Technology-Based Interventions for Learners with Dyslexia: An Evaluation of Their Effectiveness in Improving Literacy Outcomes

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***Abstract*—In recent times, many schools have turned to digital tools to support learners with dyslexia, but it is not always clear how much these tools improve reading and writing. This article reviews what existing evidence says about the effects of technology-based interventions on literacy outcomes in dyslexia. This article is a narrative critical review of peer-reviewed studies, meta-analyses and systematic reviews. Each study was measured based on its design, sample, outcome measures and relevance to dyslexia, and the paper differentiates between assistive technologies and instructional technologies. The effects depend on the skill being measured. In a randomized trial of 64 children with dyslexia, five hours of action video-game play improved text reading accuracy, rate and comprehension compared with usual school support. Digital phonics practice improved the skills that were trained, but these outcomes did not always spill to untrained tasks. Text-to-speech improved access to text and, for some learners, comprehension, yet it did not show growth in independent decoding. A 2026 meta-analysis of 30 randomized trials involving 4,851 elementary pupils with reading difficulties found a small-to-moderate effect (g = 0.35). Evidence on artificial intelligence is still early and carries a high risk of bias. This paper concludes that technology helps dyslexic learners, mostly when it is matched to a clear literacy need and used alongside explicit teaching. It also states that larger and better-designed studies are needed, especially in Nigeria and other low-income countries.**

***Index Terms*—dyslexia; assistive technology; digital literacy intervention; reading fluency; phonological awareness; inclusive education**

I. INTRODUCTION

Reading is the major means by which schools present and test knowledge. A child who cannot read words accurately and quickly is therefore held back in almost every subject. Learners with dyslexia face this problem even when they are taught well and have the ability to learn. Snowling et al. (2020) describe dyslexia as a difficulty in learning to decode and to spell, and they note that it is a neurodevelopmental condition that is heritable, lifelong and can be diagnosed early in a child. It is important to note that dyslexia is not a sign of low intelligence or academic laziness.

Over the years, dyslexia has appeared to be a common occurrence among learners. A meta-analysis of studies in primary schools around the world put the pooled prevalence of developmental dyslexia at 7.10% (95% CI 6.27–7.97%), with higher rates in boys than in girls (Yang et al., 2022). Earlier estimates ranged from 5% to 17.5%, and the figure changes with the definition and mark used. This is partly because dyslexia is better seen as a point on a continuum of reading ability than as a sharply separate condition (Snowling et al., 2020). In India, a review of six studies covering 8,133 children estimated the pooled prevalence of specific learning disorders, a wider category that includes dyslexia, at 8% (95% CI 4–11%) (Scaria et al., 2023). A survey of school children in Ernakulam, Kerala, reported 16.49% (Chacko & Vidhukumar, 2020). According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), this learning disability, which involves difficulty in reading affects 10 to 20 percent of the world population, and this

percentage could reach 30 percent in lower-income countries. These data are not interchangeable, but they are all indicators of the fact that a large group of learners experience dyslexia and therefore require intervention.

In Nigeria, dyslexia is a much more challenging matter given the fact that identification rate is poor. In a study of 147 primary school teachers in Oyo State, only 31% were found to be knowledgeable about dyslexia (Ogunsola, 2018). In another study, teachers in Nsukka and nearby communities also showed a low level of awareness (Okechukwu et al., 2023), and caregivers in Owerri Municipal lacked adequate knowledge and skill and gave children inadequate support (Iwuagwu et al., 2022). According to Madu (2024), "Education experts have said that no fewer than 25% of Nigerian children might be suffering from dyslexia". Dyslexia Help Africa, in Jaiyesimi (2020) estimated the dyslexia rate in Nigeria at 20 percent of the total population. Despite this, there is still a high risk of ignorance and lack of awareness among many Nigerians. As a result, many dyslexic children are probably never identified.

