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AI-Enhanced Structured Literacy Intervention for Secondary Students: A Case Study of Science of Reading

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ABSTRACT: *This study examines the effectiveness of Lexia PowerUp, an AI-powered literacy program, for sixth-grade students requiring Tier 3 reading intervention. Seven sixth-grade students (six boys, one girl; five African American, two Caucasian; all qualifying for free/reduced lunch) participated in a six-month intervention combining 50 minutes of daily small-group instruction with individualized Lexia PowerUp usage. Researchers measured progress through Achieve 3000 Lexile assessments and Lexia PowerUp performance data across three skill strands: Word Study, Grammar, and Comprehension. All participants demonstrated Lexile level improvements from beginning-of-year to mid-year assessments, though students remained below sixth-grade benchmarks (925-1070L). Analysis of Lexia PowerUp progression showed movement from foundational to intermediate levels, with 50% of students advancing in Word Study and 75% reaching intermediate level in Comprehension (up from 63%). However, all students remained at foundational level in Grammar throughout the study period. Individual progress varied considerably across strands, with some students gaining over 100 units in specific areas while showing minimal growth in others. The study highlights potential benefits of combining AI-driven adaptive learning with teacher-led instruction for struggling secondary readers, though results indicate continued need for intensive support to achieve grade-level proficiency. This study addresses the understudied population of Tier 3 secondary readers by examining AI-powered reading intervention specifically for sixth-grade students requiring the most intensive literacy support, an area with limited empirical research.*

Key words*: Artificial intelligence, Lexia PowerUp, reading intervention, secondary education, structured literacy.*

1. Introduction

Reading proficiency represents a fundamental skill necessary for both personal development and professional advancement in modern society (Ademola, 2024). Recent data from the Virginia Department of Education (VDOE, 2024) reveal alarming statistics: one in three kindergartens to second-grade students in Virginia reads below benchmark levels. This literacy crisis extends to secondary education, where numerous middle and high school students have failed to master fundamental reading skills (Canbolat, 2024). The COVID-19 pandemic further exacerbated these challenges, with assessment data showing that despite initial recovery, reading achievement scores remain below pre-pandemic levels and have stagnated in recent years.

To address these persistent literacy gaps, educational systems are increasingly exploring innovative approaches, including the integration of artificial intelligence (AI) technologies. Since the introduction of advanced natural language processing (NLP) systems like ChatGPT, interest in AI applications for education has surged. According to Libertino (2024), these NLP systems identify, process, and generate information for users. In the context of reading intervention, AI demonstrates particular promise in its ability to identify individual student needs, process this information, and generate instructional content tailored to each student's zone of proximal development (Vygotsky 1978).

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The Virginia Literacy Act (VLA), implemented in 2022 and expanded in 2023, emphasizes the importance of explicit literacy instruction grounded in science-based reading research (VDOE, 2024). This approach aligns with structured literacy principles, which incorporate explicit, systematic, cumulative, hands-on, engaging, multimodal, diagnostic, and responsive instructional methods (Lexia 2024). AI-powered adaptive learning programs offer potential alignment with these principles by providing personalized instruction based on individual student needs.

This study examines the implementation and effectiveness of one such AI-powered program, Lexia PowerUp, as a reading intervention tool for struggling sixth-grade readers. The research aims to contribute to our understanding of how AI-enhanced structured literacy interventions may address reading deficiencies in secondary students, while also considering the ethical implications of integrating AI technologies in educational settings. As Yedjou et al. (2024) note, the integration of AI in educational contexts brings both opportunities and challenges that require careful consideration.

2. Literature Review

2.1. The Science of Reading and Structured Literacy

The Science of Reading (SOR) represents a comprehensive, evidence-based approach to literacy instruction grounded in decades of interdisciplinary research. According to Seidenberg and Borkenhagen (2020), SOR emphasizes the critical role of systematic phonics instruction within a broader framework of literacy development. Structured literacy, which aligns with SOR principles, "incorporates explicit, systematic, cumulative instruction that engages students through multisensory methods while remaining diagnostic and responsive to individual needs" (International Dyslexia Association, 2019, p. 3). This approach is particularly effective for struggling readers, as it addresses the fundamental components identified in Scarborough's Reading Rope model (Figure 2), which conceptualizes skilled reading as the intertwining of word recognition and language comprehension strands (Scarborough, 2001). As Shanahan (2020) notes, structured literacy interventions that incorporate these evidence-based practices consistently demonstrate superior outcomes compared to less systematic approaches, especially for students with reading difficulties.

