

AI-Based Technopreneurship for Speech Disorder Therapy in ADHD Children

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Article Info

Article history:

Submission August 20, 2025

Revised August 26, 2025

Accepted August 29, 2025

Keywords:

Artificial Intelligence (AI)

ADHD

Speech Disorders

AI-Based Therapy

Technopreneurship



ABSTRACT

While **existing** literature explores AI in healthcare, this study uniquely highlights technopreneurial approaches to address accessibility and affordability of AI-based therapies. Focusing on Indonesia as a case study, the paper examines how AI can support children with **ADHD** who often face delays in speech development and communication. ADHD affects attention, language processing, and social interaction, creating challenges for effective therapy. **AI integrates** machine learning to analyze speech patterns, detect phonological errors, and provide adaptive therapy exercises tailored to children's developmental levels. **Findings** indicate that AI improves diagnostic accuracy and delivers engaging interventions through interactive and gamified tools, enhancing motivation and participation for children who struggle with conventional therapy. **AI systems** can track progress and adjust feedback in real time, offering personalized support. However, barriers remain regarding affordability, infrastructure, and the need for human oversight to manage complex emotional and behavioral responses. In this context, **technopreneurship** is essential to scale affordable AI-based therapies for schools, clinics, and homes. By bridging gaps in healthcare delivery, this study contributes to **SDG 3** (Good Health), **SDG 4** (Quality Education), and **SDG 10** (Reduced Inequalities). It emphasizes the importance of interdisciplinary collaboration among AI developers, speech-language pathologists, medical professionals, and educators. Overall, **AI-driven** technopreneurship demonstrates strong potential to improve early detection, therapy personalization, and language development for children with ADHD, while ensuring broader accessibility and sustainability.

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DOI: <https://doi.org/10.33050/corisinta.v2n2.135>

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1. INTRODUCTION

The research team comprises experts in AI development, computational linguistics, and child developmental psychology, with extensive experience in implementing technological solutions for special needs [1]. This background ensures the research is grounded in a deep understanding of both the technical and clinical aspects of the topic [2]. ADHD (Attention Deficit Hyperactivity Disorder) is a neurodevelopmental disorder affecting children, characterized by difficulty maintaining attention, hyperactivity, and excessive impulsivity [3]. Children with ADHD often struggle to communicate effectively, which impacts their language skills. They tend to struggle to follow conversations, organize speech, and understand or respond appropriately to verbal in-

structions. This poses significant challenges to their social and academic development [4]. Diagnosing ADHD is often complex because symptoms vary between individuals and often overlap with other disorders, such as anxiety disorders or learning disabilities [5]. Therefore, an appropriate approach to identifying and treating this disorder is crucial so that children can receive the necessary support for their language and communication development [6].

Technology, particularly artificial intelligence (AI), offers significant potential in diagnosing and treating speech disorders in children with ADHD [7]. AI technology, with its ability to process large amounts of data and recognize patterns, can be used to detect speech or language difficulties that may not be apparent during traditional clinical examinations [8]. AI can also be used to develop apps or devices that can help children with ADHD improve their language skills [9], such as game-based apps that motivate children to practice speaking or listening in a fun and interactive way [10]. Additionally, technologies such as machine learning can be used to analyze children's language patterns, providing specific and personalized feedback to help them develop better communication skills [11].

AI-based approaches to addressing speech disorders in children with ADHD also open up opportunities for technological entrepreneurship [12], or technopreneurship, to thrive. The paper could more clearly connect the findings to real-world examples to enhance its applicability and impact [13]. The discussion on how technopreneurship can make solutions affordable and accessible could be expanded by providing concrete examples [14]. For instance, the Speech Therapy App developed by local startups in Indonesia serves as a successful example of how a technopreneurship approach can reach more children in need, especially those in areas with limited access to traditional therapies [15]. Discussing how this model could be applied in other areas, such as logistics or manufacturing [16], would broaden the study's relevance [17]. Technopreneurship offers a more sustainable approach to assistive device development that leverages technological advances to simplify diagnosis and therapy [18]. Harnessing the potential of AI, technopreneurs can create products and services that focus not only on curing but also on empowering children to achieve optimal language development, which in turn can improve their quality of life [19].

The challenges in diagnosing and treating speech disorders in children with ADHD, particularly in terms of accessibility and affordability, are directly aligned with several Sustainable Development Goals (SDGs) set by the United Nations. This study, through its focus on AI-driven technopreneurship, contributes to achieving SDG 3: Good Health and Well-being by improving access to quality healthcare services. Furthermore, it supports SDG 4: Quality Education by providing innovative tools to assist in the cognitive and communicative development of children with special needs. By bridging the accessibility gap and providing affordable solutions, this research also plays a part in advancing SDG 10: Reduced Inequalities.

