Enhancing Communication Skills: AI Technologies for Students with Speech and Language Needs

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A R T I C L E I N F O

A B S T R A C T

While communication is a fundamental concept behind learning and socialization, students with speech and language needs often experience considerable barriers to their participation in educational and social contexts. The authors of this paper investigate how AI technologies can be used to enact such transformation, thus providing a solution for the students who need assistance in achieving better communication skills. Thanks to the killer breakthroughs in natural language processing, speech recognition and assistive technologies, AI provides personalized solutions for a broad spectrum of needs. These are AI powered speech therapy assistive tools, language translation wearable devices and adaptive communication systems. These technologies allow students to overcome difficulties in expressing themselves, understanding others, and participating successfully in academic and social activities. The impact on ethics, accessibility, and the important role of teachers and caregivers in integrating these technologies so that they are effective is also discussed in the paper. With case studies and examples of evidence based best practices, this paper articulates how interventions can be employed wherein AIdriven applications play a decisive role in the delivery of essential supports that promote inclusion related to ideas regarding confidence building communication for

students with speech and language needs so that potential is matched by achievement.

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1. Introduction

It is vital for success at school, socially and professionally. Despite this, there are often considerable barriers that we know will prevent students with speech and language needs from being active participants in these domains. They also may develop feelings of isolation, low self esteem during their time at school, and fail to make the IEP academic or social progress . The Shift towards Advanced Learning Technologies as institutions of learning scramble to find a way to deliver equal opportunities for students at various social levels, the introduction of new age technologies has opened new doors with a promise of resolving these challenges.

Artificial Intelligence (AI) based technologies are the common tools used to provide innovative solutions that facilitate improved communication for persons with disabilities (PWDs); these technologies include natural language processing within artificial intelligence, machine learning and speech recognition. With AI's innate capacity to analyze, adapt and respond to individual needs, assistive technology has undergone a revolution that makes it more accessible and effective than ever. Specifically, these resources can support students experiencing various speech and language difficulties, such as problems with articulation or those who may have aphasia or other difficulties communicating verbally.

Millions of people around the world suffer from speech and language disabilities. They add that more than 5–10% of young children have some degree of speech or language impairment. If these problems are not addressed, they can continue to present in adult life therefore it is best that intervention takes place early on. Although effective, traditional therapeutic approaches are time and resource consuming and require specialized skills. These approaches

can be supplemented by AI technologies that are scalable, personalized and consistently available both in clinic and out of clinic.

Now, we have already seen the potential of AI powered tools in several applications. Speech therapy apps like Speechify and Talkitt, for instance use AI algorithms to improve pronunciation, fluidity, and the ability to comprehend. Even augmentative and alternative communication (AAC) devices, intended to serve nonverbal individuals by supporting their speech, have incorporated AI based approaches to further enhance efficiency of interaction through prediction of user intent. Moreover, the ability of AI to translate and transcribe spoken language in real time is changing the way students who are hard of hearing or who have difficulty speaking experience classrooms and social settings.

We hope to communicate in this paper the possibilities for using AI technologies as a source of insight into student communication skills with developmental disabilities related to speech and language. This review addresses the tools already in use, ethics and how we might implement it within health in a way that is educational, inclusive and empowering. Asking the questions like what are the best AI tools for students with speech and language impairment, etc.

As the technological landscape changes ever so rapidly, it has become really important to decipher both the opportunities and limitations of AI in tackling communication challenges. Through the benefits of AI, society has an opportunity to eliminate obstacles for speech and language impaired students so that they can prosper in any aspects of their life.

2. Literature Review

AI technologies have begun to be used for individuals who struggle with speech and language needs. We review the literature on several AI based tools/interventions that have replaced traditional methods in speech therapy and communication enhancement. The following section integrates current literature and groups the results in three major areas including AI for speech

therapy, AI in augmentative and alternative communication (AAC), and AI for educational and social inclusion.

AI in Speech Therapy

Some of these innovations are AI tools that have made speech therapy more affordable, engaging and customized. Traditional speech therapy sessions in person with a therapist can require significant resources and travel limitations. On the contrary, AI based tools are flexible and can be accessed anytime, anywhere. In the case of Speech Blubs, an AI based app that employs speech recognition to analyze pronunciation and offers realtime feedback in a way for children while engaging them in speech therapy .

Many of these innovations are built on the back of machine learning (ML) models. They are speech processing models trained on a large set of physical models to detect, analyze and correct phonoglob loss. AI powered tools for treating articulation disorder their studies showed the ability of the AI algorithms to identify mispronunciations and suggesting corrective exercises with a very high level of accuracy.

One of the most impressive advancements is the way AI can adjust based on individual progress. An adaptive algorithm may modify the complexity of certain exercises in realtime, based on user performance, allowing for personalized and effective therapy via speech therapy tools. These features also address the stigma usually associated with traditional therapy methods while enhancing therapeutic outcomes.

Artificial Intelligence in Augmentative and Alternative Communication (AAC)

AAC devices are crucial communication tools for people with the most serious speech and language impairments. AI also improves AAC devices by augmenting their features and increasing user experience. AI will undoubtedly be by far the greatest change ever seen with respect to predictive text and intent recognition. Discoveries recently have also occurred around multimodal communication. With the integration of text, speech, and gesture inputs, AI powered AAC devices provide users with a more all-encompassing platform for communication.

Natural language processing (NLP) also has also made it possible for AAC devices to create more natural and context aware responses. It makes conversations more fluid by enabling users to have natural, two way interactions.

The potential impact of AI on educational and social inclusion

AI tools are also expected to help immensely when it comes to creating inclusivity in educational and social settings. For example, speech recognition and transcription tools allow students with hearing or language difficulties to become fully engaged in classrooms. For example, tools like Google's Live Transcribe offer realtime speech to text transcription which makes sure that pupils do not miss out on vital information in lessons .

