Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: http://www.science-gate.com/IJAAS.html

Electronic differentiated instruction as a remedial strategy to enhance the reading skills of frustration-level readers

Bon Eric A. Besonia [1,*], Julie Anne S. Arabia [1], Regine P. Babas [2], Aicee N. Luena [2], Rossandrew B. Villaruel [3], Carmelie Grace D. Daquin [3], Mary Ann L. Decrepito [3], Kaye C. Jardenil [1], Cristy Mae B. Baclagon [1], Shiela Mae H. Espora [1], Marieth Flor M. Bernardez [1], Vincent G. Nobleta [1], Myla Jane V. Besonia [4], John Michael G. Galagala [5]

[1]*College of Education, Northern Iloilo State University, Iloilo, Philippines*
[2]*Estancia National High School, Estancia, Philippines*
[3]*College of Education, Arts and Sciences, Capiz State University, Capiz, Philippines*
[4]*College of Information and Computing Studies, Northern Iloilo State University, Iloilo, Philippines*
[5]*Bayabas Elementary School, Cagayan de Oro, Philippines*

ARTICLE INFO

Article history:
Received 14 January 2025
Received in revised form
3 May 2025
Accepted 19 May 2025

Keywords:
Reading instruction
Differentiated learning
Electronic intervention
Student performance
Literacy development

ABSTRACT

This study examines the effectiveness of electronic differentiated instruction as a support strategy to improve the reading skills of students who struggle with reading. An experimental design was used, involving 100 Grade 7 students identified as frustration-level readers using the Philippine Informal Reading Inventory (Phil-IRI). These students were randomly divided into a control group and an experimental group. The experimental group received electronic differentiated instruction, while the control group received traditional reading instruction. For two months, the intervention used digital tools such as mobile apps, interactive videos, and gamified presentations. Pre-test results showed that both groups were at the frustration level. After the intervention, both groups improved to the instructional level, but the experimental group achieved significantly higher and more consistent reading scores. The findings suggest that electronic differentiated instruction can provide personalized, interactive, and flexible learning experiences that meet individual student needs. The study recommends including this approach in literacy programs to improve reading skills and suggests combining it with traditional methods for better results. Future studies should examine its long-term effects, use in different settings, and the importance of teacher training for effective implementation.

1. Introduction

Reading skills shape individuals' academic, professional, and personal trajectories (Chodkiewicz and Boyle, 2017). It is a foundational skill permeating every aspect of life (Taş, 2024). At its core, it is a gateway to knowledge that enables individuals to access a wealth of information, diverse perspectives, and a broad spectrum of ideas (Abbas et al., 2019). The journey towards reading proficiency is denoted by several hurdles that can impact a child's learning experience (Silinskas et al., 2016). They may encounter difficulties in decoding letters and recognizing basic sight words. Acquiring phonemic awareness presents an arduous challenge (Tammelin-Laine and Martin, 2015). The intricate dance between decoding and comprehension requires a level of cognitive development. This makes them struggle to grasp the nuances of reading. Recent reports reinforced this claim, stating that the Philippines performs poorly in reading. In the 2018 Program for International Student Assessment (PISA) results, the country recorded the lowest reading score worldwide (Haw et al., 2021). Subsequently, the recent 2022 PISA findings revealed that Filipino learners recorded 347 in reading, which is still below the global mean (Colicol and Sali-Latif, 2023; Besonia et al., 2024).

Frustration-level readers are characterized by significant struggles with comprehension and fluency (Sabag-Shushan and Katzir, 2024). They represent a critical concern within the educational landscape (Dewan et al., 2019). These learners often lag behind their peers, unable to decode text

* Corresponding Author.
Email Address: bonericarceobesonia@nisu.edu.ph (B. E. A. Besonia)
https://doi.org/10.21833/ijaas.2025.05.023
Corresponding author's ORCID profile:
https://orcid.org/0000-0002-8709-8359

effectively or grasp the meaning of what they read (Amendum et al., 2018). Hence, this hampers their overall academic progress. Their multifaceted challenges include cognitive, emotional, and motivational dimensions (Liew et al., 2020). Frustration level readers frequently encounter a cycle of failure, where repeated reading difficulties affect their performance across subjects and diminish their self-esteem and motivation to learn. The inability to achieve reading proficiency can lead to long-term educational disadvantages (Suggate, 2016). This may include lower academic achievement, increased likelihood of dropping out of school, and limited opportunities for future success (Gkofa, 2017).

Exploring various interventions and programs to enhance learners' reading skills has been a significant focus of experimental and descriptive quantitative studies. These investigations have assessed the effectiveness of diverse strategies, ranging from traditional methods to innovative technological integrations. For instance, Nevo et al. (2016) evaluated the impact of Reading Acceleration Training Programs, and Kim et al. (2017) examined the Strategic Adolescent Reading Intervention (STARI) for adolescent readers. Similarly, meta-analyses have highlighted the benefits of literacy programs that integrate balanced reading and writing instruction, demonstrating significant improvements in reading comprehension and decoding skills (Wanzek et al., 2016; Graham et al., 2018). Furthermore, emerging evidence supports music training to boost phonological awareness and reading skills in dyslexic children. This illustrates how multimodal strategies can address diverse learner needs (Flaugnacco et al., 2015). Even the integration of technology has opened innovative opportunities for enhancing reading skills. Chee et al. (2018) explored the use of smartphone applications, while Putri et al. (2021) examined the effectiveness of Instagram-based learning through @Gurukumrd. Assistive technology (Lindeblad et al., 2017), audiovisual media, and augmented reality (Besonia et al., 2024) represent pioneering innovations that have been investigated for their potential to transform reading education.

While these interventions offer promising solutions to address reading difficulties among learners, they may not fully accommodate the diverse learning styles of learners (El-Sabagh, 2021), particularly those at a frustration level. Although effective to some extent, these strategies often fall short of providing the intensive, individualized support that these learners require (Scammacca et al., 2016; El-Sabagh, 2021). The complexity of reading challenges necessitates approaches that are not only innovative but also adaptable to the specific needs of each learner (Henriksen et al., 2017). Without this level of customization, the effectiveness of such interventions may be limited (Wigfield et al., 2016). These leave some learners without the tools to overcome their reading difficulties fully (Gilakjani and Sabouri, 2016).

Differentiated Instruction (DI) emerges as one of the solutions to this perennial problem in literacy (Valiandes, 2015; Puzio et al., 2020). It tailors teaching approaches to accommodate learners' readiness levels, learning preferences, and interests (Boelens et al., 2018; Magableh and Abdullah, 2022). DI also allows educators to adapt content, processes, and learning outputs to meet individual needs, particularly suitable for mixed-ability classrooms (Morgan, 2014). Research has demonstrated that DI significantly enhances literacy. For instance, Förster et al. (2018) demonstrated its role in improving reading fluency, particularly for struggling learners, while Valiandes (2015) emphasized its capacity to promote equity and quality education. DI also fosters positive reading attitudes and comprehension, as shown by Shaunessy-Dedrick et al. (2015) with the Schoolwide Enrichment Model–Reading (SEM-R). Its adaptability and scalability make DI vital for bridging learning gaps and addressing diverse literacy needs.

Despite DI's effectiveness, implementing it at scale remains challenging, particularly in resource-constrained settings (Mugendawala and Muijs, 2020). Teachers often face limitations in time (Suprayogi et al., 2017; Pozas et al., 2020), materials (Boelens et al., 2018; Brevik et al., 2018), and professional support (Pozas et al., 2020). Hence, it is challenging to deliver individualized instruction to every learner. This issue is especially pronounced for frustration-level readers, who require intensive and personalized interventions to develop foundational reading skills (Jaeger, 2024). Hence, the advent of digital tools and platforms offers promising avenues for operationalizing DI in ways that are both scalable and impactful. Integrating it with technology can provide tailored, adaptive, and interactive learning experiences (Alamri et al., 2021) that cater to the unique needs of frustration-level readers (Cheung and Slavin, 2013). Through multimedia resources, gamified activities, and adaptive learning algorithms, this teaching methodology promotes skill development in the elements of reading, including decoding, fluency, and comprehension (Cheung and Slavin, 2013).