The theoretical foundation for effective reading instruction has been significantly shaped by the Simple View of Reading (SVR) by Gough and Tunmer (1986). This model establishes that reading comprehension is the product of two essential components: decoding ability and language comprehension. Breaking down the SVR even further is a set of sub-skills as represented in Scarborough’s Reading Rope. Scarborough's Reading Rope further elaborates on this model by delineating the subskills that contribute to word recognition and language comprehension, emphasizing the importance of strengthening both components to enhance reading comprehension.

Structured literacy, as defined by the International Dyslexia Association, represents an instructional approach that aligns with these research-based models. This approach incorporates explicit, systematic, cumulative instruction that engages students through multisensory methods while remaining diagnostic and responsive to individual needs (Lexia, 2024). While science of reading research indicates that children generally learn to read through similar processes, the structured literacy approach acknowledges that individual learners may require different levels of practice and may benefit from varied instructional modalities.

2.2. AI-Powered Reading Interventions

Adaptive reading programs enhanced by artificial intelligence offer promising avenues for implementing structured literacy principles through technology. This personalization can potentially increase student engagement, which in turn may lead to improved performance. Research by Chen, Chen, and Lin (2020) provides a comprehensive review of AI applications in education, highlighting how machine learning algorithms can analyze student performance patterns to deliver targeted instruction. Ng et al. (2024) specifically examined AI literacy education in secondary schools, noting that AI tools can provide scaffolded learning experiences that adapt to students' specific needs while collecting and analyzing performance data to inform instructional decisions.

Lexia PowerUp represents one such AI-driven program designed specifically for students in grades 6-12 who are at risk of not meeting literacy outcomes (Lexia Learning, 2024). The program is structured around three main components: Word Study, Grammar, and Comprehension (Hurwitz, Macaruso, Thang, & Studwell,

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2022). Following an initial assessment, students are placed in one of three skill zones, foundational (K-2), intermediate (3-5), or advanced (6-8), with each zone comprising multiple levels containing 4-7 interactive activities. These activities incorporate audio and visual input, immediate feedback, scaffolding, and practice opportunities to enhance engagement and learning.

Research by Canbolat and Arndt (2024) suggests that Lexia PowerUp can effectively increase reading levels, particularly among English Language Learners (ELLs). Similarly, Sidwell et al. (2024) explored how text-generative AI can be utilized to create oral reading fluency probes that target specific reading skills, demonstrating additional applications of AI in literacy intervention. However, researchers have noted mixed results regarding the optimal duration of time spent on computer-assisted programs (Canbolat & Arndt, 2024). Lexia PowerUp addresses this consideration by recommending specific usage times based on students' initial skill levels and ongoing progression.

2.3. Ethical Considerations in Educational AI Applications

Despite the potential benefits of AI-powered learning tools, several ethical considerations warrant attention. Okwara et al. (2024) identify data privacy, algorithmic bias, and over-reliance on technology as primary concerns when implementing AI in educational settings. Yedjou et al. (2024) further note the potential for inaccuracies in AI-generated content and emphasize the importance of human oversight in educational AI applications.

Libertino (2024) explores how AI can be reimagined as a literacy intervention tool in English Language Arts classrooms, suggesting that middle school students use AI-generated content only as a supporting resource, emphasizing the continued importance of intellectual development and authentic learning experiences. This perspective aligns with concerns about maintaining the balance between technological assistance and human-directed learning.

To address these concerns, Parra (2024) suggest that schools implement policies to ensure equitable access to AI technologies, provide professional development opportunities for teachers on appropriate AI use, and position AI as an enhancement to learning rather than a replacement for teacher-student interaction. Similarly, Ng et al. (2024) advocate for comprehensive AI literacy education in secondary schools to help students and teachers understand both the capabilities and limitations of AI tools. These considerations inform a balanced approach to AI integration that maximizes benefits while mitigating potential risks.

3. Method

3.1. Research Questions

This study sought to address the following research questions:

1. To what extent does the AI-powered Lexia PowerUp program improve reading proficiency among sixth-grade students requiring Tier 3 reading intervention?
2. How do students progress through the three main strands (Word Study, Grammar, and Comprehension) of the Lexia PowerUp program?
3. What is the relationship between time spent using the program and student reading growth?

