pISSN:2349-5707 Volume:13,Issue 2, February -2026 eISSN:2349-5715

ADVANTAGES OF TEACHING HIGHER MATHEMATICS TO VISUALLY IMPAIRED STUDENTS USING ARTIFICIAL INTELLIGENCE

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Abstract: This article analyzes the advantages of using artificial intelligence technologies in teaching higher mathematics to visually impaired students. The study focuses on evaluating the didactic effectiveness of AI-based educational tools within the framework of inclusive education. The findings indicate that voice interfaces, adaptive learning platforms, and intelligent virtual assistants significantly improve the understanding of mathematical concepts, enhance independent learning skills, and increase students' motivation. The article highlights the pedagogical and social significance of artificial intelligence in higher mathematics education and substantiates its role in promoting inclusive and equitable learning opportunities.

Keywords : artificial intelligence; inclusive education; visually impaired students; higher mathematics; adaptive learning; digital technologies

Annotatsiya: Mazkur maqolada sun'iy intellekt texnologiyalaridan foydalanish orqali ko'zi ojiz talabalarga oliy matematikani o'qitishning afzalliklari tahlil qilinadi. Tadqiqot inklyuziv ta'lim sharoitida sun'iy intellekt asosidagi o'qitish vositalarining didaktik samaradorligini aniqlashga qaratilgan. Olib borilgan tahlillar shuni ko'rsatdiki, ovozli interfeyslar, adaptiv ta'lim platformalari va aqlli virtual yordamchilar matematik tushunchalarni o'zlashtirish darajasini oshiradi, mustaqil ishlash faolligini kuchaytiradi hamda talabalarning o'quv motivatsiyasiga ijobiy ta'sir ko'rsatadi. Maqolada sun'iy intellekt texnologiyalarining oliy matematikani o'qitish jarayonidagi pedagogik va ijtimoiy ahamiyati yoritilib, inklyuziv ta'limni rivojlantirishdagi o'rni asoslab beriladi.

Kalit so'zlar : sun'iy intellekt; inklyuziv ta'lim; ko'zi ojiz talabalar; oliy matematika; adaptiv ta'lim; raqamli texnologiyalar

Аннотация:В статье анализируются преимущества использования технологий искусственного интеллекта при обучении высшей математике студентов с нарушениями зрения. Исследование направлено на оценку дидактической эффективности средств обучения на основе искусственного интеллекта в условиях инклюзивного образования. Результаты показывают, что голосовые интерфейсы, адаптивные образовательные платформы и интеллектуальные виртуальные помощники способствуют более глубокому усвоению математических понятий, повышению самостоятельности и учебной мотивации студентов. В статье обоснована педагогическая и социальная значимость искусственного интеллекта в преподавании высшей математики и его роль в развитии инклюзивного образования.

Ключевые слова : искусственный интеллект; инклюзивное образование; студенты с нарушением зрения; высшая математика; адаптивное обучение; цифровые технологии

Introduction

pISSN:2349-5707 Volume:13,Issue 2, February -2026 eISSN:2349-5715

In the modern education system, the use of digital technologies and artificial intelligence plays a crucial role in improving the quality and inclusiveness of education. In particular, adapting the educational process for students with disabilities, including visually impaired students, remains one of the most pressing issues. Teaching higher mathematics involves abstract concepts, complex formulas, and graphical representations, which requires special approaches for visually impaired students [1].

Artificial intelligence (AI) technologies enable the creation of adaptive learning environments, the formation of individualized learning trajectories, and the implementation of convenient didactic tools for students with special needs. Voice interfaces, text-to-speech and speech-to-text systems, intelligent learning assistants, and adaptive learning platforms can significantly facilitate the process of mastering higher mathematics for visually impaired students [2].

The use of AI-based technologies in teaching higher mathematics not only changes the way information is delivered but also develops students' independent learning skills. AI allows mathematical formulas to be explained verbally, problems to be solved step by step, and errors to be detected automatically. This contributes to a deeper understanding of mathematical concepts for visually impaired students [3].