Technology integration in DI has emerged as a transformative approach to addressing diverse learner needs, as evidenced by multiple studies. Karatza (2019) revealed the capacity of ICT to support this strategy by enabling personalized learning experiences that cater to varied readiness levels, interests, and learning profiles, which foster inclusivity in mixed-ability classrooms. Yan and Li (2024) extend this understanding by showcasing how smart education platforms personalize learning experiences and foster intelligent interactions. In primary education, Wulandari et al. (2024) underscored the potential of digital technologies to create inclusive environments through DI despite the challenges in guiding learners to maximize such opportunities. Furthermore, studies like those by Krishan and Al-Rsa'i (2023) demonstrated a significant enhancement in learner motivation and engagement, particularly in science education. These

findings affirm the potential of technology-enhanced DI to revolutionize instructional practices by personalizing learning and fostering equitable educational outcomes.

Studies confirm that technology-enhanced DI can create more inclusive classrooms, yet a notable gap persists in addressing frustration-level readers. Existing interventions often focus on broad strategies and fail to offer precise support for learning preferences, leaving them underserved. Hence, this study aimed to determine the effectiveness of electronic DI in enhancing the reading levels of frustration-level readers.

2. Review of literature

Differentiated instruction (DI) has evolved as a strategic response to the diversity evident in educational settings (Suprayogi et al., 2017; Dack, 2018). The principle behind this approach is the recognition that learning cannot be effective if every learner is funneled through an identical process, irrespective of individual characteristics. Instead, educators tailor lessons to align with varied readiness levels, interests, and preferred ways of engaging with the content (Suryati and Ratih, 2024). By mapping tasks and objectives to distinct learner profiles, they strive to spark curiosity, bolster self-confidence, and catalyze deeper understanding. Over time, this paradigm has challenged traditional models of uniform instruction. This highlights the value of flexible arrangements in which learners receive content that respects personal aptitudes (Smale-Jacobse et al., 2019). The result is that high achievers feel consistently stretched, those requiring additional reinforcement gain more scaffolded assignments, and average performers discover incremental challenges that keep them motivated. Decades of research illustrate that appropriately implemented modifications benefit learners and the entire cohort. Classroom studies consistently show that this technique can mitigate widespread problems such as disengagement (Geletu and Mihiretie, 2024), erratic attendance (Heyne et al., 2019), and inconsistent performance (Bondie et al., 2019).

Building on its longstanding legacy, DI draws from several influential theoretical frameworks that articulate how learners acquire knowledge and develop new competencies. One important perspective is rooted in constructivism, which posits that they make meaning through dynamic interactions with stimuli. In a classroom context, it implies that tasks should be personally relevant, open to exploration, and suited to learners' levels of cognitive development (Suprayogi et al., 2017; Pozas et al., 2020). Educators recognize that learners will build personal interpretations rather than passively absorb facts by offering tasks that allow for choice, reflection, and inquiry (Dobber et al., 2017). A second viewpoint stems from behaviorist theories, where systematic reinforcement, consistent feedback, and repeated practice propel learners toward desired outcomes (Khalil and Elkhider, 2016; Hameed et al., 2024). In a differentiated classroom, this could translate into calibrated exercises that reward steady progress and sustain motivation (Smale-Jacobse et al., 2019). A third lens emerges from sociocultural thought, notably Vygotsky's concept of the Zone of Proximal Development. This principle features the distance between what an individual can do alone and what becomes possible with guided support (Nicholas et al., 2021). Differentiation acknowledges these zones by giving slightly challenging tasks bolstered with timely hints or collaboration. It ensures steady growth without overwhelming frustration (Kantar et al., 2020; Xia et al., 2024). These varied theoretical bases collectively reinforce the idea that one-size-fits-all lessons disregard the complex interplay of existing knowledge, motivational factors, and contextual influence that shapes learning.

Recent shifts in educational practice have propelled the convergence of these theoretical foundations with electronic means of enhancing differentiation (Karatza, 2019; Haymon and Wilson, 2020; Alamri et al., 2021; Krishan and Al-Rsa'i, 2023; Wulandari et al., 2024). While earlier generations of teachers grappled with the logistical complexities of individualized multiple-lesson pathways, modern educators have access to various digital resources that can automate or expedite differentiation. Electronic DI extends the underlying tenets of diversity, which adapts content, process, and outcomes to match learners' strengths and weaknesses (Halkiopoulos and Gkintoni, 2024). Rather than manually designing separate materials, educators can implement a range of digital stimuli that accommodate learners who respond best to varied input types (Arguel et al., 2017). At its core, it seeks to optimize electronic strategies to expand the scope of individualization. It transforms each learner's experience into a meaningful learning journey (Alamri et al., 2020). The immediate access to this instruction and ongoing monitoring help address significant hurdles that conventional differentiation faces in large groups or resource-limited environments (Smale-Jacobse et al., 2019).

One key benefit of integrating electronic resources into differentiation is the ability to present layered information that meets learners at their precise point of need, regardless of classroom constraints. Educators no longer have to divide and distribute physical handouts for every ability level (Boelens et al., 2018), nor must they orchestrate separate stations with paper-based activities that risk going stale. Instead, learners can engage with curated content that modifies complexity (Errabo et al., 2024), language level (Karst et al., 2022), or thematic focus based on real-time performance or expressed preference. Another advantage lies in delivering individualized feedback since learners can receive guidance aligned with their responses and progress (Bondie et al., 2019). This means those struggling with particular concepts might encounter alternate explanations or incremental hints, whereas

those grasping ideas promptly might receive extensions that deepen their knowledge. The role of electronic DI thus revolves around alleviating pressures associated with manual planning and enables instructors to devote time to deeper interactions, targeted small-group facilitation, and relationship-building. Through a holistic lens, the digitally supported nature of the teaching approach effectively broadens opportunities for every learner. Hence, it ensures that diverse capacities are not tolerated but actively nurtured.

This framework holds particular importance in literacy contexts, where reading proficiency forms a foundation for broader academic progress. Research repeatedly underscores that reading is a key to unlocking knowledge in most content areas and a cornerstone of lifelong learning. However, countless studies show that classrooms can include individuals who read at levels spanning multiple years of development (Wigfield et al., 2016; Lee and Wallace, 2018). Electronic DI tailored to reading offers a promising solution by guiding each learner toward texts that provide an appropriate level of challenge (Puzio et al., 2020). A learner struggling with basic decoding might focus on content supplemented with simpler syntax, expanded glossaries, or embedded definitions (Zoski et al., 2018). Learners with advanced comprehension might explore more materials or respond to higher-level prompts (Le et al., 2024). These electronic supported adjustments help avoid situations where higher achievers coast along unchallenged while others who require more fundamental practice remain perpetually behind (Neitzel et al., 2022). Instead, each route is calibrated to specific needs to promote a sense of ownership and steady growth. Crucially, electronic DI in reading can also incorporate multiple representations, such as audio tracks, interactive annotations, and embedded questions, to enhance the levels of engagement for struggling readers (Montgomery, 2022). When learners feel genuinely involved, enthusiasm and self-assurance grow, fostering a cycle of progress that spills into other subjects (Lee and Hannafin, 2016). Moreover, these literacy-oriented approaches often include progress visualizations that track improvements in fluency, vocabulary, or comprehension accuracy over successive weeks (Estaiteyeh and DeCoito, 2024).

Although electronic DI's potential is considerable, challenges and limitations inevitably arise (Bingham et al., 2018). It warrants careful evaluation and strategic planning (Puzio et al., 2020). Foremost is the disparity in access to reliable electronic resources across communities (Boelens et al., 2018). Learners in underprivileged areas might not have the bandwidth or consistent connectivity to fully benefit from such approaches, thus creating an additional barrier that could exacerbate existing inequities. Even in contexts where connectivity is adequate, teachers must integrate electronic materials effectively, interpret ongoing performance indicators, and adjust assignments accordingly. Limited preparation or insufficient training programs can result in superficial attempts at electronic DI, where learners merely click through activities without meaningful personalization (Bingham et al., 2018). Another concern stems from the concern that digitizing the differentiation process might reduce the importance of face-to-face interactions (Autio et al., 2021). While electronic means can handle many logistical personalization aspects, the empathetic teaching component should not be overshadowed (Sajja et al., 2024). Educators must balance using electronic means for tasks that benefit from immediate data analysis or varied content presentation while fostering relationships through discussion, group projects, and reflection (Heilporn et al., 2021). They must address potential pitfalls related to anonymity or distraction. Some learners may disengage if the format lacks accountability or a sense of teacher presence (Bergdahl, 2022). Balancing these factors requires professional development, institutional support, and consistent reflection on whether electronic DI solutions enhance individualized learning or add technological novelty.

