ENCYCLOPEDIA
on Early Childhood
Development

Computer-Assisted Word Recognition Interventions

[1]Melissa V. Stalega, PhD, [2]Devin M. Kearns, PhD, [1]Nicole Landi, PhD

[1]University of Connecticut, USA, [2]North Carolina State University at Raleigh, USA

April 2025

Introduction

Children in Kindergarten (Reception) through Grade 2 must develop word recognition skills—the ability to read individual words quickly and accurately—to support reading comprehension. *Computer- or tablet-based applications* (apps) include computer-assisted instruction (CAI) tools used in schools and educational technology used at home. These apps are designed to enhance skills through interactive activities.

Subject

Many app-based word recognition programs exist, but little is known about their effectiveness or best use. These apps gradually introduce literacy concepts based on current reading performance, starting with letter sounds, then simple words (e.g., *bat*), common spelling patterns (e.g., *EE*), and eventually polysyllabic words (e.g., *robot, replacement*). Most use *receptive* exercises where children listen and select the correct word (see Figure 1), while few currently use speech recognition for spoken responses – though more are being developed.

Image not found or type unknown

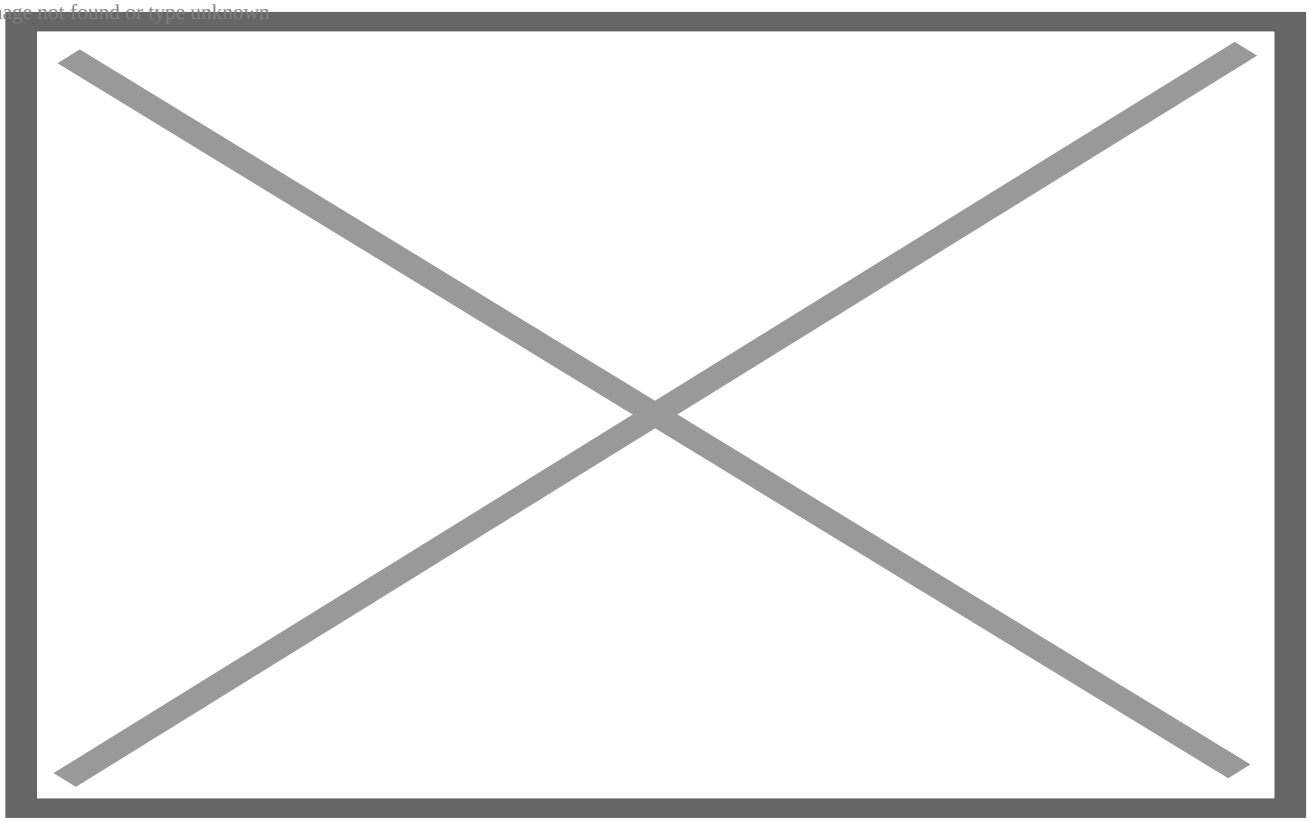

Figure 1. This child is practicing reading using a receptive learning modality. The child hears the word bat through headphones and selects the printed words that matches what is heard.