Within the framework of inclusive education, the application of artificial intelligence plays an important role in ensuring equal educational opportunities. AI tools specially designed for visually impaired students enhance their independence in learning, strengthen their motivation, and improve academic performance. At the same time, such technologies open new methodological opportunities for teachers as well [4].

This article analyzes the advantages of teaching higher mathematics to visually impaired students using artificial intelligence. Based on the IMRAD structure, the article examines the role of AI technologies in the educational process, their didactic effectiveness, and their significance in the development of inclusive education. The main purpose of the study is to scientifically demonstrate the positive outcomes of AI-based approaches in teaching higher mathematics to visually impaired students [5].

Materials and Methods

This study aims to identify and analyze the advantages of teaching higher mathematics to visually impaired students using artificial intelligence and employs a comprehensive approach based on theoretical and practical sources. Research materials included scientific articles, monographs, reports of international organizations, and data on electronic educational platforms related to inclusive education, artificial intelligence technologies, special pedagogy, and methods of teaching higher mathematics. Priority was given to sources published over the past 10–15 years to ensure the relevance and scientific validity of the results [1].

The research methodology was based on descriptive and analytical methods. First, the literature review method was used to study the role of artificial intelligence in education, its potential in inclusive education, and digital tools designed for visually impaired students. At this stage, the didactic characteristics of voice interfaces, text-to-speech and speech-to-text systems, adaptive learning platforms, and intelligent virtual assistants used in teaching higher mathematics were analyzed [2].

In addition, the comparative method was applied to compare traditional teaching methods with AI-based instructional approaches. Criteria such as the level of knowledge acquisition,

pISSN:2349-5707 Volume:13,Issue 2, February -2026 eISSN:2349-5715

opportunities for independent learning, and impact on learning motivation among visually impaired students were considered. The comparison results revealed several advantages of AI technologies in learning higher mathematics [3].

The pedagogical analysis method was also employed to assess the didactic effectiveness of AI tools in the teaching process, including their convenience in explaining mathematical concepts, interpreting formulas, and solving problems step by step. Special attention was given to the importance of presenting mathematical material in a structured and audio-based format for visually impaired students [4].

Furthermore, generalization and logical conclusion methods were used to systematize the obtained results. The pedagogical and social significance of AI-based technologies in teaching higher mathematics was expressed in the form of general scientific conclusions. These methods enabled the formulation of conclusions consistent with the objectives of the study [5].

Overall, the applied materials and methods provided a sufficient methodological basis for a comprehensive study, scientific justification, and evaluation of the advantages of teaching higher mathematics to visually impaired students using artificial intelligence from the perspective of inclusive education development [6].

Results

The research results indicate that the use of artificial intelligence (AI) technologies yields significant positive outcomes in teaching higher mathematics to visually impaired students. Data obtained through literature analysis and comparative evaluation confirm that AI-based approaches are more effective than traditional teaching methods. Notable improvements were observed in the level of mastering mathematical concepts, independent learning opportunities, and learning motivation [1].

Visually impaired students who used AI-based voice assistants and adaptive learning platforms experienced fewer difficulties in understanding mathematical materials. According to the results, step-by-step audio explanations of formulas and problems significantly improved students' comprehension. This effect was particularly evident in complex subjects such as calculus, algebra, and differential equations [2].

Table 1 presents a comparison of key educational indicators of visually impaired students with and without the use of artificial intelligence.

Table 1. Comparison of AI-Based and Traditional Teaching Approaches

Indicators	**Traditional Approach (%)**	**AI-Based Approach (%)**
Level of mastering mathematical concepts	55–60	75–85
Independent learning activity	40–45	70–75
Learning motivation	50	80

pISSN:2349-5707 Volume:13,Issue 2, February -2026 eISSN:2349-5715

Indicators	Traditional Approach (%)	AI-Based Approach (%)
Active participation in classes	45–50	78–82
Timely error detection	35	70

The table clearly demonstrates that AI-based teaching approaches outperform traditional methods across all major indicators. In particular, independent learning activity and error detection nearly doubled [3].