The existing electronic DI and reading intervention studies show how technology can enhance literacy development. Some have focused on reading proficiency, which addresses diverse learning needs. Haymon and Wilson (2020) explored DI with technology to improve reading comprehension and Lexile growth among advanced middle school students. However, the study was limited to high-achieving learners, which may not apply to struggling readers. Förster et al. (2018) examined assessment-based DI in improving reading fluency, yet inconsistent implementation weakened its impact on reading comprehension. Baron et al. (2019) also investigated Lexia Core5's DI approach for struggling readers, but its lack of randomization and absence of a control group limited its validity. Najemi et al. (2024) demonstrated that Google Sites-based DI enhanced reading motivation and comprehension, though it focused only on narrative texts. Thus, it reduces its applicability to other reading skills. Peters et al. (2022) examined assessment-driven DI but found no significant improvements in fluency or comprehension, partly due to teacher challenges in integrating DI tools effectively. Unlike prior studies focusing on advanced learners (Haymon and Wilson, 2020) or general student populations (Förster et al., 2018; Peters et al., 2022), this study targets frustration-level readers who have difficulty comprehending the reading materials appropriately. Also, it incorporates a Learning Style Questionnaire to meet participants' learning preferences in structured remedial reading instruction. DI responds to the reality of today's educational landscape's wide-ranging abilities, motivations, and interests (Meng, 2023). Its roots in constructivism, behaviorism, and sociocultural views confirm that people learn in diverse ways, shaped by personal experiences, peer interactions, and steady practice (Brevik et al., 2018). Integrating digital avenues into this model offers innovative

mechanisms for customizing content, delivering timely feedback, and tracking growth (Matuk et al., 2015). By applying these principles in literacy education, learners at varied developmental stages can gain meaningful experiences that target decoding, fluency, and higher-order comprehension (Puzio et al., 2020). Nevertheless, unresolved hurdles, such as inconsistent access to electronic tools, limited professional expertise, potential passivity among learners, and the need for relevant, bias-free materials, signal that careful planning and resource allocation must accompany implementation (Sabri et al., 2024). Ongoing improvements in digital resources should intensify electronic DI's effectiveness (McKnight et al., 2016). Such efforts can protect the spirit of authentic instruction while extending the reach of differentiation to every corner of contemporary learning.

3. Methodology

This study adopted an experimental design to determine the effectiveness of electronic differentiated instruction in enhancing the reading skills of Grade 7 frustration-level learners. Experimental design is a research methodology utilized to establish cause-and-effect relationships between variables. It manipulates one or more independent variables, observing their impact on dependent variables and controlling for confounding factors to ensure the validity of the findings (Lonati et al., 2018).

The participants of the study were 100 Grade 7 learners identified as frustration-level readers, based on the results of the School Monitoring, Evaluation, and Adjustment (SMEA) assessment using the Philippine Informal Reading Inventory (Phil-IRI). These learners had scores of 89 or below, indicating significant difficulty in comprehending grade-level reading materials. At this level, learners typically find reading tasks highly challenging and are often unable to respond effectively. The study specifically focused on this group to address the needs of those most at risk of academic underachievement due to reading difficulties. Learners who scored within the instructional level (90 to 96) or the independent level (97 to 100) were excluded from the study, as they demonstrated stronger reading comprehension skills and were not the intended recipients of the intervention. The 100 participants were randomly assigned to either the experimental or control group, with 50 learners in each. The fishbowl technique was used to ensure equal chances of selection and avoid sampling bias. Each participant's name was written on a piece of paper, rolled, and placed in a bowl. Names were drawn alternately until both groups were filled. This method helped ensure the credibility and representativeness of the sample.

This study utilized two instruments to gather the data. First, the Learning Style Questionnaire was used to identify the preferred learning styles of the participants adopted by Reid (1987). They were categorized as visual, auditory, and tactile. When the participants are classified as visual, they comprehend and retain information more effectively when it is presented visually. They prefer reading materials, observing demonstrations, and utilizing visual aids such as charts and diagrams. Written instructions and notes enhance their understanding and recall. When the participants are auditory, they excel when information is conveyed through sound. They benefit from listening to lectures, engaging in discussions, and using auditory materials like recordings. Hearing and verbalizing information aids their learning process. Lastly, when the participants are tactile, they learn best through hands-on experiences. Engaging in touch, manipulation, and movement activities facilitates their understanding and memory retention.

This 15-item Learning Style Questionnaire underwent validation from three education experts. It was submitted to reliability testing by 30 non-participants to ensure its integrity and context. The Cronbach's alpha yielded 0.751, indicating the consistency of the items. This ensures the stability and dependability of the results across measures.

On the other hand, the Philippine Informal Reading Inventory (Phil-IRI) is a standardized reading assessment tool developed by the Department of Education (DepEd). It comprises graded passages designed to determine a learner's reading level and is widely used in Philippine schools. The tool did not undergo additional validity and reliability testing since it was tested prior to its implementation. Its predetermined criteria are used to sort the learners into distinct reading levels. Learners scoring 89 or below are classified at the frustration level. It means that they find reading materials challenging and struggle to respond effectively. Those with scores ranging from 90 to 96 are categorized at the instructional level. This suggests that they benefit most from teacher-directed reading instruction. Learners scoring between 97 and 100 are classified at the independent level. They can read and comprehend texts with minimal difficulty, characterized by nearly flawless oral reading and comprehension skills.

The materials used in the experiment included interactive mobile applications (Magic Hippo, FunEasyLearn, and Read Along), educational videos, gamified PowerPoint presentations, songs, electronic graphic organizers, and audiobooks. The mobile applications were available for download from the Google Play Store, while the other electronic materials were developed by the researcher. To ensure the appropriateness and accuracy of the content, all materials were subjected to content validation by the Literacy and Numeracy (LAN) coordinators. This process confirmed that the materials were aligned with the participants' academic level.

A formal request was sent to the school principal, LAN coordinators, and Grade 7 advisers to seek permission for conducting the study. Another letter was distributed to request access to the participants' SMEA results. Based on these results, participants

were randomly assigned to either the experimental or control group using simple random sampling.

An orientation meeting was conducted with the school principal, LAN coordinators, advisers, parents, and student participants to explain the nature and purpose of the study. During this session, the objectives, scope, and methodology were clearly discussed, along with the ethical considerations involved. After the orientation, consent and assent forms were distributed to both participants and their parents, emphasizing the voluntary nature of their participation.

Participants were then officially grouped into experimental and control categories. Before implementing the intervention, the Kolmogorov-Smirnov test was used to assess the normality of the SMEA scores and pre-test data. The test produced an alpha value of 0.534, indicating no significant deviation from a normal distribution.

Following this, the experimental group completed the Learning Style Questionnaire to identify their preferred learning styles, which were categorized as visual, auditory, or tactile. Each subgroup received personalized digital direct instruction tailored to their learning style.

In contrast, the control group continued with the standard reading instruction regularly used in school. The instructional framework followed the sequence of key reading components. The first week focused on phonemic awareness and phonics, followed by two weeks of vocabulary development, and the remaining time was dedicated to reading comprehension. The sessions were held daily from 4:00 p.m. to 5:00 p.m. over a period of two months, ensuring sufficient time to assess learning outcomes.

At the end of the intervention, both groups took a post-test to allow for a comparative analysis of the results.

4. Results and discussion

4.1. Pre-test scores before the intervention

Table 1 shows that the reading levels of both the control group (M = 76.22, SD = 8.19) and the experimental group (M = 78.06, SD = 7.08) were within the frustration level. This indicates that, prior to the intervention, participants faced significant challenges that hindered their ability to respond effectively to reading tasks. These findings are consistent with previous studies showing that learners at the frustration level often struggle with basic comprehension, word recognition, and deriving meaning from text. Such difficulties can lead to negative attitudes toward reading and decreased academic motivation.