Technology is often offered as a way forward. Schools can now choose from speech-enabled texts, phonics applications, games and tools that use artificial intelligence (AI) to support dyslexic learners. But having a tool in the classroom is not the same as having evidence that it produces desired results. This article therefore asks a practical question: do technology-based interventions improve the literacy of learners with dyslexia, and under what conditions? Its objectives are to: (a) separate assistive technologies from instructional technologies,

(b) examine the evidence for five outcomes, namely decoding and accuracy, fluency and comprehension, phonological awareness, spelling and writing, and motivation, and

(c) discuss limits and implications for schools and policymakers, specifically in Nigeria.

II. CONCEPTUAL AND THEORETICAL FOUNDATIONS

2.1 Conceptual Understanding of Dyslexia

In the past, dyslexia was often defined as the unexpected occurrence of reading challenges in a child of average or high intelligence. But over the years, researchers later found no clear difference in the reading and phonological skills of children with dyslexia and children with more general learning problems, and the discrepancy definition lost credibility (Snowling et al., 2020). The Rose Review concluded that dyslexia can occur across different IQ range and that poor decoding calls for the same kinds of interventions regardless of the child's IQ. Snowling et al. also warn that loosening the criteria has widened the group who receive the label, and that dyslexia often occurs alongside other difficulties. For the purpose of this paper, dyslexia means a persistent difficulty with accurate or fluent word reading and spelling that is not explained by poor teaching, sensory problems or low general ability.

2.2 Theoretical Foundations

The phonological awareness is the most widely used basis for intervention. It holds that learning to read begins with learning how printed letters map onto the sounds of speech, and that learners with dyslexia struggle with identifying and mastering this relationship (Snowling et al., 2020). Existing evidence therefore proves that classroom instruction should therefore teach sound–letter relationships directly, in a planned order, with a substantial amount of practice. A meta-analysis of 53 studies of reading interventions for pupils with or at risk of dyslexia found a significant positive effect on reading outcomes (g = 0.33), and a review of 34 controlled trials found that phonics, morphological and orthographic approaches helped spelling and reading (Galuschka et al., 2020; Hall et al., 2023). Digital tools can add repeated practice and instant feedback to this kind of teaching.

A second idea concerns access. When word reading takes great effort, little attention is left for meaning. Presenting a text aloud removes the decoding demand and could make a learner understand a material above their reading level (Wood et al., 2018). A third line of research links dyslexia to difficulties with dynamic visual attention. Peters et al. (2021) draw on this view to explain why action video games, which do not teach reading directly, may still help.

2.3 Assistive technology and literacy intervention

Two kinds of technology are often interchanged. Assistive technology works around the difficulty. Text-to-speech, audiobooks and speech-to-text tools

gives a learner access to text content or to produce text, and they are measured by whether access, speed or comprehension improves when the tool is in use. An instructional (or remedial) intervention technologies are used to change to target the improvement of a learner's own skill. It is judged by whether the learner, when given tests that were not part of the training, can read or spell better without the tool. Both assistive technology and instructional technology are legitimate and important, but they perform different tasks. Improved access to text is beneficial for a dyslexic learner; but it is not an evidence of better decoding. The same holds for near transfer, where learners improve on tasks like those practised, and far transfer, where they improve on new words and ordinary classroom reading. Table 2 sets out this distinction by technology type.

III. TYPES OF TECHNOLOGY-BASED INTERVENTIONS

There are different types of technology-based interventions and the include the following:

