TPM Vol. 32, No. S1, 2025
ISSN: 1972-6325
https://www.tpmap.org/

THE INTEGRATION OF ARTIFICIAL INTELLIGENCE IN PHONICS-BASED BLENDING INSTRUCTION FOR STUDENTS WITH SPECIFIC LEARNING DISABILITIES AT THE PRIMARY LEVEL

R.MONITHA
PH. D RESEARCH SCHOLAR, TAMIL NADU TEACHERS EDUCATION UNIVERSITY, KARAPAKKAM, CHENNAI.

DR P. GANESAN
RESEARCH GUIDE, PROFESSOR & HOD, DEPARTMENT OF PEDAGOGICAL SCIENCE, TAMIL NADU TEACHERS EDUCATION UNIVERSITY, KARAPAKKAM, CHENNAI.

ABSTRACT
Early reading proficiency is a critical determinant of academic success. However, students with Specific Learning Disabilities (SLD), particularly dyslexia, frequently experience persistent difficulties in phonological processing and word decoding. Phonics-based blending instruction has long been recognized as an effective approach for supporting early literacy development, yet traditional classroom implementation often lacks the individualized feedback necessary for students with reading disabilities. Recent advances in Artificial Intelligence (AI) offer new opportunities to enhance phonics instruction through adaptive learning systems, automated speech recognition, and intelligent tutoring technologies. This paper examines the integration of AI-assisted tools in phonics-based blending instruction for primary school students with SLD. Drawing on theoretical frameworks including Cognitive Load Theory and the Zone of Proximal Development, the study explores how AI-supported systems can provide real-time feedback, reduce instructional barriers, and personalize learning pathways. Empirical findings from recent studies indicate that AI-assisted literacy interventions significantly improve phonemic awareness, decoding accuracy, and reading fluency among struggling readers. A quasi-experimental comparison of AI-supported instruction and traditional phonics instruction demonstrates measurable gains in reading performance among students using AI tools. The results suggest that AI technologies can function as effective supplementary instructional tools within inclusive classrooms. While concerns regarding data privacy, algorithmic bias, and digital access remain, the integration of AI in phonics-based instruction represents a promising direction for improving literacy outcomes among students with learning disabilities.

1. INTRODUCTION

Reading acquisition is one of the most important developmental milestones in early education. The ability to decode and comprehend written text determines a student's capacity to engage with academic content across all subjects. Research consistently shows that early reading proficiency strongly predicts long-term academic achievement and educational attainment (Ehri, 2005).

A central component of early reading instruction is **phonics-based learning**, which focuses on teaching the relationship between graphemes (letters) and phonemes (sounds). Within phonics instruction, **phoneme blending** plays a critical role. Blending requires students to combine individual sounds sequentially to form recognizable words. For example, blending the phonemes /c/, /a/, and /t/ produces the word *cat*.

Students with **Specific Learning Disabilities (SLD)** often experience significant challenges with this process. Dyslexia, one of the most common forms of SLD, is characterized by deficits in phonological processing, working memory, and rapid word recognition (Snowling, 2013). These cognitive challenges make decoding tasks particularly difficult for affected learners.

Traditional phonics instruction can support many students with reading difficulties. However, classroom constraints often limit the amount of individualized instruction teachers can provide. In classrooms with diverse learners, it is difficult for teachers to deliver continuous feedback during oral reading practice.

Recent developments in **Artificial Intelligence (AI)** have created new opportunities for personalized learning environments. AI technologies can analyze student responses, detect pronunciation errors, and adapt instruction based on individual performance patterns (Holmes, Bialik, & Fadel, 2019).

AI-driven literacy tools often incorporate:

- Automated speech recognition (ASR)
- Intelligent tutoring systems (ITS)
- Adaptive learning algorithms

- Real-time feedback systems

These technologies enable students to receive immediate guidance while practicing phoneme blending.
Despite rapid technological advancement, research examining the integration of AI into phonics instruction for students with SLD remains limited. This study therefore explores the role of AI-supported learning tools in improving phoneme blending and early reading development.

2. LITERATURE REVIEW

2.1 Phonics Instruction and Reading Development

Systematic phonics instruction has been widely recognized as one of the most effective approaches for teaching early reading skills (National Reading Panel, 2000). Studies show that phonics-based instruction improves word recognition, decoding accuracy, and reading fluency among beginning readers (Ehri, 2005).
Students with dyslexia often benefit from **explicit and structured phonics instruction** because it strengthens phonological awareness and letter–sound mapping (Snowling, 2013).
Research also indicates that **repeated phoneme blending practice** is essential for developing decoding automaticity (Share, 1995).
However, students with SLD often require:

- greater repetition
- explicit feedback
- individualized pacing

These instructional needs are difficult to address in traditional classroom settings.

2.2 Artificial Intelligence in Education

Artificial Intelligence has become increasingly prominent in educational technology. AI systems can analyze large volumes of student performance data and adapt instruction accordingly (Holmes et al., 2019).
Educational AI tools often include:

- automated feedback systems
- adaptive learning pathways
- predictive learning analytics
- intelligent tutoring platforms

Studies have shown that AI tutoring systems can produce learning outcomes comparable to individualized human tutoring (VanLehn, 2011).

2.3 AI Applications in Literacy Instruction

AI-based literacy tools commonly rely on **Automated Speech Recognition (ASR)** to analyze student pronunciation during oral reading exercises.
ASR systems can:

- detect phoneme mispronunciations
- measure reading fluency
- provide corrective prompts

Recent studies indicate that AI-assisted reading platforms significantly improve reading outcomes among struggling readers (Ayasrah et al., 2024).
A systematic review of AI interventions for students with learning disabilities reported improvements in reading accuracy ranging from **30% to 40%** across multiple studies (Gharaibeh et al., 2025).
These findings suggest that AI-based systems may serve as valuable supplementary tools in literacy instruction.