Problems

Despite the large and expanding market (approximately $6 billion in 2023)[1], it remains unclear whether time spent on word recognition apps yields educational benefits or which features make them effective. Research has yet to determine which children will benefit most or the ideal conditions for use.

Research Context

Many studies test whether specific apps improve reading. Small efficacy studies focus on app-specific skills, while larger effectiveness trials provide a gold standard for measuring impact. Meta-analyses combine these studies to assess overall benefits and factors (e.g., moderators) that influence effectiveness. This article draws on both small and large studies, as well as meta-analyses to identify the benefits of word recognition apps.

Key Research Questions

Do word recognition apps have a positive effect on word recognition skills in Kindergarten through Grade 2? What child characteristics and app features lead to the greatest improvement?

Recent Research Results

Overall, apps can have a small positive impact on literacy outcomes for elementary-age children[2,3]. Studies evaluating factors that influence effectiveness have considered dosage, supervision, cultural and language context, child characteristics, and app features.

Dosage

Evidence on dosage for traditional reading intervention is mixed, ranging from no effects[4] to positive effects of increased dosage mainly for at risk or reading disabled readers[5]. When it comes to app-assisted learning for reading, total time spent using the app didn't change reading outcomes in some studies[6]. This aligns with an earlier study of educational apps, which found that more than one session was better than just one, but the length of the sessions didn't make a difference[7]. In summary, massed practice (a lot of instruction in a short time) is unlikely to result in better reading outcomes than repeated practice over time, but there isn't enough evidence yet to make a clear recommendation.

Supervision

Some studies have examined the effect of adult supervision (i.e., facilitation) during app use on reading outcomes as opposed to those in which children engage in independent practice (e.g., child working on laptop alone).[7,8,9,10] Examples of adult supervision include working 1:1 with a child; small group, teacher-led instruction that supplements other instruction; and providing motivation. One particularly effective strategy is incorporating a positive reinforcement system paired with performance feedback (i.e., explaining why an answer was right or wrong[7]). In addition, prompts (e.g., hints) facilitate app-based learning[7]. For parents, this may be especially effective when apps include real-time prompts and suggestions, while teachers use their expertise to provide scaffolds and targeted support. Approaches which integrated apps into an existing curriculum are also found to be more effective for beginning readers relative to those which used them as an isolated activity[3]. While there is a general assumption that app-based instruction is child-led, findings suggest that adult facilitation is still needed to achieve the greatest academic benefits.

Cultural and Language Context

Apps for literacy have been studied across the world[11] (e.g., India[12]; Switzerland[13]; The Netherlands [14], and many international studies have shown positive effects. When it comes to different languages, the way a language is written (i.e., orthography) doesn't affect the success of technology-based early literacy programs[15]. These programs can be effective in any language as they tend to focus on generalizable reading skills. However, apps may not outperform teacher-led instruction without technology in Kenya[16] and Zimbabwe[17] and may not be the best means to improve literacy in low-resource environments.[18]

Child Characteristics

When it comes to typical reading instruction, many studies will examine how child characteristics such as grade and risk of reading difficulty change its effectiveness. Currently there are inconsistent findings pertaining to how grade and reading skills impact the effectiveness of app use. Generally, children at all grades and levels of reading ability can benefit from app-based word-recognition instruction.[2,3,15] There is one notable difference that shows that it may be particularly effective in secondary grades[8], but more research is needed to examine this difference.

App Features

Some studies have examined features of apps that might make them more effective, including whether they are adaptive, have a reinforcement system, or use certain design features. Table 1 provides a summary.