- *Assistive Reading Technologies*: These include text-to-speech (TTS), audiobooks and other read-aloud tools. Their purpose is to give learners better access to written content. A meta-analysis found that TTS and related read-aloud tools produced a small-to-moderate improvement in reading comprehension for students with reading disabilities (effect size 0.35, 95% CI 0.14–0.56), although the authors called for more work on the features that matter (Wood et al., 2018).
- *Digital Phonics and Structured Literacy Applications*: These programmes teach letter–sound relationships, blending and word reading through short, planned, and targeted tasks. GraphoLearn, a game-like application that trains grapheme–phoneme correspondences, is the best-studied example in the sources reviewed (Mehringer et al., 2020; Patel et al., 2022). A German game-based reading training for children with reading disorder is another example (Görgen et al., 2020).
- *Speech-to-Text and Writing Support*: Speech-to-text (STT) helps learners dictate rather than handwriting or typing. In Sweden, tablets with TTS and STT applications were used with pupils who had reading and writing difficulties. Teachers reported that pupils could use the apps to read and to write, but that the tools needed training and adjustment, and not all pupils benefited from them. After the project, 82% of the younger pupils and 47% of the older pupils kept using the technology (Nordström et al., 2019). These tools mainly support production of text, so they should be seen as assistive.
- *Multi-sensory Digital Learning Applications*: Multi-sensory teaching combines targeted interventions towards the senses of sight, sound and touch. A meta-analysis of 16 studies of Orton-Gillingham interventions, which are multi-sensory and structured, found a positive but non-significant effect on foundational reading skills (effect size 0.22) and urged better research (Stevens et al., 2021). In the larger synthesis by Hall et al. (2023), whether an intervention was multi-sensory did not significantly identify differences in effects; frequency of use and specific literacy challenges did.
- *Gamification and Interactive Learning Platforms*: Gamified platforms use points, levels and rewards to keep learners practising. Some platforms, like GraphoLearn, wrap real literacy content in a game. Others, like the action video games studied by Peters et al. (2021), contain no reading content at all. Game features are not teaching, so the test is always whether independent reading measures improve.
- *Artificial Intelligence-Based Learning Tools*: AI tools tailor tasks to the learner's literacy challenge, give feedback, or generate materials. A systematic review of AI-based interventions for students with learning disabilities found 11 studies with 3,033 participants, of which six concerned dyslexia. Adaptive systems and game-based learning were the most common. All 11 reported positive results, yet none was rated at low risk of bias, and the authors warned of possible publication bias (Paglialunga & Melogno, 2025). One of these studies, from Port Harcourt, Nigeria, compared a text-to-speech application with two other teaching methods among 205 secondary students identified as dyslexic and reported greater improvements in reading performance after three weeks

(Chukwuemeka & Agbarakwe, 2024, as cited in Paglialunga & Melogno, 2025).

IV. EFFECTIVENESS OF TECHNOLOGY-BASED INTERVENTIONS IN IMPROVING LITERACY OUTCOMES

Effectiveness of digital intervention tools must be measured one outcome at a time. Accuracy, fluency, comprehension, phonological awareness and spelling are related but separate skills, and a positive result in one cannot be assumed in another. Even for conventional teaching, effects are not equal across outcomes: Hall et al. (2023) found smaller effects for reading comprehension than for text reading and spelling, and larger effects when more intervention time was given. The strongest evidence comes from controlled studies that use independent tests and comparison groups, and several studies reviewed below do not meet all of these conditions in one. Figures 1 and 2 and Table 1, placed after the references, summarize the main evidence.

4.1 Effects on Reading Accuracy and Decoding Skills

Mehringer et al. (2020) tested the Swiss-German version of GraphoLearn with 34 children at risk of dyslexia. The children trained three times a week for 14 weeks in addition to normal lessons, starting either in the middle or at the end of first grade. Both groups improved in pseudo-word reading, and the group that trained earlier also improved in rapid automatized naming.

Görgen et al. (2020) randomly assigned 50 German children with reading disorder to a digital game-based reading training (n = 25) or to digitized mind games (n = 25). Reading of the trained words improved significantly, and there was a trend towards transfer to untrained words. Children found the programme motivating and it could be used at home. The pattern is typical: clear improvement on trained text, and reduced progress when transferred to new text.

The clearest dyslexia-specific test was carried out by Peters et al. (2021). Sixty-four Australian children aged about 8 to 13, with dyslexia confirmed against DSM-5 criteria, were randomly allocated to regular action video-game training (n = 22), enhanced training that used eye tracking (n = 23), or usual school reading support only (n = 19). The training was held in ten 30-minute sessions over two weeks, five hours in all. Both game groups improved significantly more than the comparison group in reading accuracy. Using test-manual age equivalents, average improvements were 8.55 months for the regular group and 6.31 months for the enhanced group, against 1.26 months for the comparison group (Figure 1). The enhanced version brought no extra benefit. The comparison group had no matched activity, follow-up was short, and the game teaches no reading skill, so the mechanism is not settled. The authors call for longer follow-up and direct comparison with phonics programmes.