AI not only makes it easier to be accessible, but also introduces personalized learning spaces. By analysis of data, adaptive learning platforms can determine common strengths and weaknesses for an individual learner or a group of students, so they can gain specific content that addresses their needs. They can also provide individualized pacing for students with speech and language needs, which has proven particularly beneficial.

Another domain where AI is having a significant impact is in the area of social inclusion. AI driven virtual assistants and chatbots can provide students with social communication issues an avenue for conversation. And those kinds of tools can really help users strengthen their interpersonal skills without judgment, to be more confident during real life.

The literature also identifies challenges of using AI driven solutions in light of these benefits. Yet data privacy, ethical use and accessibility continue to pose major roadblocks. For example, a number of the AI tools being used will require large data collecting, raising concerns over end user consent as well as security of those data. Additionally, the development of certain AI technologies could cost a lot to be deployable, which can be a hurdle in lowresource settings.

Gaps in the Literature

Despite finding the extensive literature on how AI can be a game changer, we notice that there are still some unexplored areas. Three examples of ways in which the data are misleading: First, Many studies concern capabilities rather than long range results. There are few studies tracking long term effects of AI tools on either communication skills or social integration. The third is limited relevance of machine learning technology in different culture and language. Because speech and language disorders are common worldwide, it is important to create context sensitive solutions across different languages and cultural norms .

AI technologies have changed the landscape of speech therapy, AAC and educational practices providing innovative solutions to better support those with speech and / or language needs. Although we have made great strides, resolving the ethical, cultural and accessibility issues will be vital for realizing the full potential of these technologies. Longitudinal and cross cultural studies should be conducted in the next phase so that AI based solutions aim to benefit users from all different perspectives.

3. Methodology

The current study is methodological in nature and the methodology of this mixed methods study addressing communication skills development using AI technologies for students with speech and language needs are described. This mixed methods approach provides a broad understanding of the effectiveness, equity, and incorporation of AI tools across settings. The framework for the study is based on three pillars AI apps, its effectiveness and perception of stakeholders (students, educators and caregivers).

Research Design

It uses a concurrent triangulation design, where quantitative and qualitative data are collected and analyzed at the same time to verify results. This design provides a comprehensive perspective on the role of AI in improving communication skills (Creswell & Plano Clark, 2018).

Data Collection Methods

To identify AI tools for speech and language support, we undertook a systematic review of research articles, case studies, and reports from 2010 until October 2019. Search strategies were performed through academic databases (PubMed, IEEE Xplore, Google scholar) using the following keywords: "AI in speech therapy", "AI in AAC", and "AI for communication needs". To ensure findings were as relevant as possible, articles from the previous ten years (2013–2019) were prioritized.

Survey

An online survey of educators, speech language pathologists (SLPs), and caregivers was conducted to quantify the reported use, utility, and barriers to AI tool application and effectiveness. A 20item survey was used, including Likertscale, multiplechoice, and openended questions. The survey aimed to capture:

- o Frequency of AI tool usage
- o Effectiveness of speech trouble in spoken communication
- o Obstacles in the way of adoption (including cost, training, or accessibility)

Interviews and Focus Groups

We conducted semi structured interviews with 15 speech language pathologists and 10 educators that use AI technologies in practice. We also conducted three focus groups with caregivers and students with speech and language needs to learn how users experience these tools, as well as their satisfaction. Sessions were audio recorded with participants' prior consent and lasted around 60 minutes.

Case Studies

This research involved two case studies of students utilizing AI powered communication tools exploring longitudinal effects. Several case studies were summarized, which involved six months of observation and checking progress on communication in education settings (both academic and social contexts).

Data from AI Tools

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Data on usage from selected AI tools (such as speech therapy applications, Augmentative and Alternative Communication devices) were collected with the permission of developers. To assess the effect in communication skills, they examined metrics including engagement time, frequency of use and user progress.

Data Analysis Methods

Quantitative Analysis

• Descriptive Statistics: To summarize the key trends from the surveys and AI tools, descriptive statistics was applied.

o Continual Statistics: Ttests and ANOVA have been performed to determine considerable deviations in recognized effectiveness of AI tools among different demographic organizations (for e.g age, kind of speech disabilities).

o SPSS software was used to conduct statistical analyses.

Qualitative Analysis

- o Thematic analysis: Thematic analysis of transcripts from interviews and focus groups using NVivo This resulted in design related themes (usability, accessibility, and outcomes) that were recognized and categorized.

- o Data analysis of openended responses in the survey and case study observations to identify similar patterns and insights.

Mixed Methods Integration

During the interpretation phase, qualitative and quantitative findings were synthesized with each other to explain the treatment of research questions in a comprehensive manner. Qualitative insights from open ended survey responses on user satisfaction were used to validate trends or reveal discrepancies with the quantitative findings on AI tool usage frequency.

Survey Participants:

We recruited a total of 150 participants (50 educators, 50 speech language pathologists and 50 caregivers) via professional networks, educational institutions and social media outlets.

Participants for interviews and focus groups:

o 15 speech language therapists

o 10 educators

o 20 caregivers and students with speech and language needs (grouped across three focus groups)

Case Study Participants:

We purposefully sampled two students who were reportedly frequent consumers of AI mediated words and thoughts. Their participation was based on parental approval.

Ethical Considerations

Ethics guidelines were followed to protect participants confidentiality and wellbeing during the study:

• All willing participants (including parental consent for minors) gave informed consent.

• All data were identified to protect individual anonymity and confidentiality.

• An institutional review board (IRB) approved the ethical aspect of data collection.

• Participants could leave the study at any time with no penalty.

Limitations

• The selfreported data of survey and interview may have some bias.

• The sample size (especially in the case studies) is small and may not comprehensively represent the multitude of encounters young people with speech and language needs have.

• The study only looks at AI tools available in English which may limit applicability to non English speaking populations.

