal information.
- ✓ Risks of over-reliance on technology – excessive use of digital resources can reduce students’ critical thinking and social skills.
- ✓ Need for teacher training – a large part of the teaching staff is not sufficiently prepared to effectively use AI and technology in the classroom.
- Economic Challenges**
- ✓ High initial investment – implementing smart technologies in education requires significant financial resources.
- ✓ Access Gaps – schools with limited funding may remain at a disadvantage, which exacerbates educational disparities.

4. The current state of AI integration in education in Bulgaria

In December 2020, the Council of Ministers adopted the “Concept for the Development of Artificial Intelligence in Bulgaria by 2030”, which outlines the vision and goals for the development and implementation of AI in the country. (Ministry of e-Government, 2022).

In January 2024, the first large-scale, free training on artificial intelligence aimed at teachers, organized by the Applied Academy of Education “Sindeo”, ended. This training aims to increase the competences of teachers in the use of AI technologies in the classroom. (Economy.bg, 2025).

The Ministry of Education and Science (MES) launched a pilot project in cooperation with Google, covering over 200 Bulgarian schools. These schools received access to Google’s latest educational tools, including those based on AI. The Ministry of Education and Science has an agreement with Intel, according to which Intel will provide 200 lessons in STEM education, which our country can use both to build the national STEM center and to support all educational institutions. (AI Bulgaria, 2024).

Despite these initiatives, a January 2024 survey by the Education Without Backpacks Association shows that 72% of Bulgarian teachers still do not use artificial intelligence in their practice, which highlights the need for additional training and resources. (Economy.bg, 2025).

The Goethe-Institut in Sofia, together with partners from other European cities, launched the EthicAI project, which explores how artificial intelligence and algorithms are changing art and culture. (Goethe Instityt Bulgaria, 2021).

The University of Library Studies and Information Technologies (ULSIT) offers a master's program focused on developing algorithms and models for AI, as well as analyzing large volumes of data. The program combines theoretical knowledge with practical skills, preparing students for the challenges in the field of AI and data processing. Partners such as IBM, ESRI Bulgaria and the Institute of Robotics at the Bulgarian Academy of Sciences participate in the training, providing opportunities for internships and real-world projects (ULSIT, 2025).

In 2023 ULSIT has opened an innovative laboratory combining AI and virtual reality (VR). Equipped with state-of-the-art technologies such as KAT WALK C2+, HTC Vive Cosmos and Oculus, the laboratory provides students with opportunities to create virtual worlds and develop AI algorithms. The laboratory team is working on projects such as recreating the ancient city of Skaptopara and developing methods to support children with special educational needs by combining VR and AI (Global Diplomatic, 2024).

5. Conclusion

Technological solutions not only facilitate access to educational resources, but also stimulate the participation and engagement of everyone in the learning process. Their successful implementation requires constant support from institutions, investment in appropriate devices and training of teachers in their effective use (Stancheva, 2014). Technological solutions based on artificial intelligence create opportunities for the transformation of inclusive education by personalizing the learning process, improving accessibility and automating assessment. They reduce barriers for learners with different educational needs and offer more effective teaching and support methods. Despite these advantages, challenges to the implementation of such technologies include the need for digital literacy, protection of personal data and overcoming unequal access to technological resources. In the future, it is important to seek sustainable strategies for integrating AI into the educational process so that it is accessible to all learners. One of the most frequently discussed ethical challenges in artificial intelligence is bias. It should be noted that data-driven AI systems

are essentially systems that find biases in the data that they are trained on. The question therefore is: what are the socially and culturally acceptable biases and how should they be taken into account in the development, implementation and use of AI systems. (Likova-Arsenova, Vasya, 2020). The adoption of these technologies by education systems provides an opportunity to innovate and improve both the learning process and pedagogical strategies (Grimus, 2020).

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