Studies from India lay significant concerns about transfer. Patel et al. (2022) randomly assigned 136 pupils in six classrooms to GraphoLearn English Rime or a control maths game for five weeks. GraphoLearn users made faster and greater improvement on in-game measures of letter–sound knowledge, rime recognition and word recognition, but the groups did not differ on oral and paper-based tests. These pupils were English language learners, not a dyslexia sample, so the study speaks to implementation in multilingual, resource-limited schools rather than to efficacy for dyslexia. Its main lesson is that progress in an application must be checked against independent reading tests. At the broadest level, a meta-analysis of 119 studies of educational technology in kindergarten to Grade 5 found a positive effect on decoding (0.33), though not for a dyslexia-only population (Silverman et al., 2025).

4.2 Effects on Reading Fluency and Comprehension

In the Peters et al. (2021) trial, reading rate rose by about 10.33 months in the regular game group and 6.31 months in the enhanced group, while the comparison group changed by −0.69 months. Reading comprehension rose by 19.90 and 17.82 months in the two game groups, against 1.48 months in the comparison group (Figure 1). Both groups also improved on rapid naming. The authors suggest that faster, more accurate reading may allow for greater attention to meaning.

Assistive tools tell a different story. In the meta-analysis by Wood et al. (2018), TTS raised comprehension modestly. Keelor et al. (2023) tested TTS with children aged 8 to 12 who had reading and language difficulties and grouped them as dyslexia

only or reading and language impairment. Children with dyslexia only scored higher in every condition and gained more from TTS and listen-only reading, and highlighting added no distinct benefit. A new eye-tracking study in Taiwan compared silent reading and TTS among junior high students with dyslexia, students with ADHD-related reading difficulty and typically developing students. TTS improved comprehension for the ADHD group but not for the dyslexia group, although it reduced reading time and mental effort for students with dyslexia while keeping comprehension at the same level (Chen et al., 2026).

Overall, these findings show that TTS may make reading easier without raising comprehension scores, and that it is not a measure of decoding growth.

Svensson et al. (2021) ran a trial with 149 pupils with severe reading disabilities. The intervention group received 24 sessions of training in assistive technology, and the control group received usual support. Both groups improved as much in one year as the norm group, but the improvements of the two groups did not differ immediately after the programme or at follow-up. The authors still concluded that the technology had some transfer effects and raised motivation for schoolwork. A fair conclusion is that the tools were helpful and accepted, but the test did not show that they beat normal support on measured reading.

4.3 Effects on Phonological Awareness

Direct evidence on phonological awareness as an outcome of digital tools is lower than for decoding. Mehringer et al. (2020) measured pseudo-word reading, which depends on phonological decoding, and rapid naming, and found benefits. Görgen et al. (2020) detected improvements on trained words with signs of transfer. Harrar-Eskinazi et al. (2026) studied a home-based, computer-assisted, three-stage programme for 144 children with dyslexia aged about 8 to 13. The programme trained audio-phonological, visual-attentional and orthography–phonology processes, tailored to each child. The authors report a cumulative, significant effect on reading fluency, spelling and comprehension, and that 48.8% of the children no longer met the criteria for a reading disorder at the end of the programme (about six months).

4.4 Effects on Spelling and Writing Skills

The best evidence on spelling is not specifically digital. In a review of 34 controlled trials, spelling interventions that used phonics, morphological or orthographic teaching improved the spelling and reading of learners with dyslexia, whereas only two studies tested supportive software and one tested assisted writing (Galuschka et al., 2020). It follows that there is little rigorous evidence on which digital spelling tools work. The three-stage programme above reported cumulative spelling gains (Harrar-Eskinazi et al., 2026), and a large synthesis of ed-tech studies in Grades K to 5 reported a large average effect for writing (0.81), but that sample was general and the designs varied (Silverman et al., 2025). Tools that underline mistakes or offer the correct spelling can improve how a text looks without improving how the learner spells. For that reason, speech-to-text and word prediction should be treated as assistive and be paired with direct spelling instruction.