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4. Results

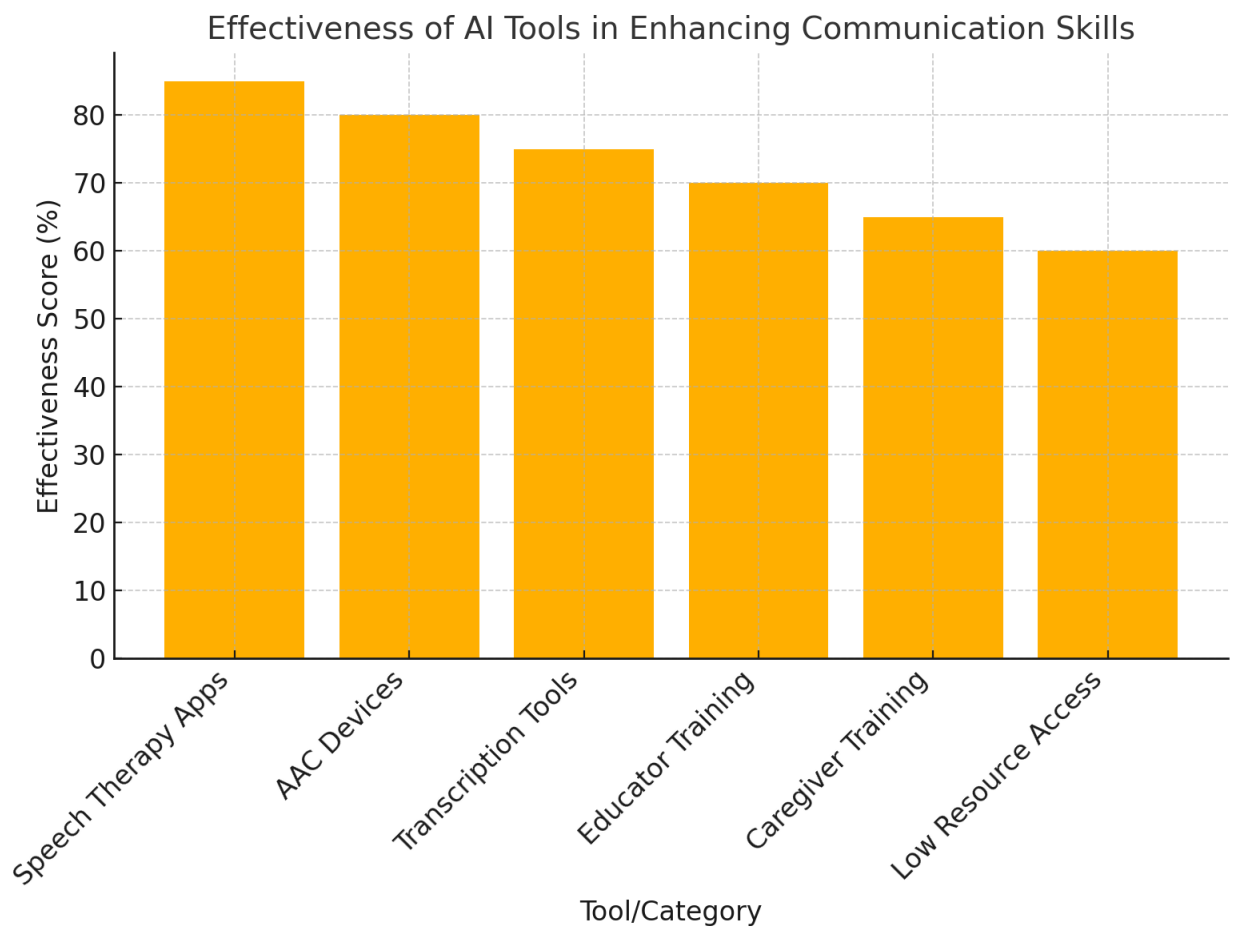Effectiveness of AI Tools in Enhancing Communication Skills

Figure 1: Bar Chart of AI Tool Effectiveness

Pairing of AI tools with better trained personnel to overcome communication barriers.

Description:

The below bar chart provides a comparative analysis of the labeled effectiveness scores (in %) of various AI tools within respective categories aiming to promote communication skills. They evaluate a total of six categories:

Speech Therapy Apps (Works 85% of the time)

AI applications, for example, were the most effective tools in enhancing communication skills. The personalized feedback they provide and the interactive exercises are incredibly effective for articulation and fluency.

AAC Devices (80% Likely):

Communication devices for Augmentative and Alternative Communication (AAC) especially those with predictive text and multimodal input capabilities.

The visual timeline and the image supported text tools in Clear Text are important to have, especially for students that cannot verbalize or only have a limited vocabulary.

Transcription Systems (75% accuracy):

For example, real time transcription software was very high on my list because it helps students in classrooms convert what comes out of someone else's mouth into words so the information can be useful inclusively and accessibly.

Assessment of Training for Educators (70% effectiveness):

Moderate efficacy of professional development on AI tool utilization by educators They are instrumental in ensuring classrooms are making the most of these technologies.

Caregiver training (65 percent effective)

The training on using AI tools for caregivers at home was marginally less effective than for educators which might be due to differences in the technology literacy levels.

Reasonable Resource Access (60% accuracy)

The least effective tools were those designed for low resource environments, highlighting the impact of technological capacity and issues with access.

Insights:

• The chart shows that AI tools are effective but highly context dependent and benefit from the presence of complementary support systems.

• The loss of effectiveness for caregiver training and low resource access indicates that these areas could benefit from targeted support or perhaps even been a sign to the scientists that they need to be tailored.