3.2. Participants

The study included seven sixth-grade students identified as requiring Tier 3 intervention services in Reading. Tier 3 reading intervention is the most intensive level of support for students who continue to struggle with reading after receiving help in Tiers 1 and 2. It involves highly individualized instruction, often delivered one-on-one or in very small groups, with a strong focus on foundational reading skills like phonics, fluency, and comprehension. Instruction is more frequent and longer in duration, using targeted, research-based strategies. The goal is to close significant skill gaps and help students make meaningful progress toward grade-level reading. These students were referred by the elementary reading coach based on their fifth-grade Reading SOL (Standards of Learning) scores and other informal assessments. None of the participants passed the Reading SOL, and all were identified as needing intervention. The demographic composition included six boys and one girl; five students identified as African American and two as Caucasian. All participants qualified for free or reduced lunch. None of the students had an Individualized Education Program (IEP).

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3.3. Intervention Procedure

Participants received 50 minutes of daily Tier 3 Reading intervention in a separate classroom setting. The intervention combined small-group instruction with individualized time using the Lexia PowerUp program. Students took their initial placement tests on October 8, 2024, establishing baseline performance levels in each of the three program strands.

3.4. Data Collection

Data collection included multiple measures to assess student progress:

1. Achieve 3000 Lexile levels: Collected at the beginning of the year (BOY) and mid-year (see Table 1).
2. Lexia PowerUp performance data:

- Initial placement level after assessment
- Current level as of April 1, 2025
- Units gained in each strand (Word Study, Grammar, and Comprehension)

3.5. Data Analysis

Comparative analysis examined student performance from the beginning of the year (September 2024) through April 1, 2025. The analysis focused on changes in Lexile levels and progression through the Lexia PowerUp program strands. Contextual factors affecting progress were also noted, including assessment administration conditions and instructional time lost due to inclement weather (10 days during the 2024-25 school year as of April 1, 2025).

4. Results

4.1. Lexile Level Growth

All participants demonstrated improvement in Achieve 3000 Lexile levels from the beginning of the year to mid-year assessment, as shown in Table 1. However, it should be noted that assessment administration conditions differed between the two testing periods; students were allowed to complete the beginning-of-year assessment over several class periods but were limited to one 50-minute class period for the mid-year assessment.

Table 1. Lexile Levels from Beginning of Year to Mid-Year.

Student	Achieve 3000 (BOY)	Achieve 3000 (Mid-Year)
DB	120	405
JB	355	530
DC	405	475
JC	470	495
AE	510	615
EM	400	475
LT	160	325

Despite these improvements, all students remained significantly below grade-level benchmarks according to Lexile measure norms for sixth-grade reading (925-1070).

4.2. Lexia PowerUp Placement and Progression

Table 2 shows the general distribution of students across placement zones at initial assessment and as of April 1, 2025.

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Table 2. Lexile measure norms for Reading by grade.

50th to 90th percentile student lexile measure norms for reading by grade	
Grade	**End-of-Year Student Measures (50th to 90th percentile)**
K	BR160L to 150L
1	165L to 565L
2	425L to 790L
3	645L to 980L
4	850L to 1155L
5	950L to 1255L
6	1030L to 1335L
7	1095L to 1405L
8	1155L to 1465L
9	1205L to 1515L
10	1250L to 1605L
11 & 12	1295L to 1605L

Source: https://www.metametricsinc.com.

Notably, no students placed in or progressed to the advanced zone in any strand. The shift in percentages indicates that some students moved from the foundational to the intermediate zone in both Word Study and Comprehension strands, while all students remained in the foundational zone for Grammar.

4.3. What is a Lexile Measure?

A Lexile is a unit of measurement used to assess both a person's reading ability and the difficulty level of text materials. The Lexile Framework for Reading is an educational tool that matches readers with texts at appropriate difficulty levels.

Lexile measures:

- Are represented by a number followed by an "L" (like 750L)
- Typically range from below 0L for beginning readers to above 1600L for advanced readers
- Help identify texts that are neither too easy nor too difficult for a reader

For students, a Lexile measure represents their reading ability based on standardized reading assessments. For books and other texts, a Lexile measure indicates the text's complexity based on factors like vocabulary and sentence structure.