4.5 Effects on Motivation, Engagement and Independent Learning

Several studies report positive improvements. Görgen et al. (2020) found their programme highly motivating, Peters et al. (2021) described action games as a fun and engaging intervention, and Svensson et al. (2021) reported higher motivation for schoolwork. In Sweden, teachers perceived that app use affected pupils' motivation and independence in working with texts, though perceptions varied between pupils (Nordström et al., 2019). Even so, learner motivation is a supporting condition. Enjoyment, log-in rates and time spent on the tasks should not be reported as evidence of reading growth.

V. EMPIRICAL REVIEW AND SYNTHESIS OF EVIDENCE

Table 1 summarises the main studies. Three significant effects appear in these studies.

Firstly, effects are real but are modest on average. A 2026 meta-analysis of 30 randomized tests, with 4,851 elementary pupils who all had reading difficulties, found a significant overall effect of technology-based reading interventions (g = 0.35, 95% CI 0.23–0.48, p < .001), and none of the moderators examined explained the variation (Alqahtani, 2026). An earlier review of 20 studies,

including single-case designs, also found a moderate effect (Alqahtani, 2024). Figure 2 places these results beside other pooled estimates.

The second point showed that, on the average, researchers cannot really say which tool works for which child. The 2026 meta-analysis covered pupils with reading difficulties in general, not only those with a dyslexia diagnosis, so it is supporting evidence rather than dyslexia-specific proof. Likewise, the ed-tech review by Silverman et al. (2025) covered 119 studies in mainstream classrooms and found effects of 0.33 for decoding, 0.30 for language comprehension and 0.23 for reading comprehension, for typical as well as struggling pupils.

Thirdly, the evidence base is uneven in quality. Studies define dyslexia differently: some of the studies tested diagnosed children, some tested at-risk children, and others children with broad reading or language difficulties. The AI review rated no study at low risk of bias (Paglialunga & Melogno, 2025). Several studies are small and short, and follow-up is brief. Languages also vary, from German and French to English as a second language in India. Notably, this is a set of converging findings, not proof that any one tool produces desired results for every learner.

VI. CHALLENGES AND LIMITATIONS OF TECHNOLOGY-BASED INTERVENTIONS

Despite the usefulness of technology-based interventions on the improvement of literacy outcomes in dyslexic learners, it faces a number of challenges and limitations. These challenges and limitations include but are not limited to the following:

- Access, Cost and Infrastructure: Devices, power, internet access and software costs are unevenly spread and are not constant in Nigeria and some other low-income countries. This causes a limitation in the use of the digital tools. For example, a tool that needs constant broadband would suit only a few schools, as many areas in Nigeria and other low-income countries do not have reliable connections. As a result, offline use, low-cost devices, shared school access and local technical support should be considered before a digital intervention tool is purchased.
- Language and Cultural Validity: Most digital intervention tools were built for English, German or French. Patel et al. (2022) show that even an effective phonics game may not carry over to ordinary tests when learners are working in a second language. Nigerian classrooms are multilingual, with Hausa, Igbo, Yoruba, Nigerian Pidgin and English in daily use, and speech recognition and text-to-speech tools can perform unevenly across different accents. Based on the aforementioned, a tool built for one writing system should not be assumed to work in another without testing. The prevalence of dyslexia is noticed across different writing systems (Yang et al., 2022), so the need for language-specific tools exists in every language.
- Teacher Preparedness and Implementation: Technology cannot make up for ignorance or poor knowledge of dyslexia. Where only 31% of teachers were knowledgeable (Ogunsola, 2018) and awareness is low (Okechukwu et al., 2023), a tablet in the classroom may become unsupervised screen time. The Swedish study found that for these digital intervention tools to produce desired results, pupils need to be trained and tools have to be customized to their specific literacy challenges (Nordström et al., 2019).
- Privacy, Ethics and the Reliability of AI: Digital systems may store a child's performance, voice and disability status and this could pose a threat to online ethics and the child's privacy. Before purchasing and using these tools, individuals, organizations and schools should ascertain data safety, privacy policy and the required consent for the use of the tools. Also, AI-generated feedback can contain errors and must therefore be checked by a professional and heavy reliance on AI without long term follow-up may lead learners to depend on the tool instead of building their own skills (Paglialunga & Melogno, 2025). Based on the above, automated screening should therefore never replace professional assessment, rather, they should go hand-in-hand.