Diagrammatic analysis further confirms these findings. Diagram 1 (conditional) illustrates the level of mastering mathematical concepts, showing that students using AI-based approaches achieved significantly higher results, with an average increase of 20–25% [4].

Diagram 2 represents students' learning motivation levels, indicating a substantial increase in interest and engagement among those using AI tools. This improvement is attributed to the interactive and adaptive features of AI-based educational technologies [5].

The results also demonstrate the possibility of individualizing mathematical content through AI. Visually impaired students were able to work at their own pace, repeatedly listen to audio explanations, and independently solve complex problems. This contributed to better knowledge retention and long-term memory development [6].

Overall, the findings scientifically confirm the high effectiveness of teaching higher mathematics to visually impaired students using artificial intelligence. The results highlight the necessity of widely implementing AI technologies in inclusive education and substantiate their pedagogical value [7].

Discussion

The conducted study demonstrates that artificial intelligence (AI) technologies are highly effective in teaching higher mathematics to visually impaired students. The results indicate that AI-based instructional approaches significantly enhance students' learning outcomes, independent activity, and motivation compared to traditional methods. These findings are consistent with previous studies and confirm the growing role of artificial intelligence in inclusive education [1].

The discussion revealed that voice interfaces and adaptive learning systems play a crucial role in facilitating the perception of mathematical concepts for visually impaired students. Step-by-step audio explanations of complex formulas and abstract concepts significantly improved comprehension and reduced errors in subjects such as calculus and algebra. This confirms the high didactic potential of AI technologies [2].

Additionally, the study demonstrated that AI tools enable the formation of individualized learning trajectories. Creating an adaptive educational environment that considers each student's learning pace and needs fully aligns with the principles of inclusive education. This approach enhances independence and active participation among visually impaired students [3].

pISSN:2349-5707 Volume:13,Issue 2, February -2026 eISSN:2349-5715

Another important finding is that AI-based systems transform teacher–student interaction. Automated analysis, error detection, and recommendation features reduce teachers' methodological workload and contribute to more effective organization of the learning process. This creates pedagogical convenience for educators as well [4].

However, several limitations were identified, including insufficient technical infrastructure, high costs of specialized software, and the need to improve teachers' digital competencies. These factors must be considered when implementing AI technologies on a broader scale [5].

Overall, the discussion highlights that teaching higher mathematics to visually impaired students using artificial intelligence has both pedagogical and social significance. AI technologies serve as a powerful tool for developing inclusive education, ensuring equal learning opportunities, and improving educational quality. Future research in this field is expected to further reveal new didactic possibilities of artificial intelligence and contribute to the advancement of the education system [6].

Conclusion

The results of this study demonstrate that the use of artificial intelligence (AI) technologies significantly enhances the effectiveness of teaching higher mathematics to visually impaired students. The analysis confirms that AI-based educational tools improve the mastery of mathematical concepts, strengthen independent learning activity, and positively influence students' motivation [1]. These outcomes are fully consistent with the principles of inclusive education.

The study revealed that voice interfaces, adaptive learning platforms, and intelligent virtual assistants facilitate the perception of mathematical material for visually impaired students. Step-by-step explanations of formulas and complex problems enable deeper understanding and reduce errors, highlighting the high didactic value of AI technologies in higher mathematics education [2].

Furthermore, the ability to create individualized learning trajectories through AI was identified as a key advantage. This approach takes into account each student's needs and learning pace, ensuring equal educational opportunities for visually impaired students [3]. As a result, students' self-confidence and engagement in the learning process increase.

In conclusion, integrating artificial intelligence technologies into the teaching of higher mathematics expands learning opportunities for visually impaired students and enhances educational quality. Future efforts should focus on developing methodological guidelines, improving specialized software, and increasing teachers' digital competencies [4]. Therefore, advancing AI-based inclusive education approaches remains a priority in modern education systems [5].

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