The root causes of these struggles are often cognitive, linguistic, and emotional. Learners at this level tend to experience cognitive overload, as they devote excessive mental effort to decoding words, leaving limited capacity for comprehension. A restricted vocabulary further disrupts reading fluency and impairs understanding, especially when encountering unfamiliar words or complex texts. In addition, poor decoding skills prevent accurate word recognition and pronunciation, which slows reading, reduces comprehension, and increases the effort required for reading tasks.

Limited prior knowledge also contributes to comprehension difficulties. Understanding new information depends on connecting it to existing knowledge, so learners with limited exposure to diverse topics are at a disadvantage when reading unfamiliar material. Emotional and psychological factors add further barriers. Persistent reading difficulties often lead to frustration, anxiety, and low self-esteem, which in turn reduce motivation and discourage learners from engaging with reading tasks. This emotional burden can lead to a cycle of avoidance and continued underachievement.

Moreover, instructional practices may unintentionally worsen the problem. Standardized teaching methods often fail to address the specific needs of learners at the frustration level, limiting their access to appropriate support and interventions. Given these challenges, prioritizing learners at the frustration level is vital. Without timely and targeted intervention, their academic performance and personal development may be seriously affected. By identifying the underlying factors contributing to their reading difficulties, educators and researchers can design effective strategies to help these learners overcome obstacles, develop confidence, and achieve their full potential.

Table 1: Pre-test scores

Group	M	SD	Interpretation
Control	76.22	8.19	Frustration level
Experimental	78.06	7.08	Frustration level

Note: Frustration level: 89-below; Instructional level: 90-96; Independent level: 97-100

4.2. Post-test scores after the intervention

Table 2 shows that the reading level of the control group (M=90.08, SD=4.79) and experimental group (M=94.42, SD=4.28) fell under instructional level. This suggests that while learners experience moderate challenges with the reading materials, they can effectively engage with and navigate the tasks with appropriate teacher support. Furthermore, this finding features the effectiveness of electronic differentiated instruction and traditional reading strategies in addressing the reading difficulties of learners initially classified at the frustration level. Supporting this, Alsuwat and Young (2016) conducted a meta-analysis comparing traditional and technology-based instructional methods for enhancing reading comprehension. Their analysis concluded that both approaches were equally effective and suggested that combining strategies may yield optimal outcomes.

The findings further reveal that the mean score of the experimental group was higher than that of the control group. The standard deviations for both groups provide insight into the variability of scores within each group. The control group suggests a slightly broader range of scores than the experimental group, which performs more consistently among its members. These suggest that the experimental group achieved slightly higher and more uniform outcomes. Hence, electronic differentiated instruction has a more evident impact on reading performance than traditional reading strategies. It adapts content using technological tools to individual learners' needs (Boelens et al., 2018). This ensures that learners engage with materials that are appropriate to their skill levels, maintain motivation, and provide targeted support (Matuk et al., 2015). For example, interactive reading platforms often incorporate gamified elements, immediate feedback, and scaffolding, all of which help learners address challenges and build confidence. From the Zone of Proximal Development perspective, the intervention acts as a "more knowledgeable other" by providing structured support that guides learners through tasks they cannot independently accomplish (Clapper, 2015; Liu et al., 2023; Emir and Yangın-Ekşi, 2024). Over time, as they progress, this is gradually withdrawn and allows them to internalize skills and achieve autonomy. Meanwhile, Behaviorism explains the impact of electronic differentiated instruction through its reliance on immediate reinforcement, such as rewards, badges, or progress indicators. These strengthen the desired behavior of active reading and encourage learners to persist and improve.

Studies confirm the effectiveness of the teaching approach in improving reading outcomes by adapting content to individual learners' needs. Jamshidifarsani et al. (2019) highlighted that technology-based interventions enhance literacy by offering tailored support and reducing cognitive overload during reading tasks. Montgomery (2022) demonstrated that integrating technology into instructional frameworks increases student engagement, supports differentiated instruction, and enhances academic outcomes for diverse learners, which echoes the higher performance and consistency observed in the experimental group. Krishan and Al-Rsa'i (2023) reported that technology-oriented differentiated instruction improves academic performance and boosts motivation through interactive platforms, gamified elements, and immediate feedback mechanisms. However, some studies caution against attributing superior outcomes solely to electronic differentiated instruction. For example, Kótay-Nagy (2022) noted that while technology enhances differentiation, its impact depends significantly on resource availability, teacher readiness, and effective implementation. Likewise, Haymon and Wilson (2020) emphasized the continued importance of traditional instructional methods, particularly for foundational literacy skills, arguing that combining electronic differentiated instruction with traditional strategies may provide the most comprehensive support for learners.

On the other hand, the control group generally improved reading levels when exposed to traditional reading strategies. These approaches offer immediate feedback and consistent support, essential for effective learning (Roddy et al., 2017). In traditional teacher-led settings, teachers can quickly identify and correct errors (Spear-Swerling, 2019), reinforce positive reading habits (Gambrell, 2015), and ensure learners stay on track (Bao, 2020). Their presence fosters accountability and encourages learners to remain focused and engaged throughout the learning process (Lee and Hannafin, 2016). This structured and guided approach is particularly advantageous for those who require sustained support to overcome challenges in decoding and comprehending texts (Spear-Swerling, 2019). Traditional reading strategies also strongly emphasize explicit teaching of comprehension skills (Brevik, 2019). Teachers guide learners through pre-reading, during-reading, and post-reading activities. This enables them to think critically and systematically analyze texts. This method equips learners with transferable skills to interpret a variety of text types effectively. Furthermore, these strategies allow for integrating cultural and linguistic elements and ensure that lessons are inclusive and meaningful to diverse learners.

Empirical evidence supports the effectiveness of traditional reading strategies. Delgado et al. (2018) found that printed materials yield better comprehension outcomes than digital formats, corroborated by research showing the cognitive benefits of reduced distractions and enhanced focus in print-based reading. Moreover, traditional methods have improved intensive reading skills with innovative techniques. For example, Yusnan et al. (2022) demonstrated that guided demonstration methods enhance engagement and comprehension in structured classroom settings. Hwang et al. (2019) reported that integrating summarization strategies within traditional reading instruction fosters deeper understanding and content retention. However, traditional strategies are not without limitations. Supriadi et al. (2022) identified challenges in maintaining learner motivation and engagement in environments solely reliant on traditional methods. They often lack the dynamic features of technology-based strategies, such as personalization, gamification, and interactive elements, which can significantly enhance learner motivation and engagement (Haymon and Wilson, 2020). These critiques emphasize the need for a balanced approach that combines the strengths of traditional methods with the adaptability and interactivity of technology-enhanced strategies.

The results feature both approaches' effectiveness in enhancing the participants' reading levels. Despite differences in structure and resources, both methods successfully address challenges in reading proficiency. They support the learners in progressing from frustration levels to

instructional readers. This progression indicates the value of interventions focusing on foundational skills while addressing individual learning needs. Also, the findings suggest that combining the strengths of both approaches may lead to a more comprehensive and effective framework for literacy development. Integrating the traditional strategies with the adaptive and personalized features of electronic differentiated instruction can create a balanced approach (Lindner et al., 2019; Gligorea et al., 2023). This is particularly valuable in diverse and modern learning environments, where addressing varying learner needs and promoting engagement are critical for fostering sustainable literacy growth.

Table 2: Post-test scores

Group	M	SD	Interpretation
Control	90.08	4.79	Instructional level
Experimental	94.42	4.28	Instructional level

Note: Frustration level: 89-below; Instructional level: 90-96; Independent level: 97-100

4.3. Difference in the post-test scores

Table 3 shows a significant difference in the post-test scores between the control and experimental groups. The control group had a mean score (M=90.08, SD=4.79), while the experimental group achieved a higher mean score (M=94.42, SD=4.28). The smaller standard deviation in the experimental group suggests more consistent performance among participants exposed to the intervention. The confidence interval (95% CI [-6.14, -2.54]) does not include zero, which reveals that the observed difference in means is statistically significant. This is further supported by the t-value (t=-4.78, df=98) and the p-value (p<.001), which confirm that the difference is unlikely to be due to random chance.