VII. IMPLICATIONS FOR INCLUSIVE EDUCATION AND POLICY

This paper poses certain implications for inclusive education and policy making, especially in Nigeria, and these implications are discussed in this section.

Firstly, while technology-based interventions are helpful, it is important to match a tool to a learner's need. For example; a learner with weak sound–letter knowledge may benefit from explicit digital phonics practice, a learner who decodes slowly but understands spoken language may benefit from TTS for access to the curriculum, a learner with spelling

difficulty may use speech-to-text while also receiving direct spelling teaching. This is more defensible than buying one tool for every dyslexic learner or using any tool without considering its use. Since greater intervention time was linked to larger effects, it is also important to pay attention to the frequency with which dyslexic learners use the tools. (Hall et al., 2023).

For teachers, technology goes hand-in-hand with structured literacy teaching. A baseline assessment should specifically identify the target skill, and progress should then be checked with short, repeated measures of accuracy, fluency, phonological awareness, comprehension or spelling. Comparing performance with and without the tool shows whether a skill is improving or whether the tool is producing desired result.

For administrators, technology-based intervention tools should be purchased based on evidence, language fit, data protection and total cost. A small pilot test with independent literacy measures should be carried out before they become widely adopted, and learners without devices must not be excluded in such tests.

For policymakers in Nigeria, dyslexia should be more specifically included into inclusive education planning, teacher education and school support. Given the low awareness found among teachers and caregivers (Iwuagwu et al., 2022; Ogunsola, 2018; Okechukwu et al., 2023), early identification and referral should come first, because no tool can help a child who has not been identified. Policy makers should also place more emphasis and invest more in offline and low-bandwidth resources, locally valid language tools and accessible digital libraries. A national research agenda is needed to estimate prevalence and test interventions in Nigerian languages and in rural and urban schools. Without local evidence, technology-based intervention tools may be adopted based on marketing rather than results.

VIII. RECOMMENDATIONS AND CONCLUSION

8.1 Recommendations

Based on the findings made from existing literature, the paper recommends the following:

1. Teachers should assess each learner's literacy profile first and choose a tool that matches one measurable goal.
2. Schools should combine digital practice with direct teaching of phonological awareness, sound–letter links, decoding, fluency, spelling and comprehension in order to ensure balanced intervention and results.
3. Text-to-speech, audiobooks and speech-to-text should be recognized as access supports and not reported as proof of independent decoding or spelling.
4. Parents should encourage dyslexic learners to take on short, regular practice and keep up shared reading and conversation about print.
5. School administrators should pilot tools, train teachers and check cost, accessibility, privacy and language fit before buying any assistive tool.
6. Policymakers should strengthen early identification and specialist support, fund inclusive digital infrastructure and back locally validated resources in Nigerian languages.
7. Researchers should carry out larger randomized studies with delayed follow-up in Nigeria, India and other under-studied settings, and report results for diagnosed dyslexia separately.
8. Developers should publish effectiveness evidence and limits, protect learner data and involve dyslexia specialists and learners in the design and testing of intervention tools.

8.2 Conclusion

This article has examined the effect of technology-based interventions on the improvement of literacy outcomes in dyslexic learners. Findings show that technology can improve certain literacy outcomes for learners with dyslexia, depending on the tool and the specific purpose for which it was designed. It postulates that technology can improve selected literacy outcomes for learners with dyslexia, but no single tool is suitable for every learner. Its effectiveness depends on the learner's specific difficulty, the quality and duration of use, teacher guidance and the presence of direct literacy instruction. As a result, technology should complement, but not replace, evidence-based teaching and professional support.