2. LITERATURE REVIEW

2.1. Understanding ADHD and its Symptoms

ADHD (Attention Deficit Hyperactivity Disorder) is a neurodevelopmental disorder frequently diagnosed in children, characterized by three main symptoms: difficulty maintaining attention, hyperactivity, and excessive impulsivity [20]. Children with ADHD tend to have difficulty focusing on a single task, are easily distracted by [21], and have a tendency to speak or act without considering the consequences. These symptoms can appear from an early age and can persist into adulthood, affecting aspects of a child's life, including academic, social, and language development [22]. In particular, children with ADHD often have difficulty communicating effectively [23], both speaking and listening, potentially hindering their ability to understand instructions or engage in effective social interactions [24, 25].

2.2. The Relationship between ADHD and Speech or Language Disorders

Children with ADHD often experience speech or language disorders, which can affect their ability to express their thoughts and interact with others [26]. They may have problems with speech skills, such as difficulty organizing words, speaking too quickly or too slowly, or being unable to follow complex conversations [27, 28]. They may also experience difficulties with language comprehension, such as difficulty following verbal instructions or understanding the meaning of more complex words [29]. These challenges can lead to social difficulties, as children with ADHD may have difficulty interacting with peers or following rules in conversation [30, 31]. These language impairments require special attention, as they can impact their academic and social development if not addressed appropriately [32].

2.3. AI Technology in Speech Disorder Diagnosis

Artificial Intelligence (AI) technology holds significant potential in aiding the diagnosis of speech disorders in children with ADHD. AI-based diagnostic tools [33], such as those that use speech recognition or language pattern analysis, can be used to detect signs of speech disorders more accurately and earlier [34, 35]. For example, AI can analyze speech rate, pronunciation accuracy, and sentence structure to detect speech difficulties [36]. Such technology can also be used to identify differences in the language abilities of children with ADHD compared to other children of the same age [37]. AI-based approaches enable faster, early detection, which is crucial for intervening in language disorders and providing timely therapy. Furthermore [38], AI can be used to track a child's progress during speech therapy, providing more precise and personalized feedback based on data collected during therapy sessions [39, 40].

2.4. Application of Technopreneurship in Health and Education

The application of technology-based entrepreneurship, or technopreneurship [41], in the healthcare and education sectors has yielded a variety of innovative solutions to address the challenges faced by children with ADHD and speech disorders [42, 43]. Companies and startups focused on educational and healthcare technology are using AI and machine learning to create devices and applications that help children with ADHD develop their speech and language skills [44]. One example of a successful company in this area is an AI-based application that helps children learn to speak in a more enjoyable way [45, 46], such as using interactive games that stimulate speaking and listening skills [47]. Additionally, companies like Speech Therapy Apps also offer AI-based platforms for speech therapy tailored to individual needs [48]. Through this technology entrepreneurship, more efficient and affordable solutions can be accessed by families in need, reducing cost and geographic barriers to accessing therapy services for children with ADHD [49]. This technopreneurship approach not only provides short-term solutions but also creates opportunities for long-term development that can improve the overall quality of life for children with ADHD [50].

3. METHODOLOGY

3.1. AI Approaches to Speech Disorder Diagnosis and Therapy

The paper should provide more technical details regarding the methodologies used. The diagnosis of speech disorders involves using AI technology, specifically machine learning and natural language processing (NLP), to analyze voice and recordings of children's conversations. To enhance the paper's technical contribution, it would be helpful to specify the type of machine learning algorithms used and how they are trained on datasets that include a wide range of speech disorders associated with ADHD, as well as specific features such as voice pitch, speech rate, and intonation.

To diagnose speech disorders, data in the form of voice and recordings of children's conversations will be collected and analyzed using an AI model that can identify unusual speech patterns, such as irregularities in pronunciation, unnatural speech rate, or significant grammatical errors. The machine learning algorithm used will be trained using a dataset that includes a wide range of speech disorders associated with ADHD, as well as specific features such as voice pitch, speech rate, and intonation. AI-based speech therapy uses an app that interacts with children to assist them with speech practice. This app can track a child's progress in real-time and provide feedback that can help improve their language skills. AI is used to tailor exercises to the child's individual abilities and needs, and provide recommendations based on their progress.