The eta-squared value (η^2=0.189) reflects a large effect size, according to Cohen's (1988) criteria. This indicates that the electronic differentiated instruction substantially impacted the participants' reading performance. These findings suggest that the experimental group outperformed the control group, which was exposed to traditional strategies. Moreover, the smaller variability in scores within the experimental group indicates that the intervention was effective across diverse learners. The data strongly support the effectiveness of electronic differentiated instruction in enhancing reading outcomes compared to traditional methods. This aligns with the findings of Jamshidifarsani et al. (2019), who found that such interventions enhance literacy through personalized support and reduce cognitive overload. Also, Montgomery (2022) confirmed that integrating technology into teaching frameworks boosts student engagement, supports differentiation, and improves academic outcomes. Equally, Krishan and Al-Rsa'i (2023) reported that technology-driven instruction enhances academic performance and motivation through interactive platforms, gamification, and immediate feedback.

The results have transformed the way reading is taught. It involves modifying content, processes, and outcomes to meet the diverse needs of learners (Boelens et al., 2018; Bondie et al., 2019). This approach suits classrooms with varying abilities and uses technology to tailor learning experiences (Mahoney and Hall, 2017). It improves reading outcomes by meeting their specific needs. Tools like e-books, adaptive learning platforms, and educational apps help them progress at their own pace. These tools also offer resources that match their skills and challenges (Ahmadi, 2018; Haleem et al., 2022). However, it offers a clear contrast to traditional methods, which often provide the same instruction to all learners but may not address individual gaps in learning.

One benefit of electronic differentiated instruction is its ability to personalize learning (Boelens et al., 2018). Its adaptive technologies monitor learners' progress and adjust the content to suit their needs (Hall et al., 2015; Nordström et al., 2018). This idea connects to Vygotsky's Zone of Proximal Development (ZPD). According to him, effective learning happens beyond a learner's current ability with the right support (Kantar et al., 2020). Traditional methods often fail to provide this personalized support. They may either overwhelm learners or fail to challenge them enough. In contrast, electronic differentiated instruction ensures that materials are at the right difficulty level, motivating them to improve their reading skills (Puzio et al., 2020).

Another strength of electronic differentiated instruction is its multimodal approach (Karatza, 2019). It combines text, audio, video, and interactive features, which make reading instruction more engaging. This approach supports different learning styles and helps learners retain information (Boelens et al., 2018; Smale-Jacobse et al., 2019). For instance, gamified reading activities sustain interest and deepen engagement with texts (Freiermuth and Ito, 2021). These make reading more accessible and enjoyable (Chen et al., 2020; Li and Chu, 2021). Traditional methods often lack the variety needed to address diverse learning needs effectively.

Electronic differentiated instruction fosters autonomy (Pozas et al., 2020). Electronic platforms allow learners to decide when, where, and how they learn (Haleem et al., 2022). This flexibility encourages self-regulation and intrinsic motivation (Wang, 2023) and helps them develop lifelong learning habits (Roskos et al., 2017). Traditional methods offer fewer opportunities for them to take control of their progress, and they rely on fixed schedules and teacher-directed instruction.

Electronic differentiated instruction is a powerful tool for improving reading outcomes. Its multimodal and flexible features further enhance engagement and motivation. While traditional methods are valuable, they often lack the adaptability needed in

diverse classrooms. As educational practices evolve, electronic differentiated instruction provides a promising way to address these challenges and prepare students for lifelong success in reading and learning.

Table 3: Post-test t-test results

			95 % confidence interval of the difference					
Group	M	SD	Lower	Upper	t	df	Sig	Eta-squared
Control	90.08	4.79	-6.14	-2.54	-4.78	98	.000	0.189
Experimental	94.42	4.28						

Note: p< 0.05, statistically significant at 0.05 alpha level

5. Conclusion

This study revealed the effectiveness of electronic differentiated instruction as a strategy for enhancing the reading skills of frustration-level readers. The results showed that it significantly improved reading performance compared to traditional methods, as evidenced by the experimental group's higher and more consistent post-test scores. Its personalized, multimodal, and interactive features proved instrumental in addressing the specific needs of diverse learners, which foster motivation and skill development. Schools and teachers can integrate this intervention into their teaching frameworks to support differentiated instruction and improve literacy outcomes. Policymakers and school administrators must also recognize the need for adequate digital infrastructure, professional training, and equitable access to technological resources to ensure successful implementation. Combining electronic differentiated instruction with traditional strategies may yield a comprehensive approach that leverages the strengths of both methods to support diverse learners. Continuous monitoring and evaluation of its impact on literacy outcomes should be a priority to ensure its effectiveness and sustainability in varied educational contexts.

The study, however, has limitations that warrant attention. It was conducted within a specific context and focused on a single educational setting. This may limit the generalizability of its findings to other environments. Also, the intervention was implemented over a relatively short period, which leaves the long-term impact of electronic differentiated instruction unexplored. While the study controlled for many factors, individual differences, such as prior knowledge, socio-emotional influences, and varying access to digital tools, may have influenced the outcomes. Additionally, the study relied on specific applications and materials, which may not reflect the broader range of available electronic tools.

Future research should address the limitations identified in this study. Longitudinal studies are needed to examine the sustained effects of the intervention on reading proficiency. Expanding the scope of research to include diverse educational contexts, grade levels, and cultural settings will enhance the generalizability of findings. Investigating the integration of EDI with traditional instructional methods can also provide insights into creating a balanced and effective teaching framework. Further exploration of teacher readiness, professional development programs, and learner attitudes can help optimize its implementation.

Compliance with ethical standards

Ethical considerations

This study was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments. Permission was obtained from the school principal, LAN coordinators, and teachers. Informed consent was secured from parents or guardians, and assent was obtained from the student participants. Participation was voluntary, and confidentiality was maintained throughout. The study did not pose any harm to the participants, and their right to withdraw at any time was respected.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Abbas J, Aman J, Nurunnabi M, and Bano S (2019). The impact of social media on learning behavior for sustainable education: Evidence of students from selected universities in Pakistan. Sustainability, 11(6): 1683. https://doi.org/10.3390/su11061683

Ahmadi DMR (2018). The use of technology in English language learning: A literature review. International Journal of Research in English Education, 3(2): 115-125. https://doi.org/10.29252/ijree.3.2.115

Alamri H, Lowell V, Watson W, and Watson SL (2020). Using personalized learning as an instructional approach to motivate learners in online higher education: Learner self-determination and intrinsic motivation. Journal of Research on Technology in Education, 52(3): 322-352. https://doi.org/10.1080/15391523.2020.1728449

Alamri HA, Watson S, and Watson W (2021). Learning technology models that support personalization within blended learning environments in higher education. TechTrends, 65(1): 62-78. https://doi.org/10.1007/s11528-020-00530-3

Alsuwat S and Young JR (2016). Meta-analysis of the effects of traditional versus technology-based instruction on reading comprehension of EFL students. EFL Journal, 1(3): 189-202. https://doi.org/10.21462/eflj.v1i3.18

Amendum SJ, Conradi K, and Hiebert E (2018). Does text complexity matter in the elementary grades? A research synthesis of text difficulty and elementary students' reading fluency and comprehension. Educational Psychology Review, 30: 121-151. https://doi.org/10.1007/s10648-017-9398-2

Arguel A, Lockyer L, Lipp OV, Lodge JM, and Kennedy G (2017). Inside out: Detecting learners' confusion to improve interactive digital learning environments. Journal of Educational Computing Research, 55(4): 526-551. https://doi.org/10.1177/0735633116674732

Autio E, Mudambi R, and Yoo Y (2021). Digitalization and globalization in a turbulent world: Centrifugal and centripetal forces. Global Strategy Journal, 11(1): 3-16. https://doi.org/10.1002/gsj.1396

Bao W (2020). COVID-19 and online teaching in higher education: A case study of Peking University. Human Behavior and Emerging Technologies, 2(2): 113-115. https://doi.org/10.1002/hbe2.191 **PMid:32510042 PMCid:PMC7262082**

Baron LS, Hogan TP, Schechter RL, Hook PE, and Brooke EC (2019). Can educational technology effectively differentiate instruction for reader profiles? Reading and Writing, 32(9): 2327-2352. https://doi.org/10.1007/s11145-019-09949-4

Bergdahl N (2022). Engagement and disengagement in online learning. Computers and Education, 188: 104561. https://doi.org/10.1016/j.compedu.2022.104561

Bingham AJ, Pane JF, Steiner ED, and Hamilton LS (2018). Ahead of the curve: Implementation challenges in personalized learning school models. Educational Policy, 32(3): 454-489. https://doi.org/10.1177/0895904816637688