Declarations

Use of generative AI: Generative AI tools such as Claude, Anthropic, Chat GPT were used to help organize and edit the text. The author has edited, reviewed and revised the content, and takes full responsibility for the final manuscript.

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Table 1. Summary of selected empirical evidence

Study	Design and sample	Main finding	Caution
Mehringer et al. (2020)	34 children at risk of dyslexia; GraphoLearn, 3 times weekly for 14 weeks	Gains in pseudoword reading; rapid naming improved in the earlier-training group	Small sample; at-risk, not diagnosed; no randomised comparison
Görgen et al. (2020)	Randomised; 50 children with reading disorder; game-based training vs digital mind games	Better reading of trained words; trend towards transfer; motivating	Transfer to untrained words not firmly shown
Peters et al. (2021)	Randomised; 64 children with dyslexia; 5 hours of action video-game play	Accuracy, rate, comprehension and rapid naming improved vs usual support	Short follow-up; no matched activity; mechanism unsettled
Patel et al. (2022)	Randomised; 136 pupils, India; GraphoLearn vs maths game; 5 weeks	Greater in-game gains; no difference on oral and paper tests	English language learners, not dyslexia; limited transfer
Svensson et al. (2021)	149 pupils with severe reading disability; 24 assistive-technology sessions vs usual support	Both groups improved; no group difference; motivation reported higher	Group gains did not differ
Keelor et al. (2023)	Children aged 8–12 with reading and language difficulties; TTS conditions	TTS helpful, most for dyslexia-only group; no added benefit from highlighting	Mixed sample; comprehension tested during use
Chen et al. (2026)	Junior high students with dyslexia, ADHD-related difficulty and typical readers; silent reading vs TTS	No comprehension gain for dyslexia group; less time and effort	Access, not decoding, was improved
Harrar-Eskinazi et al. (2026)	144 children with dyslexia; three-stage home-based computer programme, about 6 months	Cumulative gains in fluency, spelling, comprehension; 48.8% free of reading disorder	Needs replication; no untreated control for whole programme
Alqahtani (2026)	Meta-analysis; 30 randomised trials; 4,851 elementary pupils with reading difficulties	g = 0.35, 95% CI 0.23–0.48	Not limited to diagnosed dyslexia

Note. TTS = text-to-speech. Participant groups differ across studies and are stated as described by the original authors.

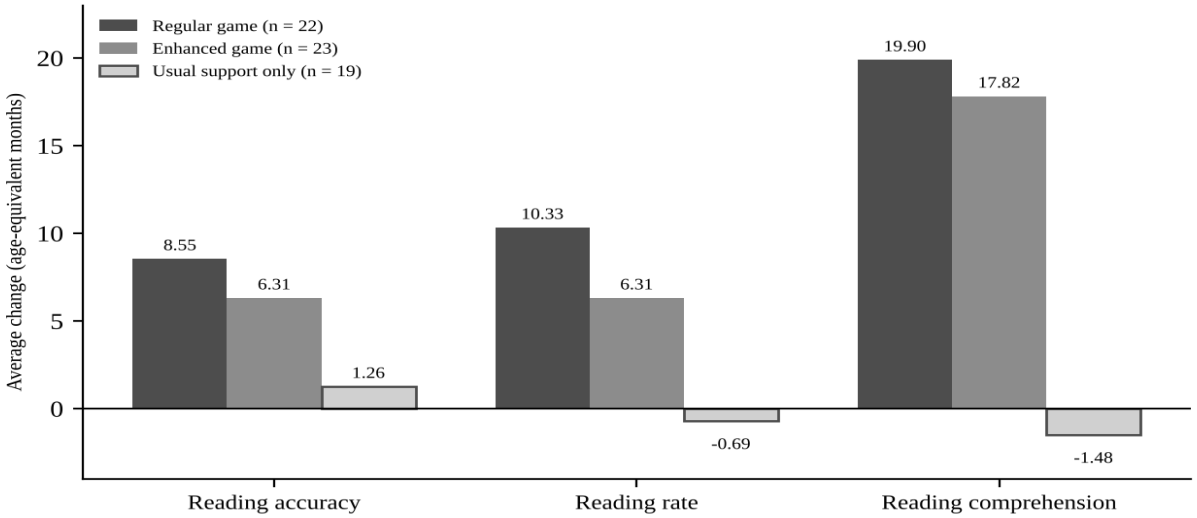
Table 2. Assistive technology compared with literacy intervention