Table 1. App Features and the Relation with Child Academic Performance

App Design Feature	Definition	Examples	Level of Evidence

Adaptivity[19,20,21]	Changing the difficulty of lessons in response to performance.	• Child moves on to more complex sound-spellings after 80% accuracy on easier ones. • Child does additional practice reading for fluency after giving a number of accurate but slow responses.	Moderate favoring adaptivity Negative if adaptivity is based on completing tasks, not performance[7]
Reinforcement[7]	A way to maintain engagement while using app that includes performance feedback and/or performance- or effort-contingent rewards.	• Child earns a badge after reaching a new level in a game. • Child receives a number of points after correcting a mistake in an activity.	Limited favoring reinforcement including performance feedback

Schematic design[7]	Type of visuals used to present the game: • Simple interfaces with few elements outside the learning content • Interfaces with cartoons for photo-realistic characters or environments that take attention away from content	• Simple: App uses icons to show how to move to the next activity or ask for a word to be repeated. • Cartoon: App has cartoon characters that perform acrobatic tricks after every correct answer. • Photo-realistic: App has a virtual host who “talks” to the child at length.	Weak favoring simple interfaces

Table 1. *Summary of design features that may be associated with child success using apps—based on studies including children in elementary schools that come from multiple content areas—not literacy specifically.*

Research Gaps

Despite significant research, gaps remain in studies on app-based instruction. There is limited systematic analysis of app features, making it difficult to provide clear recommendations. For example, research on dosage is limited, so we do not fully understand how much time should be spent on app-based instruction. Additionally, few studies compare effectiveness in different settings, like at home versus at school. Some research suggests supervision improves outcomes[7,9]

but there has not yet been a comparison of what this should look like among education professionals versus parents/guardians. Finally, most research has focused on high-income countries, with less attention to socioeconomic factors or studies in developing regions. These gaps highlight the need for more inclusive and targeted research to better understand the effectiveness of word recognition apps.

Conclusions

While use of word recognition apps for early readers holds promise for supplementing teacher-led instruction, current research gaps limit conclusions about optimal use conditions. Overall, extant studies find small positive effects with minimal differences in outcomes as a function of child characteristics (e.g., reading disability or at-risk status, grade, culture or language of instruction). With limited systematic examination of app features, setting, or dosage and most meta-analyses combining data from multiple apps, strong recommendations for development or use are premature.

Implications for Parents, Services and Policy

To build word recognition skills, most children need direct, explicit reading instruction and an adequate number of practice opportunities. Apps can be used as a tool to increase the number of practice opportunities and supplement formal reading instruction. Apps are not a replacement for teacher-provided instruction, particularly among beginning readers learning phonological awareness and the alphabetic principle.[15] There is not sufficient evidence to recommend or discourage use of apps at home as the majority of use has been within school settings. Overall, current studies have demonstrated that using apps for academic learning has promising benefits, but there is limited understanding about the best way to use it. Future studies should focus on developing explicit guides for use that are linked to maximizing reading outcomes.

Note

* All asterisked references are meta-analyses or research syntheses.

References

1. PR Newswire. Education Apps Market to Grow by USD 47.97 Billion from 2023 to 2028; Deployment Of Learning Performance Management Systems (LPMSs), Cloud Computing, Government Initiatives, and Integration of AR in Educational Apps to Boost Growth -

Technavio. Yahoo Finance. https://finance.yahoo.com/news/education-apps-market-grow-usd-155500184.html. Published March 4, 2023. Accessed March 4, 2025.