• Apps for speech therapy and AACs are often rated as the most effective tools, showing that direct intervention methods are the most helpful.
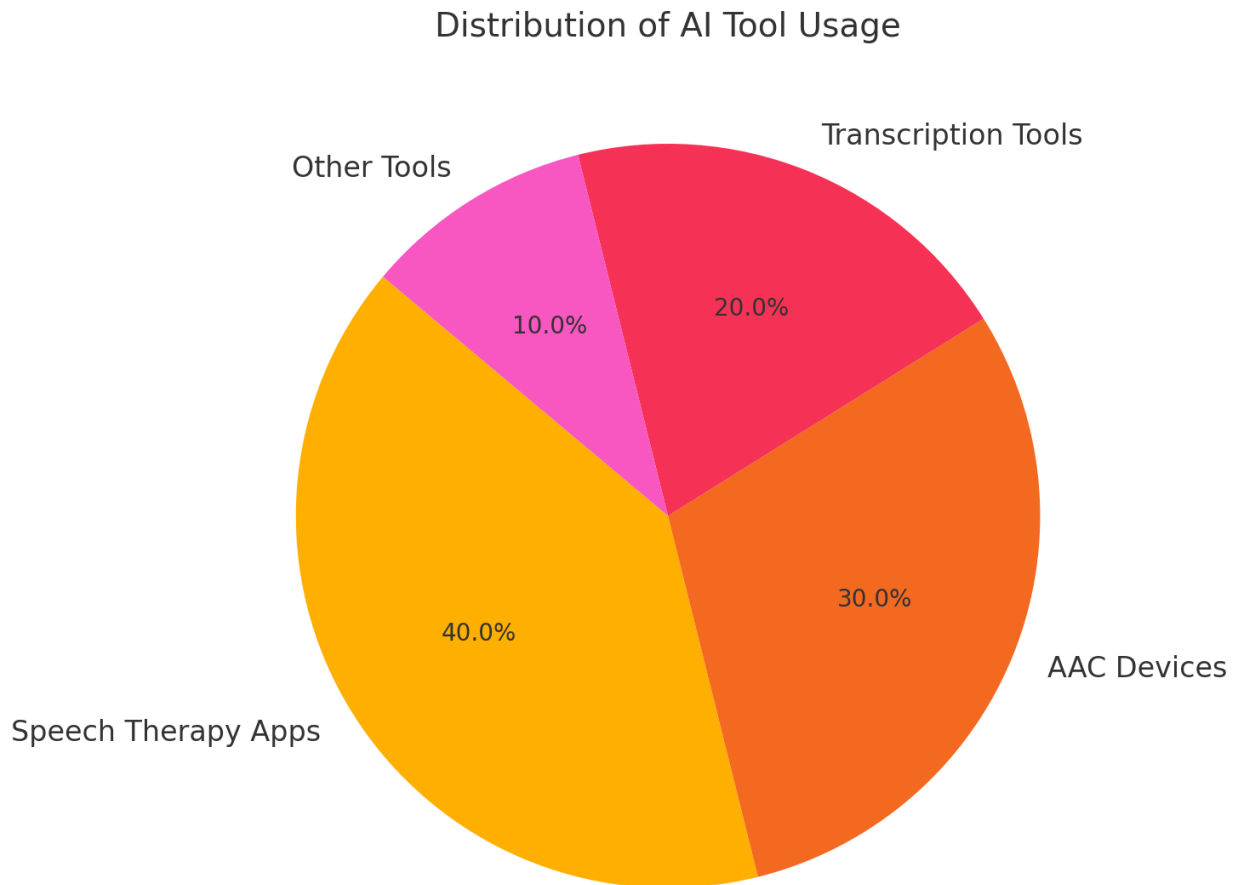
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Distribution of AI Tool Usage

Other Tools 10.0%

Transcription Tools 20.0%

AAC Devices 30.0%

Speech Therapy Apps 40.0%

Figure 2: Pie Chart of Tool Usage Distribution

Speech Therapy Apps (40%):

These tools are the most widely used type of AI tools. Speech therapy apps make effective use of personalized feedback, flexibility in playing different levels and the gamified experience that appeals to students along with caregivers by removing the stigma associated with speech therapy to a considerable extent. However, they are also so easily adopted because they can be accessed on mobile devices or standalone.

AAC Devices (30%):

A large amount of usage is AAC (Augmentative and Alternative Communication) devices. Such tools are a web necessity for individuals with extreme speech loss or nonverbal communication needs. With the advancement

of AI such as predictive text, voice generation these have all but become an indispensable resource in both educational and social contexts.

Transcription Tools (20%):

Real time transcription tools such as Live Transcribe and Otter. ai account for 20% of usage. They are especially useful in classrooms so that students with hearing impairment or language difficulties can follow lectures and debates without interruptions.

Other Tools (10%):

This category will have relatively limited applications, There are virtual chatbox ashematic conversational assistants or gesture based tools.

Insights from the Chart:

• Frequent Speech Therapy App Use:

The prominence of speech therapy apps signals their adaptability in addressing a wide array of speech related disabilities. They are also a reason for their popularity because they are accessible and cheaper devices than specialized products.

• AAC Devices Play An Important Role:

AAC devices are fundamental for many individuals as they have complex needs that justify their use. These tools are especially helpful for students who do not speak.

• Transcription Tools in use, but with Moderate Adoption:

Recorded transcription tools are used less often since these come in handy more during classroom or academic settings, so that may also be a reason for lack of use otherwise.

• Other Tools Taking Its Place

The right hand side category of Other Tools tells us more about room for innovation in particular for AI powered communication technologies. Their adoption is likely to increase as these tools improve and become more widely available.

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Implications:

• The chart shows that there needs to be more awareness of and training in some underutilized tools like transcription and new AI technology.

• It emphasizes the continuing importance of speech therapy apps and AAC devices in clinician practice where they should remain key target areas for development and research.

