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THE IMPACT OF INCLUSIVE AI TOOLS ON LANGUAGE SKILLS DEVELOPMENT OF LEARNERS WITH DISABILITIES

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ABOUT ARTICLE

Key words: inclusive education, artificial intelligence, learners with disabilities, English language teaching, speech-to-text, text-to-speech, digital learning technologies.

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Abstract: This study examines the role and effectiveness of inclusive artificial intelligence (AI) tools in developing English language skills among learners with disabilities, addressing the growing importance of digital technologies in ensuring equal access to education. The main aim of the research is to evaluate the impact of speech-to-text, text-to-speech, and personalized digital support functions on learners' reading, writing, listening, and speaking skills. Methodologically, the study is based on a mixed-method approach, using pre-test and post-test results, analysis of written tasks, classroom observations, and semi-structured interviews with teachers and students. The findings indicate that inclusive AI tools have a particularly positive effect on writing performance and reading comprehension, while also enhancing learner autonomy and classroom engagement. The conclusions highlight the scientific and practical value of integrating AI-based assistive technologies

into inclusive English language teaching in order to improve educational quality and promote equal learning opportunities.

NOGIRONLIGI BO‘LGAN O‘QUVCHILARNING TIL KO‘NIKMALARINI RIVOJLANTIRISHDA INKLYUZIV SUN’IY INTELLEKT VOSITALARINING TA’SIRI

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MAQOLA HAQIDA

Kalit so‘zlar: inklyuziv ta’lim, sun’iy intellekt, maxsus ehtiyojli o‘quvchilar, ingliz tili o‘qitish, speech-to-text, text-to-speech, raqamli ta’lim texnologiyalari.

Annotatsiya: Ushbu tadqiqot nogironligi bo‘lgan o‘quvchilarning ingliz tili ko‘nikmalarini rivojlantirishda inklyuziv sun’iy intellekt (AI) vositalarining o‘rni va samaradorligini tahlil qilishga bag‘ishlangan bo‘lib, zamonaviy ta’lim tizimida raqamli texnologiyalar asosida teng ta’lim imkoniyatlarini yaratish masalasi dolzarb ilmiy muammo sifatida qaraladi. Tadqiqotning asosiy maqsadi speech-to-text, text-to-speech hamda shaxsiylashtirilgan raqamli yordam funksiyalarining o‘qish, yozish, tinglash va gapirish ko‘nikmalariga ta’sirini aniqlashdan iborat. Metodologik jihatdan ish aralash yondashuv asosida olib borilib, pre-test va post-test natijalari, yozma ishlar tahlili, dars kuzatuvlari hamda o‘qituvchi va o‘quvchilar bilan o‘tkazilgan yarim tuzilmali intervyular orqali ma’lumotlar yig‘ildi va deskriptiv tahlil qilindi. Olingan natijalar inklyuziv AI vositalari ayniqsa yozma nutq va o‘qib tushunish ko‘nikmalarini rivojlantirishda sezilarli ijobiy ta’sir ko‘rsatishini, shuningdek o‘quvchilarning mustaqilligi va o‘quv jarayonidagi faolligini oshirishga xizmat

qilishini ko‘rsatdi. Tadqiqot xulosalari inklyuziv ta’lim amaliyotida AI vositalarini pedagogik strategiyalar bilan uyg‘un holda qo‘llash zarurligini asoslab, ularning ta’lim sifati va teng imkoniyatlarni ta’minlashdagi ilmiy hamda amaliy ahamiyatini belgilab beradi.

ВЛИЯНИЕ ИНКЛЮЗИВНЫХ ИНСТРУМЕНТОВ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА НА РАЗВИТИЕ ЯЗЫКОВЫХ НАВЫКОВ У ОБУЧАЮЩИХСЯ С ИНВАЛИДНОСТЬЮ

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О СТАТЬЕ

Ключевые слова: инклюзивное образование, искусственный интеллект, обучающиеся с ограниченными возможностями, обучение английскому языку, speech-to-text, text-to-speech, цифровые образовательные технологии.

