Generative AI Applications in Helping Children with Speech Language Issues

Helen Qin

Thomas Jefferson High School for Science and Technology
helen.ty.qin@gmail.com

Abstract

This paper reports how generative AI can help children with specific language impairment (SLI) issues by developing an AI-assisted tool to support children with challenges in phonological development in English, especially children with English as the secondary language. Children from bilingual families often experience challenges in developing proficiency in English pronunciation and communication, which has been exacerbated by remote learning during the pandemic and led to learning loss. School-aged children with speech problems require timely intervention because children with language disorders find it difficult to communicate with others, leading to social isolation and academic difficulties. The needed intervention is often delayed due to the high cost of speech services and the shortage of Speech and Language Pathologists (SLPs). An AI-assisted Phonological Development (AI-PD) tool was prototyped, aiming to alleviate these challenges by assisting caregivers in evaluating children's phonological development, assisting SLPs in lesson preparation, and mitigating the severe shortage of SLPs.

Overview

The National Center for Health Statistics of the United States reported that approximately 7% of children from ages 3 to 17 years old have speech and language disorders (Black et al. 2015) and the Department of Education of the United States reported that speech and language disorders are the second most common disability among children receiving special education (US Department of Education - National Center for Education Statistics 2023). In 2019, the Annie E. Casey Foundation found that 23% of school-aged children nationwide spoke a language other than English at home (Annie E. Casey Foundation 2019). Children with speech impediment issues are left unnoticed because of other languages used at home. Families who require speech services often do not have access to timely intervention due to high-cost and shortage of speech language pathologists, especially in rural areas and under-served communities (Harris 2007, AMN Healthcare 2022). The American Speech-Language-Hearing Association emphasizes the need for early speech therapy intervention (American Speech-Language-Hearing Association 2023). Recent advancements in AI-assisted tools present an opportunity to support families and caregivers in need of speech-language therapy (Deka et al. 2022).

AI-Assisted Phonological Development for Children

Phonological development is a crucial aspect of language acquisition. The current practice of Speech-Language Pathologists (SLPs) is to customize flashcards that target specific sounds, word structures, or phonological patterns the student finds challenging after assessing each student's phonological abilities and challenges. Flashcards are used to help students make connections between sounds (phonemes) and letters or groups of letters (graphemes). SLPs may provide students with flashcards to take home for additional practice, involving parents or caregivers in the therapeutic process. SLPs often work closely with teachers to ensure that the phonological skills targeted with flashcards are reinforced in the classroom setting. The AI-PD tool uses generative AI technology to help with the preparation of flash card-based lessons preparation and practices with caregivers to meet the personalized needs of students. The AI-PD tool has engaging modules to address phonological processes such as Reduplication, Weak Syllable Deletion, Final Consonant Deletion, Gliding, and Alveolarization that are central to speech development. For example, reduplication occurs when students repeat sounds in words, in a way similar to "mama" or "dada." Reduplication can become a concern if not resolved at a proper age, leading to further learning and social difficulties (Schwartz et al.

1980). Another example of why bilingual students may have challenges in phonological development issues is the consonant clusters in English, which often don't exist in languages in other regions. Based on learners' needs, my AI-PD tool can produce a set of words together with engaging flashcards for caregivers or speech language pathologists to work with learners on different phonological processes.

A website is prototyped to demonstrate the application of generative AI in providing speech therapy modules for common phonological development issues at https://sites.google.com/view/helen-slp/ (Figure 1). When a child's specific speech issues are identified, caregivers can provide the child with a personalized learning module based on his/her phonological development. It is technically challenging to have a seamless interface between the AI-PD application and existing generative tools such as ChatGPT because the output varies given prompts. For example, one learner may need more practice on Alveolarization and Gliding. There are potential risks to displaying generated flashcards to children without moderation. In our AI-PD tool, the set of age-appropriate words and engaging images was evaluated by school-aged children. Figure 1 presents an example of the Alveolarization process. Alveolarization refers to the replacement of consonants made with the teeth or lips with consonants made at the alveolar ridge., such as "four" versus "sore" and "thick" versus "sick".
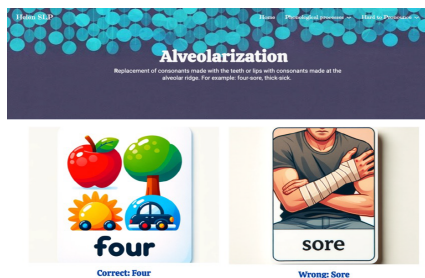

Figure 1. An example of AI-PD therapeutic exercise, Alveolarization, speaking "four" versus "sore".

AI-Assisted Phonological Development for Children

Children from bilingual families often do not have sufficient opportunities to learn and practice English speech and language at home, although they are important in learning, academic, and social interactions. During the pandemic, school-aged children stayed home for remote learning, which was not an effective way for children in the process of phonological development. Speech and language issues are left unnoticed in these children. Even when issues are noticed, children cannot receive timely intervention due to the high cost and shortage of SLPs. The problem of "learning to read" will become "reading to learn" when children finish a few years in elementary school. Generative AI applications in the intervention of speech language impairment can help to improve the well-being of impacted individuals. It has the potential to significantly lower screening costs and time. It will help SLPs to manage their workload so that students in need will have access to SLP services. This is an example how generative AI can contribute to social goods, bridge social equity gaps, and contribute to a more inclusive learning community for students from different backgrounds.

In the future, more features will be added to the AI-PD tool. The generative AI-based tool will screen children's speech which helps caregivers understand the extent of a child's phonological development. The tool will help SLPs to develop personalized engaging lessons based on the progress of individual students. Storytelling and Interactive Content will be added to further engage students. For example, a storytelling exercise can be designed around an axolotl who believes that she belongs to the salamander family by being able to say "F" instead of "S".

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