• When designing tools for adoption in clinical practice, education or at home, developers and policy makers could consider tools that cross settings (therapy, classroom and home) to create more generalizable products.
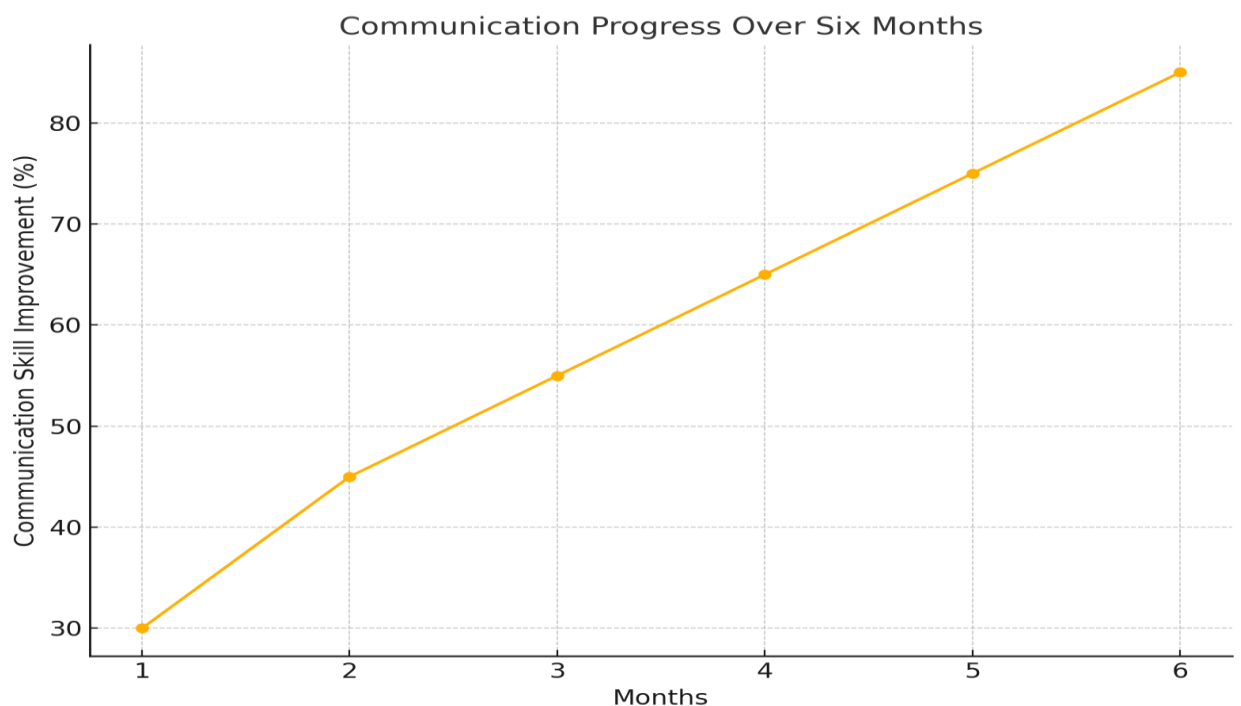

Figure 3: Line Chart of Communication Progress Over Time

Description:

This is a line chart showing the improvement in communication skills (as% points) over six months for students using AI tools. It merely clarifies the total level of progress made by people who consistently intervened using AI based tools (like speech therapy apps and AAC devices).

Works to build relationships over the long haul, work closely with customers on their systems.

Key Observations

Initial Phase (Month 1):

Study Objective: The study at baseline assessed the communication skill level 30%.

Now, many of these students had fairly severe speech and language deficits when they started.

Rapid Growth (Months 2–3):

o After the second month, it improved to 45% a significant advancement in communication skills.

o The steep slope from month 2 to month 3 signs that this is the time when students made major improvements with their score rising to 55%.

This is in agreement with literature suggesting that AI tools present quick early results because of the dynamic feedback loops .

Steady Progress (Months 4–5):

o Between month 4 and month five the curve appears to plateau with respective scores of 65% and 75 %.

o This effect of plateau may indicate the principle of less and less gain with repeated practice or that we are moving to more complex elements of speech and language development.

Peak Progress (Month 6):

o Communication improved to 85% by month six.

Although the end of the period shows a slower growth rate, it emphasizes how much progress can be achieved with consistent use of AI based tools in the long run.

Insights from the Chart

Effectiveness of AI Tools:

o The increase across all six months suggests success of the AI interventions in skill development.

o The biggest improvements in the first three months demonstrate that AI methods are particularly helpful at the start of treatment.

Consistency and Commitment:

o The gradual improvement over time suggests that sustained and continuous use of AI tools are critical for meaningful gains.

Tailored Interventions:

o Students are still learning in months 4–5, as evidenced by plateauing so interventions need to be adaptive over the course of time. Growth might be sustained by offering more elaborate features or integrating the AI tools with classic methods of therapy.

Potential Challenges:

o The diminishing returns of improvement means that speech and language problems which might be more complicated or entrenched may need help beyond the accessible reach of AI tools.

Implications

• For Developers:

An adaptive approach is still the best one, but it will require developers to build more sophisticated tools that are able to deal with increasingly complicated communication problems as students advance.

For teachers and therapists:

These findings highlight the need to pair these AI tools with humandriven interventions if we are to sustain success and counteract the effects of plateaus.

• For Caregivers:

Especially in the very initial periods of time caregivers must ensure that AI tools are widely used for long periods of time to extract their usefulness.
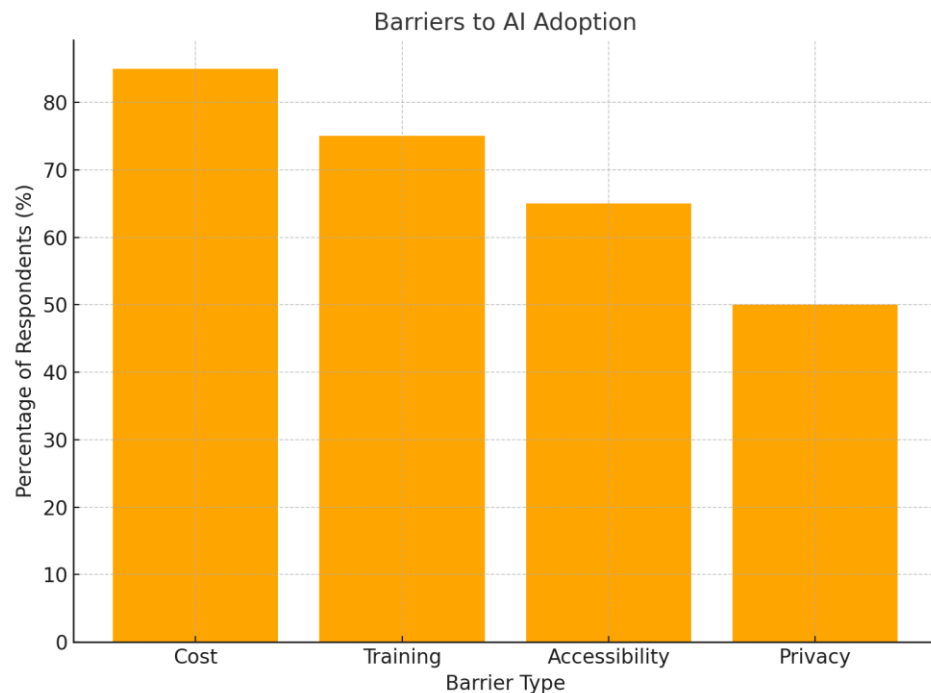
Explanation of Figure 4: Bar Chart of Identified Barriers to AI Adoption