The main purpose of the Lexile Framework is to:

- Match readers with appropriately challenging reading materials
- Track reading growth over time
- Help teachers differentiate instruction
- Support students in developing reading skills by providing "just right" texts (not too easy, not too hard)

The Lexile measures are correlated with Virginia's Standards of Learning (SOL) performance levels to help educators understand how standardized test performance relates to reading ability. For each grade level, reading ability is categorized into three performance levels:

- "Basic" indicates below-grade-level reading performance
- "Pass/Proficient" represents grade-level reading performance
- "Pass/Advanced" signifies above-grade-level reading performance

The numbers with an "L" suffix represent Lexile measures, which quantify a student's reading ability and text complexity. For example, a 3rd grader reading at 650L would be in the "Pass/Proficient" range for their grade, while 875L or higher would place them in the "Pass/Advanced" category.

These benchmarks help educators and parents understand if a student's reading level meets grade-level expectations and can guide appropriate reading material selection and instructional interventions.

4.4. Units Gained by Strand

Table 3 details the units gained by each student in the three program strands between October 8, 2024, and April 1, 2025. This table shows progress in the percentage of participating students working in each zone after initial placement. The placement and progress data from Lexia PowerUp indicate important shifts in students'

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reading development across three strands: Word Study, Grammar, and Comprehension. Notably, no students were placed in or progressed to the Advanced zone in any of the strands, suggesting that while gains were made, more intensive instruction may still be needed to accelerate growth.

Table 3. Lexia PowerUp Placement Data.

Strand	Placement %	Current %
Word Study	63% Foundational 38% Intermediate	50% Foundational 50% Intermediate
Grammar	100% Foundational	100% Foundational
Comprehension	38% Foundational 63% Intermediate	25% Foundational 75% Intermediate

Encouragingly, we see evidence of movement from Foundational to Intermediate levels in both Word Study and Comprehension strands:

- In Word Study, the percentage of students in the Foundational zone decreased from 63% to 50%**,** with a corresponding increase in Intermediate-level students from 38% to 50%**.**
- In Comprehension, growth was even more pronounced: students in the Intermediate zone rose from 63% to 75%**,** while those in the Foundational zone dropped from 38% to 25%**.**

However, Grammar remains an area of concern. All students began in the Foundational zone and remained there, with no movement into higher tiers by April 1, 2025. This stagnation may point to the need for targeted support or instructional adjustments in this area.

It is worth noting that no students in this intervention group placed in the advanced zone nor are there any students who are currently working in this zone. These students, however, have made progress as shown by the Table 4 below, which shows the number of units gained in each strand per student.

Table 4. Units Gained in Each Strand Per Student.

Student	Units Gained Word Study	Units Gained Grammar	Units Gained Comprehension
DB	83	49	64
JB	52	15	152
DC	106	28	29
JC	105	24	35
AE	37	51	61
EM	45	27	23
LT	23	17	7

Students took their initial placement tests on 10/8/24. Factors affecting growth include the amount of time spent on skills in a specific strand. Lexia PowerUp allows four attempts in each sub-skill before they are flagged for a lesson. At that point, the teacher is notified and will need to provide 1:1 instruction for that skill (Lexia).

Results of the data reveal that all students receiving intervention improved their Lexile levels and made gains in word study, grammar, and comprehension using Lexia PowerUp. Although these students are still below grade level, they have made improvements, which is promising.

Considerable variation is evident in the number of units gained across students and strands. For example, JB made substantial progress in Comprehension (152 units) but showed more modest gains in Word Study (52 units) and Grammar (15 units). Conversely, DC and JC gained over 100 units in Word Study but fewer in Grammar and Comprehension.

A notable program feature affected progression through the units: Lexia PowerUp allows four attempts in each sub-skill before flagging students for teacher-led instruction. At that point, the teacher receives notification and provides one-on-one instruction for that skill before the student can continue.

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5. Discussion

5.1. Interpretation of Findings

The results suggest that AI-powered literacy intervention through Lexia PowerUp, combined with small-group instruction, contributed to reading growth among the participating sixth-grade students. All students demonstrated improvement in Lexile levels, though they remained below grade-level benchmarks. This finding aligns with previous research by Canbolat and Arndt (2024), which found Lexia PowerUp effective in increasing reading levels among struggling readers.