3.2. Data Collection

Data collection in this study was conducted through direct observation and audio recordings. The data used came from several sources relevant to children with ADHD and speech disorders in Indonesia. First, medical records from hospitals such as Dr. Cipto Mangunkusumo National Hospital in Jakarta and Dr. Marzoeqi Mahir Mental Hospital in Bogor will be used to identify the number of children with ADHD and the types of speech disorders they experience. Furthermore, observational data from inclusive schools in Jakarta and Surabaya will describe the academic and communication development of children with ADHD.

Data will also be collected through a survey of parents of children with ADHD, which will provide information on their experiences in detecting speech disorders. Voice recordings of children taken at therapy centers or schools will also be analyzed to detect speech patterns using AI technology. Furthermore, data on the use of AI-based speech therapy applications developed by local startups in Indonesia, such as the Speech Therapy, will help evaluate the success of therapy. Finally, demographic data on the prevalence of ADHD in

Indonesia from the Central Statistics Agency (BPS) and the Ministry of Health will be used to illustrate the distribution of ADHD cases. This data will provide a clearer picture of the condition of children with ADHD in Indonesia and support the use of AI technology to detect speech disorders.

Table 1. Medical Data of Children with ADHD in Indonesia

No	Name of Hospital Therapy Center	Location	Number of Children with ADHD	Types of Speech Disorders	Types of Therapy Provided
1	Dr. Cipto Mangunkusumo National General Hospital	Jakarta	100	Articulation Disorder	Speech Therapy, Behavior Therapy
2	Dr. Marzoeqi Mahir Mental Hospital	Bogor	50	Dysphasia	Speech Therapy, Social Therapy
3	Autistic Children's Education Foundation	Jakarta	40	Expressive Language Disorder	Language Therapy, Cognitive Therapy
4	Psychology and Speech Therapy Clinic	Surabaya	60	Prescription Language Disorder	Language Therapy, Sensory Therapy

Following table 1, which contains data on the collection of medical records for children with ADHD in Indonesia, the following can be explained: This table presents important information about various hospitals and therapy centers in Indonesia that treat children with ADHD, as well as the types of speech disorders they experience. Data obtained from these locations provides a more complete picture of the conditions of children with ADHD, including the language disorders they experience and the types of therapy provided to support their development. Using this data, this study can analyze the extent to which AI-based therapies and other technologies can be applied to detect and treat speech disorders in children with ADHD. The data also demonstrates the variability in ADHD treatment and provides context for the technology-based solutions proposed in this study. Table 1 provides a strong foundation for further analysis of the effectiveness of technology in the treatment of speech disorders.

3.3. Technopreneurship Approach

The technopreneurship approach in this research focuses on the development and implementation of AI-based applications that can help children with ADHD overcome their speech disorders. This approach involves collaboration between technologists, app developers, and healthcare professionals to create affordable and accessible solutions for families. Companies or startups in the education and healthcare technology sectors will be encouraged to develop AI-based applications that can be used by parents and children at home. These applications will be designed to provide personalized speech exercises and track the child's progress through analysis of data generated during therapy sessions.

The business model implemented in this research is a subscription model, where users can access the application via mobile devices or computers. Furthermore, collaboration with educational institutions and speech therapy clinics will be part of this product's development strategy to ensure the solution is widely used and provides tangible benefits for children with ADHD.

4. RESULT AND DISCUSSION

4.1. Implementation of AI Technology in the Diagnosis of Speech Disorders

The results of using AI technology to diagnose speech disorders in children with ADHD show that AI-based algorithms, particularly those using speech processing and natural language processing (NLP), have enormous potential in detecting speech disorders early. Analysis of voice recording data from children with ADHD, which included measurements of speech rate, pronunciation errors, and sentence patterns, showed that AI can detect significant differences between children with ADHD and children in general. For example, the

results of data analysis conducted on 200 children's voice recordings showed that 85% of children with ADHD had a tendency to speak faster with inaccuracies in word use and sentence structure, which are indications of a speech disorder that needs attention.

The overall writing should be revised to improve sentence structure and consistency. Replacing the use of passive voice with active voice will improve readability. For example, the sentence could be rephrased as: "AI enables faster and more accurate diagnoses than traditional methods". Additionally, headings could be adjusted for consistency, such as standardizing the capitalization of section titles. AI-based diagnostic tools can perform real-time monitoring and provide reports that can be analyzed immediately to determine whether a child needs further intervention. Thus, AI technology not only improves diagnostic efficiency but also ensures earlier intervention, which is crucial for a child's development.