3. THEORETICAL FRAMEWORK

3.1 Cognitive Load Theory

Cognitive Load Theory (Sweller, 1988) explains how limitations in working memory influence learning.
During phoneme blending tasks, students must:

1. identify individual sounds
2. maintain phonemes in working memory
3. combine sounds sequentially

Students with dyslexia often experience reduced phonological memory capacity, increasing the cognitive demands of decoding tasks (Snowling, 2013).
AI-supported systems can reduce cognitive load by:

- segmenting phonetic units
- providing visual cues
- offering guided feedback

Table 1. Cognitive Load and AI Instructional Support

Cognitive Load Type	Impact on SLD Students	AI Mitigation Strategy
Intrinsic load	Difficulty holding multiple phonemes	Adaptive segmentation of sounds
Extraneous load	Distractions in materials	Simplified digital interface
Germane load	Effort to form phoneme–grapheme connections	Immediate feedback and guided practice

3.2 Zone of Proximal Development

Vygotsky's **Zone of Proximal Development (ZPD)** proposes that learning occurs most effectively when instructional support is calibrated slightly above the learner's current ability (Vygotsky, 1978).

AI reading systems can function as digital scaffolds by:

- detecting hesitation during reading
- providing phonetic prompts
- adjusting task difficulty

This adaptive scaffolding helps maintain learners within their optimal learning zone

4. METHODOLOGY

Research Design

A **quasi-experimental design** was used to compare traditional phonics instruction with AI-assisted phonics instruction.

Participants

Thirty primary school students diagnosed with reading-related learning disabilities participated in the study. Participants were divided into two groups:

Group	Instruction Method	Students
Control Group	Traditional phonics instruction	15
Experimental Group	AI-assisted phonics instruction	15

Instructional Intervention

The intervention lasted **four weeks**.

Students in the experimental group used an AI-based phonics learning platform incorporating:

- speech recognition feedback
- adaptive word lists
- phoneme blending exercises

Students practiced **20 minutes per day**.

Data Collection

Two assessments were used:

1. Phoneme Blending Test
2. Reading Fluency Test (Words per Minute)

Pre-tests and post-tests were administered.

5. RESULTS

Table 2. Phoneme Blending Test Scores

Group	Pre-Test Mean	Post-Test Mean	Gain
Control	42	55	+13
Experimental	41	68	+27

Table 3. Reading Fluency (Words per Minute)

Group	Pre-Test	Post-Test	Gain
Control	38	47	+9
Experimental	37	58	+21

Statistical Comparison

A simple independent t-test comparison of improvement scores indicates a statistically significant difference between the groups.

Table 4. Statistical Comparison of Reading Gains

Measure	Control Mean Gain	Experimental Mean Gain	Significance
Phoneme Blending	13	27	$p < 0.05$
Reading Fluency	9	21	$p < 0.05$

Students receiving AI-assisted instruction demonstrated **approximately double the improvement** observed in the control group.

6. DISCUSSION

The results indicate that AI-supported phonics instruction significantly improves phoneme blending accuracy and reading fluency among students with Specific Learning Disabilities.

Several factors likely contributed to this improvement.

First, AI systems provide **immediate feedback**, allowing students to correct pronunciation errors in real time. Immediate correction prevents the reinforcement of incorrect phonetic patterns.

Second, AI platforms offer **adaptive learning pathways** that adjust instructional difficulty based on individual performance. This personalization enables students to progress at their own pace.

Third, the interactive nature of AI learning tools may increase **student engagement and practice time**, which are essential factors in developing reading fluency.

These findings are consistent with previous research indicating that AI tutoring systems can produce learning gains comparable to one-to-one tutoring (VanLehn, 2011).

However, AI systems should not replace classroom teachers. Instead, they should function as supportive tools that enhance teacher-led instruction.

7. Limitations

Several limitations should be noted.

The study involved a relatively small sample size. Larger studies are needed to confirm the generalizability of the findings.

Additionally, the intervention period was limited to four weeks. Long-term studies would provide greater insight into the sustained impact of AI-assisted instruction.

Finally, access to AI-based learning technologies may be uneven across educational settings.

8. CONCLUSION

Phonics-based blending instruction remains essential for early literacy development. Students with Specific Learning Disabilities often require additional support to master phonological decoding skills.

Artificial Intelligence offers promising tools for addressing these instructional challenges. AI-assisted learning platforms provide adaptive instruction, real-time feedback, and personalized learning experiences.

The findings of this study suggest that AI-supported phonics instruction can significantly improve reading outcomes among students with learning disabilities.

When integrated thoughtfully into classroom instruction, AI technologies have the potential to enhance inclusive education and support more effective literacy instruction for struggling readers.

REFERENCES (APA)

1. Ayasrah, M., et al. (2024). Artificial intelligence interventions for students with learning disabilities.
2. Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading*.
3. Gharaibeh, S., et al. (2025). Artificial intelligence and reading comprehension among dyslexic learners.

4. Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education.*
5. National Reading Panel. (2000). *Teaching children to read.*
6. Scanlon, P. (2020). Speech recognition technologies in literacy education.
7. Share, D. (1995). Phonological recoding and self-teaching.
8. Snowling, M. (2013). Dyslexia and phonological deficits.
9. Sweller, J. (1988). Cognitive load theory.
10. VanLehn, K. (2011). Intelligent tutoring systems.
11. Vygotsky, L. (1978). *Mind in Society.*