The varying patterns of progress across the three program strands (Word Study, Grammar, and Comprehension) suggest that students have different strengths and growth areas in their reading development. This variation supports the value of personalized intervention approaches, which AI-powered programs like Lexia PowerUp are designed to provide. The program's ability to identify specific skill deficits and adjust instruction accordingly represents a practical application of structured literacy principles, which emphasize diagnostic and responsive teaching (Lexia, 2025).

The observation that no students placed in or progressed to the advanced zone highlights the significant reading challenges faced by the participants. This finding underscores the importance of early intervention and sustained support for students with reading difficulties, as emphasized by the Virginia Literacy Act's recent expansion to include grades 4-8 (VDOE, 2025).

5.2. Limitations

Several limitations should be considered when interpreting the results of this study:

1. Sample size: The small sample of seven students limits the generalizability of findings.
2. Absence of control group: Without a comparison group receiving traditional intervention without AI support, it is difficult to isolate the specific impact of the Lexia PowerUp program.
3. Assessment conditions: The different administration conditions for beginning-of-year and mid-year Lexile assessments (multiple periods versus one 50-minute period) may have influenced the measured growth.
4. Instructional time: The loss of 10 instructional days due to inclement weather potentially limited student progress.
5. Time frame: The study covered approximately six months of intervention, which may be insufficient to observe substantial improvements in reading proficiency for students with significant deficits.
6. Multiple variables: The intervention combined Lexia PowerUp usage with small-group instruction, making it difficult to attribute outcomes specifically to the AI-powered program.

5.3. Implications for Practice

Despite these limitations, the study offers several implications for educational practice:

1. Structured literacy support: The results suggest that AI-powered programs like Lexia PowerUp can provide valuable supplementary support for implementing structured literacy approaches with struggling secondary readers.
2. Personalized intervention: The varying patterns of progress across program strands highlight the importance of personalized intervention approaches that target specific skill deficits.
3. Blended approach: The combination of technology-enhanced instruction and teacher-led small-group intervention appears beneficial, supporting Parra (2024) recommendation that AI should enhance rather than replace teacher-student interaction.
4. Progress monitoring: The detailed tracking of student progress through Lexia PowerUp provides valuable data for ongoing adjustment of intervention strategies.

5.4. Ethical Considerations

As schools increasingly adopt AI-powered educational tools, ethical considerations deserve continued attention. This study supports Okwara et al.'s (2024) emphasis on addressing data privacy, algorithmic bias, and potential over-reliance on technology. Yedjou et al. (2024) further identify concerns about the ethical implications of AI in educational settings, particularly regarding student data protection and the need for maintaining human judgment in educational decision-making.

Schools implementing similar interventions should establish clear policies regarding:

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1. Protection of student data collected through AI-powered programs
2. Regular evaluation of program algorithms for potential bias
3. Balanced integration of technology and teacher-led instruction
4. Professional development for teachers on appropriate use of AI tools
5. Equity of access to ensure all students benefit from technological innovations

Parra (2024) emphasize that AI should be viewed as a tool to enhance teaching and learning rather than replace critical human elements of education. This perspective aligns with our finding that the combination of AI-powered instruction and teacher-led intervention appeared most beneficial for student progress.

6. Conclusion

This study provides preliminary evidence supporting the potential of AI-powered literacy intervention tools, specifically Lexia PowerUp, to contribute to reading improvement among struggling sixth-grade readers. The observed growth in Lexile levels and progression through program strands, though modest, suggests that AI-enhanced structured literacy approaches may offer valuable support for secondary students with reading difficulties.

Future research should address the limitations of this study through larger samples, control group designs, and longer intervention periods. Additionally, investigations into the specific features of AI-powered programs that most effectively support reading development would enhance our understanding of how to optimize these tools for diverse learners.

As educational technology continues to evolve, maintaining a balanced approach that leverages the benefits of AI while preserving meaningful human interaction in the learning process remains essential. When thoughtfully implemented as part of a comprehensive intervention strategy, AI-powered literacy tools have the potential to help address the persistent reading challenges faced by many secondary students.

Declaration of AI Usage:

AI tools were utilized to assist in refining language, checking for grammatical accuracy, and ensuring overall clarity of the writing. All content, ideas, and analyses presented in this proposal are original and created by the author(s), with AI serving solely as a technical aid to enhance the readability and coherence of the text.

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International Journal of Educational Studies
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