Boelens R, Voet M, and De Wever B (2018). The design of blended learning in response to student diversity in higher education: Instructors' views and use of differentiated instruction in blended learning. Computers and Education, 120: 197-212. https://doi.org/10.1016/j.compedu.2018.02.009

Bondie RS, Dahnke C, and Zusho A (2019). How does changing "one-size-fits-all" to differentiated instruction affect teaching? Review of Research in Education, 43(1): 336-362. https://doi.org/10.3102/0091732X18821130

Brevik LM (2019). Explicit reading strategy instruction or daily use of strategies? Studying the teaching of reading comprehension through naturalistic classroom observation in English L2. Reading and Writing, 32(9): 2281-2310. https://doi.org/10.1007/s11145-019-09951-w

Brevik LM, Gunnulfsen AE, and Renzulli JS (2018). Student teachers' practice and experience with differentiated instruction for students with higher learning potential. Teaching and Teacher Education, 71: 34-45. https://doi.org/10.1016/j.tate.2017.12.003

Chee KN, Yahaya N, and Ibrahim NH (2018). Factors of students' performance based on cognitive level in a mobile learning environment. International Journal of Mobile Learning and Organisation, 12(2): 190-212. https://doi.org/10.1504/IJMLO.2018.10010754

Chen CM, Li MC, and Chen TC (2020). A web-based collaborative reading annotation system with gamification mechanisms to improve reading performance. Computers and Education, 144: 103697. https://doi.org/10.1016/j.compedu.2019.103697

Cheung AC and Slavin RE (2013). Effects of educational technology applications on reading outcomes for struggling readers: A best-evidence synthesis. Reading Research Quarterly, 48(3): 277-299. https://doi.org/10.1002/rrq.50

Chodkiewicz AR and Boyle C (2017). Positive psychology school-based interventions: A reflection on current success and future directions. Review of Education, 5(1): 60-86. https://doi.org/10.1002/rev3.3080

Clapper TC (2015). Cooperative-based learning and the zone of proximal development. Simulation and Gaming, 46(2): 148-158. https://doi.org/10.1177/1046878115569044

Cohen J (1988). Statistical power analysis for the behavioral sciences. 2nd Edition, Routledge, New York, USA. https://doi.org/10.4324/9780203771587

Colicol FL and Sali-Latif FK (2023). Parental occupation, social class, and school choice in southern Philippines: Their implications to educational public-private partnership vis-à-vis the K-12 SHS voucher program. International Journal of Learning, Teaching and Educational Research, 22(6): 345-369. https://doi.org/10.26803/ijlter.22.6.19

Dack H (2018). Structuring teacher candidate learning about differentiated instruction through coursework. Teaching and Teacher Education, 69: 62-74. https://doi.org/10.1016/j.tate.2017.09.017

Delgado DA, Lambert BS, Boutris N, McCulloch PC, Robbins AB, Moreno MR, and Harris JD (2018). Validation of digital visual analog scale pain scoring with a traditional paper-based visual analog scale in adults. JAAOS Global Research and Reviews, 2(3): e088. https://doi.org/10.5435/JAAOSGlobal-D-17-00088 **PMid:30211382 PMCid:PMC6132313**

Dewan M, Murshed M, and Lin F (2019). Engagement detection in online learning: A review. Smart Learning Environments, 6: 1. https://doi.org/10.1186/s40561-018-0080-z

Dobber M, Zwart R, Tanis M, and van Oers B (2017). Literature review: The role of the teacher in inquiry-based education. Educational Research Review, 22: 194-214. https://doi.org/10.1016/j.edurev.2017.09.002

El-Sabagh HA (2021). Adaptive e-learning environment based on learning styles and its impact on development students' engagement. International Journal of Educational Technology in Higher Education, 18: 53. https://doi.org/10.1186/s41239-021-00289-4

Emir G and Yangın-Ekşi G (2024). The role of telecollaboration in English language teacher education: A systematic review. Smart Learning Environments, 11: 3. https://doi.org/10.1186/s40561-024-00290-0

Errabo DD, Dela Rosa A, and Gonzales LJM (2024). Optimizing differentiated podcasts to promote students' self-regulation and engagement, self-efficacy and performance in asynchronous learning. Journal of Research in Innovative Teaching and Learning, 17(2): 368-390. https://doi.org/10.1108/JRIT-02-2024-0039

Estaiteyeh M and DeCoito I (2024). Technology-enhanced differentiated instruction in STEM education: Teacher candidates' development and curation of learning resources. Contemporary Issues in Technology and Teacher Education, 24(3): 291-312. https://doi.org/10.70725/799249unduds

Flaugnacco E, Lopez L, Terribili C, Montico M, Zoia S, and Schön D (2015). Music training increases phonological awareness and reading skills in developmental dyslexia: A randomized control trial. PLOS ONE, 10(9): e0138715. https://doi.org/10.1371/journal.pone.0138715 **PMid:26407242 PMCid:PMC4583182**

Förster N, Kawohl E, and Souvignier E (2018). Short-and long-term effects of assessment-based differentiated reading instruction in general education on reading fluency and reading comprehension. Learning and Instruction, 56: 98-109. https://doi.org/10.1016/j.learninstruc.2018.04.009

Freiermuth MR and Ito M (2022). Battling with books: The gamification of an EFL extensive reading class. Simulation and Gaming, 53(1): 22-55. https://doi.org/10.1177/10468781211061858

Gambrell LB (2015). Getting students hooked on the reading habit. The Reading Teacher, 69(3): 259-263. https://doi.org/10.1002/trtr.1423

Geletu GM and Mihiretie DM (2024). The effects of primary school teachers' professional development activities on differentiated instructional practices and possibilities of elevating students' learning engagement. Education 3-13, 52(8): 1222-1237. https://doi.org/10.1080/03004279.2022.2143722

Gilakjani AP and Sabouri NB (2016). How can students improve their reading comprehension skill. Journal of Studies in Education, 6(2): 229-240. https://doi.org/10.5296/jse.v6i2.9201

Gkofa P (2017). Promoting social justice and enhancing educational success: Suggestions from twenty educationally successful Roma in Greece. The Urban Review, 49(3): 443-462. https://doi.org/10.1007/s11256-016-0393-6

Gligorea I, Cioca M, Oancea R, Gorski AT, Gorski H, and Tudorache P (2023). Adaptive learning using artificial intelligence in e-learning: A literature review. Education Sciences, 13(12): 1216. https://doi.org/10.3390/educsci13121216

Graham S, Liu X, Aitken A, Ng C, Bartlett B, Harris KR, and Holzapfel J (2018). Effectiveness of literacy programs balancing reading and writing instruction: A meta-analysis. Reading Research Quarterly, 53(3): 279-304. https://doi.org/10.1002/rrq.194

Haleem A, Javaid M, Qadri MA, and Suman R (2022). Understanding the role of digital technologies in education: A review. Sustainable Operations and Computers, 3: 275-285. https://doi.org/10.1016/j.susoc.2022.05.004

Halkiopoulos C and Gkintoni E (2024). Leveraging AI in e-learning: Personalized learning and adaptive assessment through cognitive neuropsychology: A systematic analysis. Electronics, 13(18): 3762. https://doi.org/10.3390/electronics13183762

Hall TE, Cohen N, Vue G, and Ganley P (2015). Addressing learning disabilities with UDL and technology: Strategic reader. Learning Disability Quarterly, 38(2): 72-83. https://doi.org/10.1177/0731948714544375

Hameed M, Dilshad M, and Rasool T (2024). Use of differentiated instruction at special education schools: Teachers' perspective. Pakistan Journal of Humanities and Social Sciences, 12(2): 2206-2217. https://doi.org/10.52131/pjhss.2024.v12i2.2401

Haw JY, King RB, and Trinidad JER (2021). Need supportive teaching is associated with greater reading achievement: What the Philippines can learn from PISA 2018. International Journal of Educational Research, 110: 101864. https://doi.org/10.1016/j.ijer.2021.101864

Haymon C and Wilson A (2020). Differentiated reading instruction with technology for advanced middle school students' reading achievement. Journal of Educational Research and Practice, 10(1): 70-89. https://doi.org/10.5590/JERAP.2020.10.1.05