Technology type	Main purpose	Best evidence in this review	What it does not show
Text-to-speech, audiobooks (assistive)	Access to text; lower decoding demand	Modest comprehension gain (Wood et al., 2018); steady comprehension with less effort in dyslexia (Chen et al., 2026)	Growth in independent decoding
Speech-to-text, word prediction (assistive)	Produce written text	Usable by pupils with training (Nordström et al., 2019); no group difference in trial (Svensson et al., 2021)	Better unaided spelling or handwriting
Digital phonics (instructional)	Teach sound–letter links and word reading	Gains on trained skills (Mehringer et al., 2020; Görgen et al., 2020)	Reliable transfer to oral and paper tests (Patel et al., 2022)

Technology type	Main purpose	Best evidence in this review	What it does not show
Action video games (instructional, indirect)	Train visual attention	Gains in accuracy, rate and comprehension (Peters et al., 2021)	Long-term effects; why it works
Multi-component programmes	Train several processes in sequence	Cumulative gains (Harrar-Eskinazi et al., 2026)	Which component matters; effect without replication
AI-based tools	Adapt tasks, feedback or content	Positive results, but studies at moderate to high risk of bias (Paglialunga & Melogno, 2025)	Reliable effectiveness or long-term effects

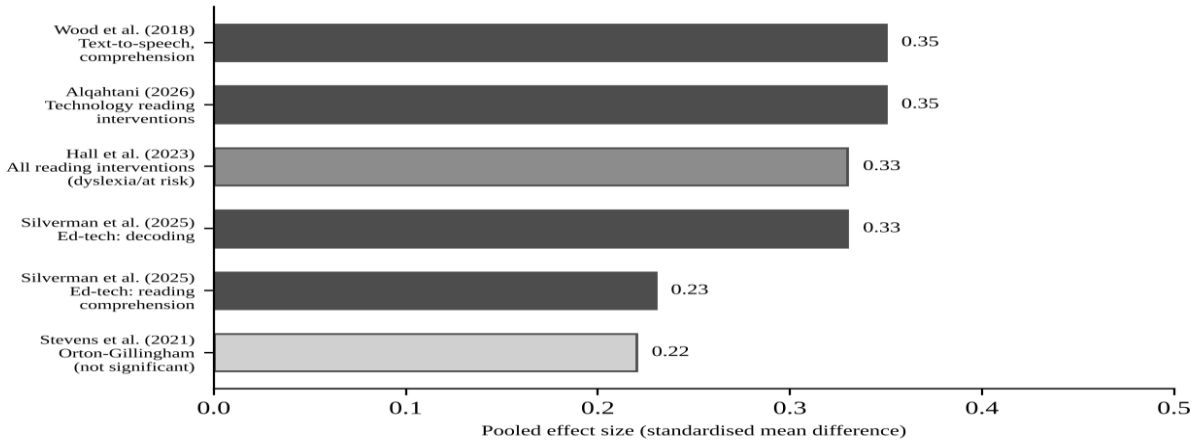
Note. Evidence statements are limited to the studies reviewed in this article.

Figure 1. Average change in reading scores after action video-game training or usual support



Note. Data from Peters et al. (2021). Values are changes in age-equivalent months estimated from test manuals, not months of schooling.

Figure 2. Pooled effect sizes reported in selected meta-analyses



Note. Effect sizes are as reported by the original authors (Hedges' g or Cohen's d). Populations and outcomes differ, so the bars are not directly comparable. Sources: Wood et al. (2018); Alqahtani (2026); Hall et al. (2023); Silverman et al. (2025); Stevens et al. (2021).