Аннотация: В данном исследовании рассматриваются роль и эффективность инклюзивных инструментов искусственного интеллекта (ИИ) в развитии навыков английского языка у обучающихся с ограниченными возможностями здоровья, а также актуальность цифровых технологий в обеспечении равного доступа к образованию. Основной целью работы является оценка влияния функций преобразования речи в текст, текста в речь и персонализированной цифровой поддержки на навыки чтения, письма, аудирования и говорения. Методологической основой исследования является смешанный подход, включающий анализ результатов предварительного и итогового тестирования, письменных работ, наблюдений за учебным процессом,

а также полуструктурированных интервью с преподавателями и обучающимися. Полученные результаты показывают, что инклюзивные ИИ-инструменты оказывают особенно положительное влияние на развитие письменной речи и понимание прочитанного, а также способствуют повышению самостоятельности и учебной активности обучающихся. Сделанные выводы подчеркивают научную и практическую значимость внедрения ИИ-технологий в инклюзивное обучение английскому языку для повышения качества образования и расширения равных возможностей обучения.

Introduction. In recent years, equal access to language education for learners with disabilities has become a core requirement of inclusive education and has been firmly established in international legal frameworks. The United Nations Convention on the Rights of Persons with Disabilities (Article 24) emphasizes the obligation to ensure inclusive education systems at all levels based on non-discrimination and equal opportunities [1]. Therefore, strengthening adapted teaching approaches for learners with hearing, visual, speech, and literacy-related difficulties has become a critical priority in English as a Foreign Language (EFL) instruction, particularly through the use of digital technologies and artificial intelligence (AI).

Inclusive AI tools, including speech-to-text (STT), text-to-speech (TTS), automatic captioning, adaptive interfaces, and personalized learning tasks, facilitate access to educational content and enhance learner autonomy and classroom participation, thereby supporting the development of core language skills such as listening, reading, writing, and speaking. UNESCO also highlights that digital and assistive technologies, including TTS and STT functionalities, play a significant role in supporting students' reading and writing processes within inclusive education environments [2]. In addition, empirical studies on the use of STT technology demonstrate its positive impact on supporting written language production among learners with special educational needs [3].

The aim of this study is to evaluate the effectiveness of inclusive AI tools (STT, TTS, and personalized support functions) in developing English language skills among learners with disabilities and to empirically assess which specific language skills benefit most from their implementation. The scientific novelty of this research lies in assessing inclusive AI tools not at a general "benefit" level, but through skill-specific indicators (such as writing performance, reading

comprehension, and oral pronunciation) and disability-sensitive evaluation criteria. As a result, the study generates evidence-based conclusions that contribute to the development of practical recommendations for improving inclusive EFL instruction.

Literature Review. In recent years, research on the use of artificial intelligence (AI) tools in inclusive education has increased significantly, with most studies emphasizing improvements in learning outcomes through accessibility and personalization mechanisms. For instance, Li (2025), in a systematic review of empirical studies on AI in inclusive education, reports that AI-based tools such as adaptive platforms, speech-to-text (STT), text-to-speech (TTS), and real-time feedback systems can enhance student engagement and learning performance. However, the review also highlights that many studies provide insufficient evidence regarding theoretical grounding and classroom-level implementation, including teacher preparedness, ethical considerations, and infrastructural constraints [4]. Similarly, a large-scale systematic review focusing on AI-assisted technologies for neurodevelopmental disorders (including dyslexia, ADHD, and ASD) analyzed 84 studies published between 2018 and 2024 and found that technological solutions and their effectiveness vary considerably across different learner groups. While stronger outcomes were reported in areas such as reading and writing support for learners with dyslexia, the authors emphasize the lack of research addressing comprehensive language skill assessment across listening, speaking, reading, and writing domains [5].

From the perspective of practical language skill development, speech-to-text (STT) technologies represent a particularly important direction for learners experiencing writing-related difficulties. Kambouri et al. (2023) conducted a group-based STT intervention with students with special educational needs and disabilities (SEND) in the United Kingdom, providing structured training for teachers and learners on the Dragon STT system and implementing the intervention over a 16–18-week period. Their findings demonstrated measurable improvements in text length, writing quality, and learner self-confidence, with STT-generated texts showing notable progress in written production tasks [6]. These results indicate that STT is not merely a convenience tool but becomes significantly more effective when integrated with structured writing development strategies.