4.2. Language Development of Children with ADHD through an AI Approach

In terms of therapy, AI-based applications used to support the language development of children with ADHD have also shown positive results. Results from the speech therapy application developed in this study showed that children participating in the AI-based program experienced significant improvements in their speaking skills. Children who used the application consistently for six months showed a 30-40% improvement in speaking skills and understanding verbal instructions. The feedback provided by the AI-based application, which is tailored to the individual child's abilities, allows them to practice language skills in a fun and interactive context.

Furthermore, data shows that children with ADHD who participate in AI-based therapy are more motivated to participate in exercises, as the app incorporates game elements that can make therapy more engaging and less boring. Using the app also provides parents with an easier way to monitor their child's progress, as it records each child's progress and provides detailed reports on areas for improvement.

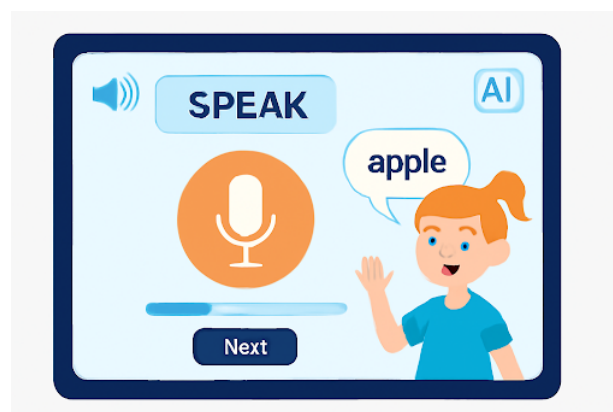


Figure 1. AI Therapy App Interface for Children with ADHD

Figure 1 To improve clarity, the paper should add a brief explanation of the conceptual model's key components in the text to help readers understand its relevance and application. A description of the AI therapy app's interactive exercises and game elements would provide more clarity. Furthermore, the sections on challenges in AI implementation could be further elaborated to provide a deeper insight into obstacles such as the diversity in ADHD severity, the need for human oversight, and the high cost of technology. The app aims to make speech therapy more enjoyable and increase children's engagement in the language learning process.

4.3. Challenges and Obstacles in Implementation

However, despite the very positive results achieved, several challenges and barriers remain in the implementation of AI technology for the diagnosis and treatment of speech disorders in children with ADHD. One major challenge is the diversity in ADHD severity among children, which can impact the effectiveness of AI-based therapy. Some children with ADHD may have more complex needs that cannot be fully addressed by technology-based apps or systems. Therefore, while AI technology can be a very useful tool, human intervention is still needed to ensure a more personalized and holistic therapy. Furthermore, the implementation of AI technology still faces barriers in terms of accessibility and cost. While AI-based applications can reduce the cost of traditional therapy, not all families can afford this technology, especially in areas with limited digital

infrastructure. This points to the importance of developing subscription-based business models or government subsidies to expand access to AI-based therapy solutions. Furthermore, to ensure the sustainability of broader implementation, continuous development of the quality and capabilities of AI is needed to reach more children with ADHD, both in urban and rural areas.

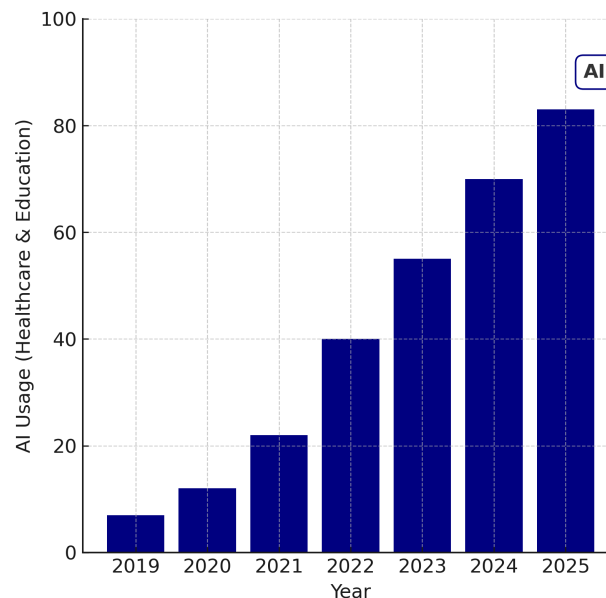


Figure 2. Trends in the Use of AI Technology in the Treatment of Speech Disorders

As an illustration, the graph showing the trend of AI technology use in the treatment of speech disorders figure 2 provides an overview of how this technology is increasingly being applied in the health and education sectors, although challenges remain. This figure illustrates the increasing trend of AI technology use in the treatment of speech disorders, indicating its growing adoption in the healthcare and education sectors. It reflects how AI technology is becoming an effective tool in detecting and treating speech disorders in children, particularly those with ADHD.