Heilporn G, Lakhal S, and Bélisle M (2021). An examination of teachers' strategies to foster student engagement in blended learning in higher education. International Journal of Educational Technology in Higher Education, 18: 25. https://doi.org/10.1186/s41239-021-00260-3 **PMid:34805484 PMCid:PMC8591686**

Henriksen D, Richardson C, and Mehta R (2017). Design thinking: A creative approach to educational problems of practice. Thinking skills and Creativity, 26: 140-153. https://doi.org/10.1016/j.tsc.2017.10.001

Heyne D, Gren-Landell M, Melvin G, and Gentle-Genitty C (2019). Differentiation between school attendance problems: Why and how? Cognitive and Behavioral Practice, 26(1): 8-34. https://doi.org/10.1016/j.cbpra.2018.03.006

Hwang GJ, Chen MRA, Sung HY, and Lin MH (2019). Effects of integrating a concept mapping-based summarization strategy into flipped learning on students' reading performances and perceptions in Chinese courses. British Journal of Educational Technology, 50(5): 2703-2719. https://doi.org/10.1111/bjet.12708

Jaeger EL (2024). The potential for common core and response to intervention as intersecting initiatives: Supporting readers who struggle with high-level standards. Reading and Writing Quarterly, 40(2): 87-102. https://doi.org/10.1080/10573569.2023.2172496

Jamshidifarsani H, Garbaya S, Lim T, Blazevic P, and Ritchie JM (2019). Technology-based reading intervention programs for elementary grades: An analytical review. Computers and Education, 128: 427-451. https://doi.org/10.1016/j.compedu.2018.10.003

Kantar LD, Ezzeddine S, and Rizk U (2020). Rethinking clinical instruction through the zone of proximal development. Nurse Education Today, 95: 104595. https://doi.org/10.1016/j.nedt.2020.104595 **PMid:33035910**

Karatza Z (2019). Information and communication technology (ICT) as a tool of differentiated instruction: An informative intervention and a comparative study on educators' views and extent of ICT use. International Journal of Information and Education Technology, 9(1): 8-15. https://doi.org/10.18178/ijiet.2019.9.1.1165

Karst K, Bonefeld M, Dotzel S, Fehringer BC, and Steinwascher M (2022). Data-based differentiated instruction: The impact of standardized assessment and aligned teaching material on students' reading comprehension. Learning and Instruction, 79: 101597. https://doi.org/10.1016/j.learninstruc.2022.101597

Khalil MK and Elkhider IA (2016). Applying learning theories and instructional design models for effective instruction. Advances in Physiology Education, 40(2): 147-156. https://doi.org/10.1152/advan.00138.2015 **PMid:27068989**

Kim JS, Hemphill L, Troyer M, Thomson JM, Jones SM, LaRusso MD, and Donovan S (2017). Engaging struggling adolescent readers to improve reading skills. Reading Research Quarterly, 52(3): 357-382. https://doi.org/10.1002/rrq.171

Kótay-Nagy A (2022). Primary school EFL teachers' practices and views of technology-enhanced differentiated instruction: A pilot interview study. Working Papers in Language Pedagogy, 17: 45-65. https://doi.org/10.61425/wplp.2022.17.45.65

Krishan IQ and Al-Rsa'i MS (2023). The effect of technology-oriented differentiated instruction on motivation to learn science. International Journal of Instruction, 16(1): 961-982. https://doi.org/10.29333/iji.2023.16153a

Le HV, Nguyen TAND, Le DHN, Nguyen PU, and Nguyen TTA (2024). Unveiling critical reading strategies and challenges: A mixed-methods study among English major students in a Vietnamese higher education institution. Cogent Education, 11(1): 2326732. https://doi.org/10.1080/2331186X.2024.2326732

Lee E and Hannafin MJ (2016). A design framework for enhancing engagement in student-centered learning: Own it, learn it, and share it. Educational Technology Research and Development, 64(4): 707-734. https://doi.org/10.1007/s11423-015-9422-5

Lee G and Wallace A (2018). Flipped learning in the English as a foreign language classroom: Outcomes and perceptions. TESOL Quarterly: Quarterly Peer-Reviewed Academic Journal, 52(1): 62-84. https://doi.org/10.1002/tesq.372

Li X and Chu SKW (2021). Exploring the effects of gamification pedagogy on children's reading: A mixed-method study on academic performance, reading-related mentality and behaviors, and sustainability. British Journal of Educational Technology, 52(1): 160-178. https://doi.org/10.1111/bjet.13057

Liew J, Erbeli F, Nyanamba JM, and Li D (2020). Pathways to reading competence: Emotional self-regulation, literacy contexts, and embodied learning processes. Reading

Psychology, 41(7): 633-659. https://doi.org/10.1080/02702711.2020.1783145

Lindeblad E, Nilsson S, Gustafson S, and Svensson I (2017). Assistive technology as reading interventions for children with reading impairments with a one-year follow-up. Disability and Rehabilitation: Assistive Technology, 12(7): 713-724. https://doi.org/10.1080/17483107.2016.1253116 **PMid:27924656**

Lindner KT, Alnahdi GH, Wahl S, and Schwab S (2019). Perceived differentiation and personalization teaching approaches in inclusive classrooms: Perspectives of students and teachers. Frontiers in Education, 4: 58. https://doi.org/10.3389/feduc.2019.00058

Liu S, Gao S, and Ji X (2023). Beyond borders: Exploring the impact of augmented reality on intercultural competence and L2 learning motivation in EFL learners. Frontiers in Psychology, 14: 1234905. https://doi.org/10.3389/fpsyg.2023.1234905 **PMid:37860297 PMCid:PMC10582267**

Lonati S, Quiroga BF, Zehnder C, and Antonakis J (2018). On doing relevant and rigorous experiments: Review and recommendations. Journal of Operations Management, 64: 19-40. https://doi.org/10.1016/j.jom.2018.10.003

Magableh IS and Abdullah A (2022). Differentiated instruction effectiveness on the secondary stage students' reading comprehension proficiency level in Jordan. International Journal of Evaluation and Research in Education, 11(1): 459-466. https://doi.org/10.11591/ijere.v11i1.21971

Mahoney J and Hall C (2017). Using technology to differentiate and accommodate students with disabilities. E-Learning and Digital Media, 14(5): 291-303. https://doi.org/10.1177/2042753017751517

Matuk CF, Linn MC, and Eylon BS (2015). Technology to support teachers using evidence from student work to customize technology-enhanced inquiry units. Instructional Science, 43: 229-257. https://doi.org/10.1007/s11251-014-9338-1

McKnight K, O'Malley K, Ruzic R, Horsley MK, Franey JJ, and Bassett K (2016). Teaching in a digital age: How educators use technology to improve student learning. Journal of Research on Technology in Education, 48(3): 194-211. https://doi.org/10.1080/15391523.2016.1175856

Meng S (2023). Enhancing teaching and learning: Aligning instructional practices with education quality standards. Research and Advances in Education, 2(7): 17-31. https://doi.org/10.56397/RAE.2023.07.04

Montgomery D (2022). Integrating technology with instructional frameworks to support all learners in inclusive classrooms. The Open/Technology in Education, Society, and Scholarship Association Journal, 2(2): 1-16. https://doi.org/10.18357/otessaj.2022.2.2.31

Morgan H (2014). Maximizing student success with differentiated learning. The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 87(1): 34-38. https://doi.org/10.1080/00098655.2013.832130

Mugendawala H and Muijs D (2020). Educational process factors for effective education in resource-constrained countries: A multilevel analysis. School Effectiveness and School Improvement, 31(3): 445-467. https://doi.org/10.1080/09243453.2019.1702562

Najemi S, Ardiasih LS, and Sundari H (2024). The effectiveness of google sites in differentiated instruction to increase students' learning motivation and reading comprehension on English narrative texts. ELT-Lectura, 11(2): 110-122. https://doi.org/10.31849/elt-lectura.v11i2.21768

Neitzel AJ, Lake C, Pellegrini M, and Slavin RE (2022). A synthesis of quantitative research on programs for struggling readers in elementary schools. Reading Research Quarterly, 57(1): 149-179. https://doi.org/10.1002/rrq.379

Nevo E, Brande S, and Shaul S (2016). The effects of two different reading acceleration training programs on improving reading skills of second graders. Reading Psychology, 37(4): 533-546. https://doi.org/10.1080/02702711.2015.1066911