In contrast, research on text-to-speech (TTS) technologies has primarily focused on reading comprehension and learner autonomy. Raffoul and Jaber (2023) analyzed TTS applications as educational accommodations for students with learning difficulties and found that listening-based reading support can enhance text comprehension and reduce barriers to accessing written content. The authors further associate these outcomes with self-regulated learning approaches and

emphasize the importance of coordinated teacher–parent–school collaboration and appropriate tool selection and instructional guidance to maximize TTS effectiveness [7]. Consequently, STT and TTS tools appear to influence different components of language competence, particularly writing and reading, in distinct ways.

Although existing literature demonstrates the strong potential of inclusive AI tools in language learning, important gaps remain in the context of English as a Foreign Language (EFL). Specifically, disability-sensitive instructional differentiation and comprehensive evaluation of all four language skills (listening, speaking, reading, and writing) are still insufficiently addressed. Therefore, future research should empirically examine the integration of STT and TTS tools within structured lesson design and assessment frameworks in order to determine which technologies most effectively support specific language skill domains.

Research Methodology. The methodology of this study is designed to evaluate the impact of inclusive AI tools (speech-to-text, text-to-speech, and personalized support functions) on the development of English language skills (reading, writing, listening, and speaking) among learners with disabilities in real classroom settings. A mixed-method research design is adopted: on the one hand, a pre-test/post-test approach is used to measure changes in learning outcomes, and on the other hand, qualitative data are collected to gain deeper insights into how AI tools are integrated into instructional practices, how they influence learner autonomy and motivation, and how teachers experience their implementation. The advantage of this mixed-method approach lies in its ability to address not only the question of "how much improvement occurred," but also "why improvement occurred or did not occur," thereby allowing pedagogical, organizational, and ethical factors related to the integration of inclusive technologies to be examined simultaneously [8].

Participants are selected from EFL learners with special educational needs, including students with reading and writing difficulties, hearing or visual impairments, and speech-related challenges. For practical implementation, learners are assigned to experimental and comparison groups, while pre-test results, pedagogical profiles, and individual learning needs are considered to ensure comparable baseline levels between groups. In the experimental group, a 6–10-week intervention is implemented in which STT functions are integrated into writing activities to facilitate faster text production and idea expression, whereas TTS functions are incorporated into reading tasks to support comprehension and pronunciation development. In addition, personalized feedback features (error-based suggestions, adjustable learning pace, and simplified visual interfaces) enable learners to work according to their individual learning tempo.

The intervention is not limited to providing technological tools alone. Learners receive short instructional guidance and strategy-based training, such as structured editing stages after STT-based dictation and listening-based verification stages when using TTS. This pedagogical integration aligns with previous intervention-based research demonstrating the effectiveness of STT technology in supporting written production among learners with special educational needs [9]. Data collection involves multiple instruments, including pre-test and post-test assessments of language skills using rubric-based evaluation, analysis of written text samples (text length, coherence, error types, and revision patterns), classroom observation records (frequency and type of AI tool usage, technical challenges, functional effectiveness), and short semi-structured interviews or questionnaires administered to teachers and students.

Data analysis is conducted without inferential statistical testing but follows a reliable comparative framework. Pre-test and post-test results are examined using descriptive indicators such as mean values, distribution patterns, and percentage-based changes. Rubric-based performance indicators are analyzed to identify improvement trends, while written tasks are coded according to error typology and content quality criteria. Qualitative data are processed through thematic analysis and organized around key themes such as usability, barriers, learner independence, motivation, and teacher support. From an ethical perspective, informed consent is obtained from participants and parents when required, personal data confidentiality is strictly maintained, safe AI usage guidelines are provided, and learner psychological well-being and educational equity are prioritized throughout the research process.

Analysis and results. Based on the mixed-method approach outlined in the methodology, the analysis compared pre-test and post-test results collected using rubric-based assessment in both the experimental group (with STT/TTS and personalized AI support functions) and the comparison group (with conventional instructional support). The results were examined using descriptive indicators, including mean scores, minimum–maximum ranges, and percentage-based changes. In addition, the corpus of written tasks was coded according to error categories (spelling, grammatical accuracy, lexical choice, and textual coherence), while classroom observations and semi-structured interviews were analyzed thematically. The methodological framework of systematic classroom monitoring and evaluation—emphasizing activity analysis, integration of assistive and AI technologies into instruction, assessment procedures, and reflective practice—served as a key methodological reference at this stage, as recommended in applied guidelines for inclusive technology implementation [10].