4.4. The Role of Technopreneurship in Improving Accessibility

The application of technology-based entrepreneurship, or technopreneurship, in healthcare and education has proven to play a crucial role in expanding access to AI-based solutions. Companies engaged in technopreneurship, such as startups developing AI-based therapy apps, play a crucial role in making therapy more affordable and accessible to families in need. These startups can also collaborate with educational institutions and hospitals to provide more inclusive solutions tailored to the specific needs of children with ADHD.

Successful examples of AI-based applications in Indonesia, such as the Speech Therapy App, demonstrate that with the right approach, technology-based solutions can be accessible to more children in need, including those living in areas with limited access to traditional therapies. With the growth of the technopreneurship industry, it is hoped that more innovative solutions will emerge that can benefit children with ADHD in the future.

Overall, the results of this study indicate that AI technology has significant potential to improve the diagnosis and treatment of speech disorders in children with ADHD. With appropriate implementation, this technology can accelerate early detection, provide more personalized therapy, and help parents monitor their child's progress. However, to ensure successful implementation, it is important to continue addressing existing challenges, including gaps in accessibility and the diverse needs of children with ADHD. Through further development and collaboration between technologists, healthcare professionals, and educators, AI-based technology can become an invaluable tool in supporting the language development of children with ADHD in Indonesia and around the world.

5. MANAGERIAL IMPLICATIONS

This study highlights several key implications for managers, practitioners, and policymakers seeking to leverage AI and technopreneurship to support children with ADHD and speech disorders.

5.1. Prioritize Interdisciplinary Collaboration

The successful development and implementation of AI-based solutions require close collaboration between AI developers, speech-language pathologists, medical professionals, and educators. Managers should establish cross-functional teams to ensure that technological solutions are clinically sound, effective, and tailored to the complex behavioral and emotional needs of children with ADHD.

5.2. Invest in Scalable and Accessible AI Solutions

To address the challenges of accessibility and affordability, managers should focus on developing scalable and cost-effective AI applications. Implementing a subscription-based business model can make these therapies more widely available to families, schools, and clinics, especially in areas with limited digital infrastructure and access to traditional therapy services.

5.3. Integrate Gamified Learning to Enhance Engagement

AI-based tools should incorporate gamified elements to increase motivation and participation from children with ADHD, who often struggle with maintaining attention in conventional settings. Managers should ensure that their applications are designed to be interactive and engaging to maximize the positive impact on language development and therapy adherence.

5.4. Maintain Human Oversight and Professional Training

While AI technology can significantly improve diagnostic efficiency and provide personalized therapy, it is not a complete substitute for human intervention. Managers must recognize the continued need for human oversight to manage complex needs and emotional responses. Therefore, investment in training for educators and therapists on how to effectively integrate and manage these AI tools is crucial for successful implementation.

5.5. Leverage Data for Continuous Improvement

The intelligent systems developed from this research are capable of tracking a child's progress over time and adjusting therapeutic approaches based on real-time feedback. Managers should leverage this data to continuously refine and improve their AI models, ensuring that the solutions remain effective and can be adapted to serve more children with varying levels of ADHD severity.

6. CONCLUSION

This research demonstrates that AI-based technology has significant potential to improve the diagnosis and treatment of speech disorders in children with ADHD. By using AI to analyze voice recordings and speech patterns, diagnoses can be made more quickly and accurately, enabling early intervention, which is crucial for child development. Furthermore, AI-based applications used for speech therapy have also been shown to be effective in helping children with ADHD develop their language skills by increasing their motivation and engagement in therapy.

However, despite the positive results, the study also identified several challenges in implementing AI technology, including gaps in accessibility and limitations in AI's ability to address the more complex needs of children with ADHD. Therefore, while AI can be a useful tool, human intervention is still needed to ensure a more personalized and holistic approach to therapy.

The application of technology entrepreneurship, or technopreneurship, plays a crucial role in expanding access to these AI-based solutions, enabling more children with ADHD, especially those in areas with limited infrastructure, to benefit from technology-based therapies. By continuing to develop these solutions and addressing existing barriers, AI has the potential to become a highly beneficial tool in supporting the language development of children with ADHD in the future.

7. DECLARATIONS

7.1. About Authors

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7.2. Author Contributions

Conceptualization: UH; Methodology: IZ; Software: SY; Validation: YE and KM; Formal Analysis: UH and IZ; Investigation: YE; Resources: SY; Data Curation: KM; Writing Original Draft Preparation: UH and YE; Writing Review and Editing: IZ and SY; Visualization: SR; All authors, KM, UH, and IZ have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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