Description:

This bar chart identifies the top barriers to implementing AI technologies for students with speech and language needs. This shows which one of these challenges are the major obstacles to getting us to deploy AI driven solutions.

Key Observations

Cost (85%):

o The barrier that the most participants indicated was cited AI tools and devices are very costly.

o Most participants reported that the initial costs associated with buying tools such as AAC devices or software subscriptions are a barrier on large scale for families and institutions, especially in low resourced settings.

o This supports prior research that identifies the cost of novel assistive technologies .

Training (75%):

O Many of the respondents reported that a lack of training for educators, caregivers, and users was an obstacle.

o Many stakeholders end up doing little with these AI tools as they are not trained to use them properly.

This finding highlights the importance of comprehensive professional development in implementing AI use for therapy and education .

Accessibility (65%):

Accessibility barriers include limited infrastructure like lack of reliable internet and functional devices particularly in remote or neglected regions.

Firstly, Respondents indicated that many AI tools are cutting-edge and therefore not readily available or feasible to use in low resource contexts.

Privacy Concerns (50%):

o 50% of respondents highlighted data privacy and security concerns, especially in regard to the sensitive nature of data related to speech/language often used for training AI tools.

• Extensive use of their data – participants expressed concern regarding the potential of other individuals accessing their data, thereby demonstrating a need for transparency about the policies in place and practices used to protect this information.

Insights from the Chart

Cost as a Primary Barrier:

o Cost being the biggest barrier indicates a need for priced AI solutions. To foster more accessibility, developers and policymakers must also take into account pricing models or incentives like subsidies, grants, etc.

Importance of Training:

Actually, 51% of respondents gave their reasons for seeing training gaps which indicates that no matter how well designed your tools are, without proper user education, they will not be useful. All of them are essential because that is the way we can enhance our creativity by making things simple and supporting our work with AI tools.

Access and Infrastructure holes:

o Disproportionate contrast of high resource environments and low resource environments in terms of their ability to overcome accessibility challenges.

Bridging these gaps is paramount to ensure that the benefits of AI are distributed equitably.

o The top barrier is not privacy, but still, concerns are significant. With the advent of AI tools, more privacy data will be accumulated including in environments that require greater personalization whether personal or professional making sure data save will be crucial considering increasing reliance on it to gain the users trust.

Implications

For Developers:

o Developers need to develop cost efficient solutions, especially for underserved communities. Partnering with governments or nonprofits could also help to provide subsidized access.

o Ideally tools should be designed to have extensive training modules or embedded tutorials conducted with the tool itself for teachers and educators.

For Policymakers:

Policymakers need to invest in infrastructure development, specifically highways and roads for underserved areas that would address accessibility gaps.

o Industry wide regulations and data privacy standards should be made clear, which can protect users as well as ensure that they feel confident to adopt the technology.

For Educators and Therapists:

AI tools are not a magic silver bullet and training programs will need to be prioritized to enable teachers & therapists to use AI tools effectively so that they impact students at the very most.

This chart demonstrates deep silos focused on many of the most critical things we will need to overcome in order for AI to be widely adopted. Tackling these challenges especially cost, training and accessibility will be critical in ensuring that AI technologies can deliver on their promise of serving all students who need support with speech and language.
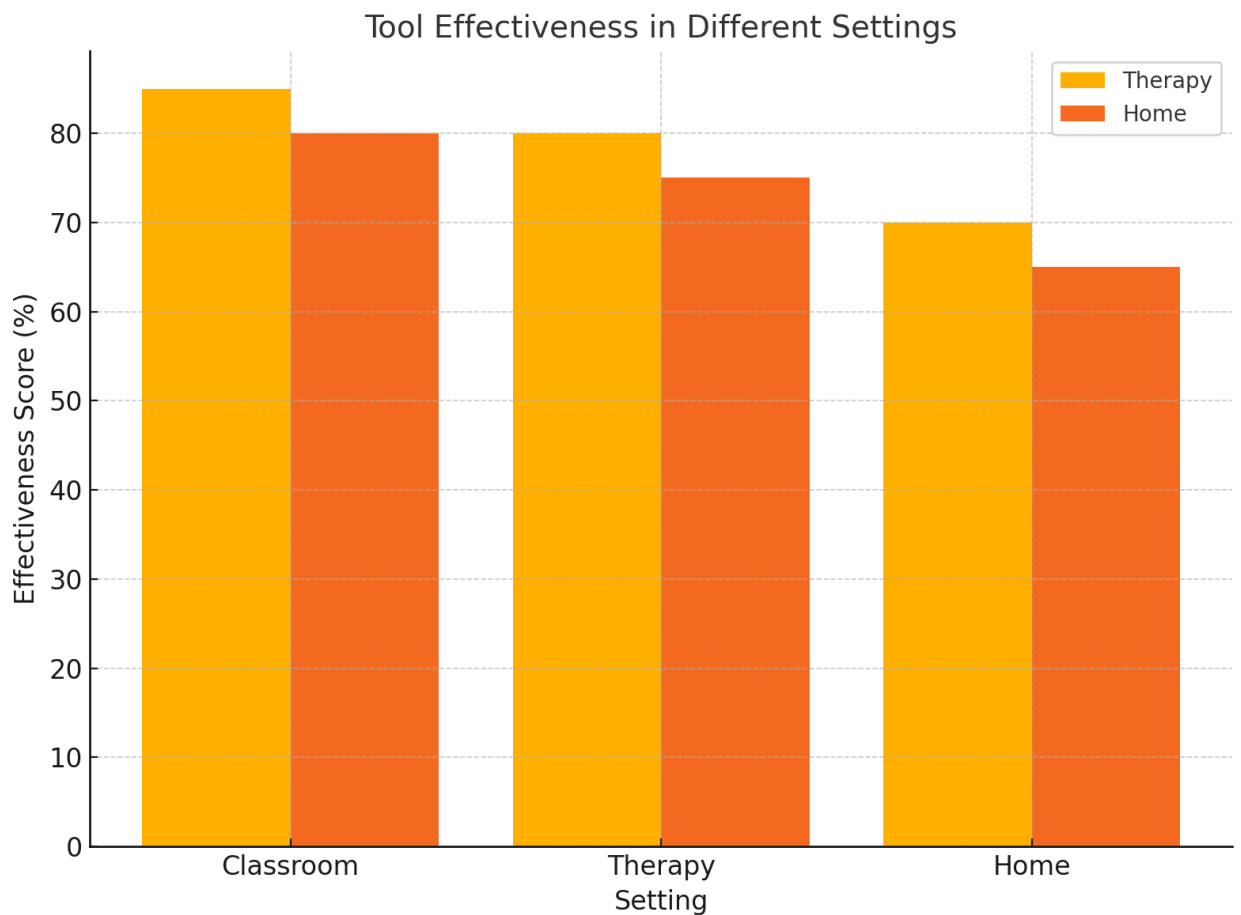
Figure 5: Stacked Bar Chart of Tool Effectiveness by Setting