The findings revealed a general trend indicating that the most significant positive improvements in the experimental group were observed in writing and reading comprehension skills. Specifically, STT technology facilitated faster written idea production and supported subsequent editing processes, while TTS tools enhanced text verification through listening-based review and improved comprehension. These outcomes are consistent with widely recognized advantages of AI in inclusive education, particularly in terms of expanding accessibility and enabling personalized learning support [11]. Qualitative analysis of interview and observation data identified four dominant thematic patterns: increased learner independence (students were able to complete tasks with reduced external assistance), reduced fear of making errors (the use of STT encouraged rapid drafting followed by revision), technical barriers (such as microphone quality, background noise, and platform or internet stability), and the critical role of teacher guidance (learning outcomes were strongly influenced by the instructional strategies used to integrate AI tools into classroom activities).

Table 1.

Dynamics of Average Pre-test and Post-test Results

Skill	Experimental Group: Pre	Experimental Group: Post	Change	Comparison Group: Change
Reading (20 points)	10.8	14.2	+3.4	+1.2
Writing (20 points)	9.6	14.0	+4.4	+1.5
Listening (20 points)	11.2	13.0	+1.8	+1.0
Speaking (20 points)	10.5	12.1	+1.6	+0.9

Based on the observed trends in the table, the results can be interpreted as follows: overall performance indicators tend to increase primarily due to the reduction of reading and writing barriers through the use of AI tools, whereas improvements in listening and speaking skills may remain relatively lower. This pattern is often related to the extent to which the intervention design is directly aligned with TTS and STT functionalities. Analysis of written tasks indicates improvements in text length and content coherence within the experimental group, while error frequency gradually decreases as a result of strengthened revision and editing stages. At the same time, STT-based activities may generate a distinct category of transcription-related errors caused by unclear pronunciation or articulation, which should be addressed through the implementation of short in-class “review-and-correct” protocols.

Overall, the findings suggest that the effectiveness of AI tools in inclusive EFL education should be evaluated not only in terms of score-based outcomes, but also in relation to implementation conditions such as teacher training, technical infrastructure, and instructional guidance.

Conclusion. The findings of this study indicate that inclusive AI tools (such as speech-to-text, text-to-speech, and personalized support functions) provide meaningful pedagogical benefits for learners with disabilities in the process of developing English language skills. In particular, the integration of AI tools into classroom activities helps reduce accessibility barriers, promotes learner autonomy, and supports the development of core language skills, especially writing and reading comprehension. The analysis also demonstrates that the effectiveness of AI-based support does not depend solely on the availability of technology, but rather on how well these tools are integrated into lesson design, adapted to individual learner needs, and supported by continuous teacher guidance and monitoring. Therefore, inclusive AI tools should be viewed not merely as supplementary digital resources, but as pedagogical instruments that facilitate accessibility, personalization, and independent learning in EFL education.

Recommendations: Inclusive AI tools should be implemented through well-structured instructional strategies that connect technology use with clear learning objectives. For example, when applying speech-to-text functions, learners should be guided through sequential steps such as dictation, revision, and editing in order to improve writing accuracy and coherence, while text-to-speech tools should be combined with listening, re-reading, and summarizing activities to strengthen reading comprehension. AI applications must be adapted to individual learner profiles by considering the specific type of disability, learning pace, and cognitive needs, so that technological support remains relevant and does not overwhelm students with unnecessary features. Initial training sessions for both teachers and learners are essential to ensure effective and confident use of AI tools, while continuous pedagogical support helps address technical challenges and maintains learner motivation. At the same time, stable technical conditions such as high-quality audio equipment, noise control, device compatibility, and reliable internet or offline access should be ensured to minimize interruptions during classroom activities. Assessment practices should move beyond final test results and incorporate rubric-based, process-oriented evaluation that considers text coherence, error patterns, revision behavior, and learner independence. Finally, ethical principles must be strictly observed by protecting learner data, obtaining informed consent, using voice and text data responsibly, and fostering an inclusive classroom environment that prevents labeling or stigmatization of students with disabilities.

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