2. *Dahl-Leonard K, Hall C, Peacott D. A meta-analysis of technology-delivered literacy instruction for elementary students. *Educational Technology Research and Development*. 2024;72:1507-1538. doi:10.1007/s11423-024-10354-0
3. *Verhoeven L, Voeten M, van Setten E, & Segers E. Computer-supported early literacy intervention effects in preschool and kindergarten: A meta-analysis. *Educational Research Review.* 2020;30:100325. doi:10.1016/j.edurev.2020.100325
4. *Wanzek J, Stevens EA, Williams KJ, Scammacca N, Vaughn S, Sargent K. Current evidence on the effects of intensive early reading interventions. *Journal of Learning Disabilities*. 2018;51(6):612-624. doi:10.1177/0022219418775110
5. *Hall C, Dahl-Leonard K, Cho E, et al. Forty years of reading intervention research for elementary students with or at risk for dyslexia: A systematic review and meta-analysis. *Reading Research Quarterly*. 2023;58(2):285-312. doi:10.1002/rrq.477
6. *McTigue EM, Solheim OJ, Zimmer WK, & Uppstad PH. Critically reviewing GraphoGame across the world: Recommendations and cautions for research and implementation of computer-assisted instruction for word-reading acquisition. *Reading Research Quarterly*. 2020;55(1):45-73. doi:10.1002/rrq.256
7. Clark DB, Virk SS, Barnes J, Adams DM. Self-explanation and digital games: adaptively increasing abstraction. *Computers & Education*. 2016;103:28-43. doi:10.1016/j.compedu.2016.09.010
8. *Cheung AC, Slavin RE. The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: a meta-analysis. *Educational Research Review*. 2013;9:88-113. doi:10.1016/j.edurev.2013.01.001
9. Furenes MI, Kucirkova N, Bus AG. A comparison of children's reading on paper versus screen: a meta-analysis. *Review of Educational Research*. 2021;91(4):483-517. doi:10.3102/003465432199807
10. Neumann MM, Neumann DL. Touch screen tablets and emergent literacy. *Early Childhood Education Journal*. 2014;42:231-239. doi:10.1007/s10643-013-0608-3
11. Norman A. Educational technology for reading instruction in developing countries: a systematic literature review. *Review of Education*. 2023;11(3):e3423. doi:10.1002/rev3.3423

12. Patel P, Torppa M, Aro M, Richardson U, Lyytinen H. Assessing the effectiveness of a game-based phonics intervention for first and second grade English language learners in India: a randomized controlled trial. *Journal of Computer Assisted Learning*. 2022;38(1):76-89. doi.org/10.1111/jcal.12592

13. Mehringer H, Fraga-González G, Pleisch G, et al. (Swiss) GraphoLearn: an app-based tool to support beginning readers. *Research and Practice in Technology Enhanced Learning*. 2020;15(1):5. doi:10.1186/s41039-020-0125-0

14. Van Gorp K, Segers E, Verhoeven L. Enhancing decoding efficiency in poor readers via a word identification game. *Reading Research Quarterly*. 2017;52(1):105-123. doi:10.1002/rrq.156

15. Verhoeven L, Voeten M, Segers E. Computer-assisted word reading intervention effects throughout the primary grades: A meta-analysis. *Educational Research Review*. 2022;37:100486. doi:10.1016/j.edurev.2022.100486

16. Piper B, Zuilkowski SS, Kwayumba D, Strigel C. Does technology improve reading outcomes? Comparing the effectiveness and cost-effectiveness of ICT interventions for early grade reading in Kenya. *International Journal of Educational Development.* 2016;49:204-214. doi:10.1016/j.ijedudev.2016.03.006.

17. Schling M, Winters P. Computer-assisted instruction for child development: evidence from an educational programme in rural Zambia. *Journal of Development Studies.* 2018;54(7):1121-1136. doi:10.1080/00220388.2017.1366454

18. Gonfa MH, Birhanu AL, Gendo KM. Review on practice and challenges of ICT integration as pedagogical tools in Ethiopian primary school curriculum implementation. *Discover Education.* 2024;3(1):88. doi:10.1007/s44217-024-00184-w

19. Debeer D, Vanbecelaere S, Van Den Noortgate W, Reynvoet B, Depaepe F. The effect of adaptivity in digital learning technologies: modelling learning efficiency using data from an educational game. *British Journal of Educational Technology*. 2021;52(5):1881-1897. doi:10.1111/bjet.13103

20. Benton L, Mavrikis M, Vasalou A, et al. Designing for "challenge" in a large-scale adaptive literacy game for primary school children. *British Journal of Educational Technology.* 2021;52(5):1862-1880. doi:10.1111/bjet.13146

21. Liu Z, Moon J, Kim B, Dai CP. Integrating adaptivity in educational games: a combined bibliometric analysis and meta-analysis review. *Educational Technology Research Development.* 2020;68:1931-959. doi:10.1007/s11423-020-09791-4