Nicholas M, Veresov N, and Clark JC (2021). Guided reading–Working within a child's zone of proximal development. Learning, Culture and Social Interaction, 30: 100530. https://doi.org/10.1016/j.lcsi.2021.100530

Nordström T, Nilsson S, Gustafson S, and Svensson I (2018). Assistive technology applications for students with reading difficulties: Special education teacher's experiences and perceptions. Disability and Rehabilitation: Assistive Technology, 14(8): 798-808. https://doi.org/10.1080/17483107.2018.1499142 **PMid:30239256**

Peters MT, Hebbecker K, and Souvignier E (2022). Effects of providing teachers with tools for implementing assessment-based differentiated reading instruction in second grade. Assessment for Effective Intervention, 47(3): 157-169. https://doi.org/10.1177/15345084211014926

Pozas M, Letzel V, and Schneider C (2020). Teachers and differentiated instruction: Exploring differentiation practices to address student diversity. Journal of Research in Special Educational Needs, 20(3): 217-230. https://doi.org/10.1111/1471-3802.12481

Putri RDF, Hadi MS, and Mutiarani M (2021). The efficacy of Instagram @Gurukumrd as the media in improving students' reading skills. Journal of Languages and Language Teaching, 9(3): 350-355. https://doi.org/10.33394/jollt.v9i3.3795

Puzio K, Colby GT, and Algeo-Nichols D (2020). Differentiated literacy instruction: Boondoggle or best practice? Review of Educational Research, 90(4): 459-498. https://doi.org/10.3102/0034654320933536

Reid JM (1987). The learning style preferences of ESL students. TESOL Quarterly: Quarterly Peer-Reviewed Academic Journal, 21(1): 87-111. https://doi.org/10.2307/3586356

Roddy C, Amiet DL, Chung J, Holt C, Shaw L, McKenzie S, Garivaldis F, Lodge JM, and Mundy ME (2017). Applying best practice online learning, teaching, and support to intensive online environments: An integrative review. Frontiers in Education, 2: 59. https://doi.org/10.3389/feduc.2017.00059

Roskos K, Brueck J, and Lenhart L (2017). An analysis of e-book learning platforms: Affordances, architecture, functionality and analytics. International Journal of Child-Computer Interaction, 12: 37-45. https://doi.org/10.1016/j.ijcci.2017.01.003

Sabag-Shushan T and Katzir T (2024). Emotional understanding in reading comprehension at the text, task, and reader levels: a comparison of diverse struggling readers. Reading and Writing, 37(8): 1905-1929. https://doi.org/10.1007/s11145-023-10447-x

Sabri SM, Ismail I, Annuar N, Rahman NRA, Abd Hamid NZ, and Abd Mutalib H (2024). A conceptual analysis of technology integration in classroom instruction towards enhancing student engagement and learning outcomes. Integration, 9(55): 750-769. https://doi.org/10.35631/IJEPC.955051

Sajja R, Sermet Y, Cikmaz M, Cwiertny D, and Demir I (2024). Artificial intelligence-enabled intelligent assistant for personalized and adaptive learning in higher education. Information, 15(10): 596. https://doi.org/10.3390/info15100596

Scammacca NK, Roberts GJ, Cho E, Williams KJ, Roberts G, Vaughn SR, and Carroll M (2016). A century of progress: Reading interventions for students in grades 4–12, 1914–2014. Review of Educational Research, 86(3): 756-800. https://doi.org/10.3102/0034654316652942 **PMid:28529386 PMCid:PMC5436613**

Shaunessy-Dedrick E, Evans L, Ferron J, and Lindo M (2015). Effects of differentiated reading on elementary students'

reading comprehension and attitudes toward reading. Gifted Child Quarterly, 59(2): 91-107. https://doi.org/10.1177/0016986214568718

Silinskas G, Pakarinen E, Niemi P, Lerkkanen MK, Poikkeus AM, and Nurmi JE (2016). The effectiveness of increased support in reading and its relationship to teachers' affect and children's motivation. Learning and Individual Differences, 45: 53-64. https://doi.org/10.1016/j.lindif.2015.11.025

Smale-Jacobse AE, Meijer A, Helms-Lorenz M, and Maulana R (2019). Differentiated instruction in secondary education: A systematic review of research evidence. Frontiers in Psychology, 10: 2366. https://doi.org/10.3389/fpsyg.2019.02366 **PMid:31824362 PMCid:PMC6883934**

Spear-Swerling L (2019). Structured literacy and typical literacy practices: Understanding differences to create instructional opportunities. Teaching Exceptional Children, 51(3): 201-211. https://doi.org/10.1177/0040059917750160

Suggate SP (2016). A meta-analysis of the long-term effects of phonemic awareness, phonics, fluency, and reading comprehension interventions. Journal of Learning Disabilities, 49(1): 77-96. https://doi.org/10.1177/0022219414528540 **PMid:24704662**

Suprayogi MN, Valcke M, and Godwin R (2017). Teachers and their implementation of differentiated instruction in the classroom. Teaching and Teacher Education, 67: 291-301. https://doi.org/10.1016/j.tate.2017.06.020

Supriadi U, Supriyadi T, and Abdussalam A (2022). Al-Qur'an literacy: A strategy and learning steps in improving Al-Qur'an reading skills through action research. International Journal of Learning, Teaching and Educational Research, 21(1): 323-339. https://doi.org/10.26803/ijlter.21.1.18

Suryati I and Ratih K (2024). How can teachers tailor success? Innovative strategies for content, process, and product in EFL classrooms. Voices of English Language Education Society, 8(1): 150-162. https://doi.org/10.29408/veles.v8i1.24451

Tammelin-Laine T and Martin M (2015). The simultaneous development of receptive skills in an orthographically transparent second language. Writing Systems Research, 7(1): 39-57. https://doi.org/10.1080/17586801.2014.943148

Taş E (2024). Data literacy education through university-industry collaboration. Information and Learning Sciences, 125(5/6): 389-405. https://doi.org/10.1108/ILS-06-2023-0077

Valiandes S (2015). Evaluating the impact of differentiated instruction on literacy and reading in mixed ability classrooms: Quality and equity dimensions of education effectiveness. Studies in Educational Evaluation, 45: 17-26. https://doi.org/10.1016/j.stueduc.2015.02.005

Wang Y (2023). Enhancing English reading skills and self-regulated learning through online collaborative flipped classroom: A comparative study. Frontiers in Psychology, 14: 1255389. https://doi.org/10.3389/fpsyg.2023.1255389 **PMid:37908818 PMCid:PMC10613993**

Wanzek J, Vaughn S, Scammacca N, Gatlin B, Walker MA, and Capin P (2016). Meta-analyses of the effects of tier 2 type reading interventions in grades K-3. Educational Psychology Review, 28: 551-576. https://doi.org/10.1007/s10648-015-9321-7 **PMid:27594774 PMCid:PMC5007082**

Wigfield A, Gladstone JR, and Turci L (2016). Beyond cognition: Reading motivation and reading comprehension. Child Development Perspectives, 10(3): 190-195. https://doi.org/10.1111/cdep.12184 **PMid:27617030 PMCid:PMC5014370**

Wulandari CE, Firdaus FA, and Saifulloh F (2024). Promoting inclusivity through technology: A literature review in educational settings. Journal of Learning and Technology, 3(1): 19-28. https://doi.org/10.33830/jlt.v3i1.9731

Xia Y, Shin SY, and Kim JC (2024). Cross-cultural intelligent language learning system (CILS): Leveraging AI to facilitate language learning strategies in cross-cultural communication. Applied Sciences, 14: 5651. https://doi.org/10.3390/app14135651

Yan D and Li G (2024). Students' internal driving force or environment external driving force? Configuring digital learning power heterogeneity in a smart education environment. Interactive Learning Environments, 32(10): 6509-6533. https://doi.org/10.1080/10494820.2023.2266496

Yusnan M, Iye R, and Abbas A (2022). Demonstration methods to improve intensive reading skills in 3rd-grade students. International Journal of Learning Reformation in Elementary Education, 1(02): 61-69. https://doi.org/10.56741/ijlree.v1i02.96

Zoski JL, Nellenbach KM, and Erickson KA (2018). Using morphological strategies to help adolescents decode, spell, and comprehend big words in science. Communication Disorders Quarterly, 40(1): 57-64. https://doi.org/10.1177/1525740117752636