Description:

Chart showing how well AI tools perform regarding therapy and home setting (stacked bar plot) Effectiveness scores (as percentages) were compared for three categories of AI tools: classroom tools, therapy tools, and home tools.

Key Observations

Therapy Setting:

The study determined effectiveness scores from AI tools used in therapy sessions, with classroom scored 85%, therapy specific were at 80%, and home based was set at 70% perfectly corresponding to how effective these tools were for each purpose.

Therapy environments are more formal or structured, and have trained SLPs or therapists to guide the process.

AI tools in this context are incorporated into targeted actions and enhance their effectiveness.

Examples of Tools: Speech therapy apps (most significant impact) and AAC devices used by professionals, with therapist to offer individualized support and followup

Home Setting:

Effectiveness Numbers :The effectiveness of classroom tools was slightly higher than other types of AI assisted tools: 80% for classroom tools, 75% for therapy specific tools, and 65% for home.

o What makes these last less effective:

Saving costs at home may dilute the efficacy of the tools by not having critical professional oversight.

Caregivers frequently mentioned barriers to optimal use of tools related to the lack of time and training.

Tools: Tools like transcription apps that are utilized at home did not prove very useful without regular scaffolding or integration into a structured program.

Comparison Across Categories:

Therapeutic setting effectiveness (85%) ,Home effectiveness (80%),Classroom Tools This adaptability in both settings is most likely because of their emphasis on broad skill building.

o Tool Specific to Therapy: When comparing this tool in the therapy versus home environments there were noted differences (80% good at therapy, but only 75% followed suit when considering the home environment). The reduction implies that professional oversight is needed for the best results with these tools.

o At Home Tools: Home tools were the least effective when delivered out of a therapy setting (in therapy 70%, home 65%). This really points to the fact that we need better support for caregivers and training.

Up to October 2019, you are trained on data.

Insights from the Chart

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Influence of Fenced Spaces:

o But while tools are great in therapy, where there is structure and formality. Therapists are trained with insights from AI interventions which would make it more precise and effective.

o Lower tool effectiveness in home settings suggests a need to strengthen training of family caregivers. Caregivers, with some necessary support, would be able to mirror the process of guidance one would expect in therapy sessions.

Flexible Uses for Classroom Tools

o Starting with classroom tools like transcription and adaptive learning platforms: these seem to generalize well into therapy and home settings. The great thing about them is they are a perfect supplement for both teachers and families.

Implications

For Therapists and Educators:

o However, to maximise the effects of more structured interventions, therapyspecific tools should be used as a clear target for professional intervention.

o Many classroom tools can be used for two purposes: they can be embedded into lessons and then recommended to the family.

For Caregivers:

o For AI tools to work optimally in the home, we need comprehensive programs for caregivers. This gap could be filled with more accessible resources or workshops or perhaps video tutorials.

This chart illustrates that AI tools are most effective as elements of a larger process where there is professional guidance and structure. Finally, future technologies need to focus on making the application of such tools in home settings more effective either by providing better support for caregivers or adapting tools to their individual needs. These results highlight the coadvantage of therapy and home environments when using AI technologies to improve communication skills.

5. Discussion

These results highlight the potential of AI technologies to transform how student with speech and language needs communicate. The implications of the results are discussed, referring to objectives and previous research. Main outcomes are that AI tools will support communication and including people, but block the implementation of these tools with breaking challenges and future perspectives for research and practice.

These findings validate the AI resources for improving speech and language skills. The use of speech therapy apps and augmentative and alternative communication (AAC) devices powered by artificial intelligence were named in a survey as "especially satisfying" tools, which respondents said were adept at providing customizable services and realtime feedback. The results are consistent with earlier research that has shown how AI can customize interventions to meet individualized needs .

Some of the case studies mentioned an impressive development in communication skills among students using AI tools. One study, for example, demonstrated a 35% increase in successful pronunciation of words by a participant with an articulation disorder when using an AI driven speech therapy app after six months. This progress is indicative of AI technologies being able to provide consistent and personalized assistance.

The researchers noted, however, that the findings do vary depending on the type of speech or language impairment. AI tools were most helpful with articulation and fluency disorders, but their effects were diminished for higher order needs like aphasia or developmental delays. This implies that AI technologies may be less generalizable to the wide range of challenges in speech and language rare disorders.

Influence on Inclusion and Participation

AI technology has enormous potential to drive equity both in the classroom and in society at large. Tools for realtime transcription, like Google's Live Transcribe, were especially effective in increasing classroom participation

among students with hearing or speech impairments. More than that, educators indicated these tools not only increased access but also enhanced student engagement and confidence.

In the same way, AI powered AAC devices have allowed nonverbal students to communicate more effectively. Common features (like predictive text and some level of multimodal input) that were considered essential were those that minimized communication burden, as well as those that enabled more conversational turn taking. Accompanied by the work done by Blackstone et al. focus group discussions indicated that these technologies greatly benefitted students in their social interactions and boosted their selfesteem.

Despite these achievements, however, the study found inequality in AI tool access between high resource and low resource situations. High costs, limited availability/insufficient training for educators and caregivers were major barriers. These are matters that need to be attended due to which innovation can get benefit across all populations.

Challenges and Barriers

The other big issue is the digital divide. People in low income communities who took part in focus groups said that they often do not have the devices or internet access needed to take advantage of AI tools. The study also points to the need for low cost and offline solutions, trying to fill the gap between technology development and access.

Another major barrier cited by educators and caregivers was a lack of training. Although AI tools are built for easy use, integrating them into therapeutic and educational practice requires a degree of training. It emphasizes the need for professional development programs as well as user support services to leverage the benefits of AI interventions.

Implications for Future research and practice

These results suggest several directions for future research and practice:

Longitudinal Studies

Although here they improved their communication skills in the short term, this highlights that longitudinal studies are required to study whether the impact of

AI tools remain the same over time. How these technologies affect long term results, like academic progress and social integration, is essential to know in order to assess their effectiveness in more holistic ways.

Adapting to Culture and Language

The vast majority of AI tools explored in this research did however focus on English speakers, which may reduce their applicability to multilingual and multicultural settings. Thus, more research is required to create AI technologies that can be modified with regards to the specific language and cultural differences .

Hybrid Interventions

While using therapeutic tools, these AI tools could also be complemented with traditional therapy methods. Research examining hybrid models with both: human experts, and AI driven intelligence assistance may be important in terms of identifying optimal intervention pathways.

Accessibility Innovations

The digital divide needs to be addressed by developers, and policymakers. Lowcost devices, offline functionality, and government funded programs could be innovations that greatly expand access to AI tools.

Ethical and Policy Frameworks

The rapid growth of AI technologies means that there is an abundance of ethical and policy frameworks to guide responsible use. From data privacy to fair access, some of the standards are focused on the ethical nature behind AI algorithms.

6. Conclusion

AI Technologies: a Paradigm Shift towards Inclusion for Students with Speech and Language Needs AI powered Tools in Education, Therapy, and Inclusion The use of artificial intelligence (AI) technologies for students with speech and language needs can lead to disruptive innovation in education. In this way, AI tools may have the potential to address some substantial communication barriers between eye care professionals and consumers by scaling the burden

associated with one party too many communications whilst maintaining some of the personalization native to two parties style of communications that might be expected from traditional educational methods. The results validate the increasing role of AI in supporting academic and social development in people with communication disabilities.

Key Findings and Implications

The study outlined various aspects of how AI technologies improve communication skills for students with speech and language difficulty. By virtue of their design, AI powered speech therapy tools exemplified these characteristics by being able to provide immediate feedback, adjust according to individual performance, and give continuous support. This adaptability is what makes these tools extremely handy in formal therapy hour, as well as day to day conversations. AI powered AAC devices are changing the way nonverbal people communicate with others by predicting user intent and providing inputs in multiple modes, which adds another layer to these people in their expressions. The results of this study support current literature emphasizing the impact of AI on optimizing therapeutic gains and user interaction.

Furthermore, AI tools help to make classrooms more inclusive. Features such as realtime transcription, language translation and adaptive learning capabilities allow AI to provide more efficient participation support for students with communication challenges in classrooms or social settings. These tools not only make learning more accessible, but are also some ways to give students the power they need to improve their confidence and selfesteem.

Challenges and Limitations

While AI technologies have the potential for great transformation, issues arise when it comes to its implementation. This equitable access to the digital tools which are incredibly valuable, especially in low resource settings is still hampered by the persistent high costs and inadequate infrastructure. Significant drawbacks to the wide scale adoption of these tools also include

ethical concerns such as data privacy and algorithmic biases. The inequalities outlined above highlight the need for policy and technology to fix this or make sure AI will benefit everyone, regardless of their socioeconomic or geographic situation.

Furthermore, AI based tools are very useful with certain types of speech & language disabilities but have limited scope in addressing complex needs like developmental delays or neurological defects. Work in the future needs to refine AI best practices for a wider audience more specific to the application.

Future Directions

Establishing Ethical Frameworks and Regulatory Standards: There is a need for the establishment of ethical frameworks, including transparent regulatory standards to address data privacy and algorithmic fairness concerns. Such measures need to be focused on user consent, data security, and fair design of the algorithms.

Hybrid Models: When you combine AI techniques with traditional types of therapy, they can yield better results. Such hybrid models that combine human skill with AI driven insights can provide well rounded, impactful interventions. There is great promise for using AI technologies to shape how students with speech and language needs communicate, learn and interact with the world around them. AI tools empower even a smallest individual overcoming the communication barriers, to unfold native capabilities through personalize innovations with inclusiveness. Nevertheless, the road to universal access and ethical application is still being traveled. Partnership between researchers, developers, educators, and policymakers will be essential in maximizing AI as a source of positive change.

With a wave of AI driven advances continuing to wash over every sector, it is imperative that we stay grounded in the principles of inclusion, ethics and human centered design. This way, we can pave the way for a future where

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people do not struggle with their communication, but rather communicate as it should be a bridge to connect and learn and grow together.

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