



Enhancing Early Reading Skills Through Syllable Card Media: A Quasi-Experimental Study Among First-Grade Elementary Students in Indonesia

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Abstract: Early reading skills are very important for elementary school students' future academic success, but many struggle to learn to read and become fluent. Reading science-based learning methods stresses structured phonological learning to help kids learn to read early on. The objective of this study was to evaluate the efficacy of syllable flashcards in enhancing early reading skills among first-grade elementary school students. We used a quantitative quasi-experimental design with a non-equivalent control group. There were 62 students at Lemah Abang Public Elementary School in Kasemen District, Serang City, Indonesia. The experimental group was taught using syllable flashcards, while the control group learned in the usual way, using textbooks. We gathered data by administering a pre-test and a post-test that measured six aspects of students' early reading skills. Statistical analysis using paired and independent-samples t-tests indicated a significant improvement in students' reading performance post-intervention ($p < 0.05$). The experimental group exhibited significantly elevated post-test scores, characterized by substantial within-group and moderate between-group effect sizes, signifying a significant educational impact. These results show that syllable card media can improve phonological decoding and support steady early reading development. This has practical implications for evidence-based literacy teaching and for elementary school practices aligned with SDG 4: Quality Education.

Keywords: Early Reading Skills; Syllable Card Media; Primary Education Literacy; Quality Education

Abstrak: Kemampuan membaca permulaan siswa SD merupakan dasar fundamental bagi prestasi akademik mereka di masa depan, namun banyak pembaca pemula mengalami kesulitan dalam menguraikan bahasa tulis dan mengembangkan kelancaran membaca. Pendekatan pembelajaran yang selaras dengan ilmu membaca menekankan pembelajaran fonologis terstruktur untuk mendukung perkembangan literasi awal. Studi ini bertujuan untuk menguji efektivitas media kartu suku kata dalam meningkatkan kemampuan membaca awal di kalangan siswa kelas satu sekolah dasar. Sebanyak 62 siswa dari SD Negeri Lemah Abang, Kecamatan Kasemen, Kota Serang, Indonesia, berpartisipasi dalam desain kuantitatif kuasi-eksperimental dengan kelompok kontrol yang tidak setara. Kelompok eksperimen menerima pengajaran menggunakan media kartu suku kata, sedangkan kelompok kontrol mengikuti pembelajaran berbasis buku teks konvensional. Data dikumpulkan

melalui penilaian pre-tes dan pos-tes yang mengukur enam indikator kemampuan membaca awal. Analisis statistik menggunakan uji-t sampel berpasangan dan independen menunjukkan peningkatan signifikan dalam kinerja membaca siswa setelah intervensi ($p < 0,05$). Kelompok eksperimen menunjukkan skor pasca-tes yang jauh lebih tinggi dengan ukuran efek dalam kelompok yang besar dan ukuran efek antar kelompok yang sedang, menunjukkan dampak pendidikan yang bermakna. Temuan ini menunjukkan bahwa media kartu suku kata secara efektif memperkuat proses penguraian fonologis dan mendukung perkembangan membaca awal yang konsisten, memberikan implikasi praktis untuk pengajaran literasi berbasis bukti dan praktik pendidikan dasar yang selaras dengan SDG 4 Pendidikan Berkualitas.

Kata Kunci: Keterampilan Membaca Awal; Media Kartu Suku Kata; Literasi Pendidikan Dasar; Pendidikan Berkualitas

Introduction

The acquisition of early reading skills by students is a pivotal phase in a child's educational trajectory, as literacy functions as a conduit to subsequent academic learning (Nagler et al., 2018; Zugarramurdi et al., 2022). Many studies have shown that students who do not learn to decode well in the first few years of school are more likely to do poorly in school for a long time and to be less interested in learning (Câmara-Costa et al., 2016; Hotulainen et al., 2010; Judge, 2013). Consequently, early literacy development is increasingly regarded not merely as a linguistic outcome but as a cognitive developmental process that integrates phonological processing, orthographic mapping, and linguistic comprehension.

In the context of reading science, phonological awareness has been recognized as a significant predictor of early reading achievement across various languages and educational settings. Sulistianti et al. (2025) and Almeida (2024) conducted empirical studies showing that how well children can separate, combine, and manipulate sound units is a strong predictor of how well they can decode and recognize words and become fluent readers. Research conducted by Gioia et al. (2026) indicates that phonological awareness is inadequate in isolation; learners must concurrently cultivate an understanding of the alphabetic principle, which associates sounds with written symbols and facilitates effective reading acquisition. Experimental studies conducted by Kiss and Csapó (2025) and Brooks et al. (2025) underscore the necessity for early literacy instruction to explicitly incorporate syllable- and phoneme-level learning activities alongside print exposure, thereby enhancing grapheme-phoneme mapping and cognitive decoding efficiency. These findings collectively substantiate the theoretical claim that reading is not inherently acquired but requires structured instructional support.

Even though there is widespread agreement on the theory, many school systems still use traditional teaching methods that focus on reading textbooks and teacher explanations rather than structured phonological interactions. Such methodologies often limit students' opportunities to actively manipulate linguistic units, resulting in deficient decoding skills among novice readers. Research in neuroscience concerning literacy acquisition demonstrates that interactive, structured phonological activities markedly enhance early reading comprehension by fortifying sound-symbol associations within learners' cognitive processing frameworks (Bach et al., 2010; Craig, 2006; Kurnia et al., 2025; Lee & Kim, 2025; Nagler et al., 2018). As a result, more and more scholars are advocating for teaching tools that turn abstract language structures into real-world learning experiences, enabling young students to build their reading skills through active engagement.

Syllable flashcards (Écalle et al., 2021; Müller et al., 2020, 2021) are a promising yet underutilized learning tool that allows students to physically rearrange syllables to form simple words and sentences. From a cognitive standpoint, syllable segmentation alleviates intrinsic cognitive load by presenting linguistic units in manageable segments (Drienkó, 2018; Rey et al., 2019; Segawa et al., 2019), thereby facilitating working memory processing during word decoding tasks. Prior studies have explored phonics instruction (Moats, 2019; Piasta & Hudson, 2022), vocabulary interventions (Rahn et al., 2023; Requa et al., 2022), and digital literacy tools (Marques de Souza et al., 2022; Wilkes et al., 2020); however, empirical research concentrating on low-tech syllable-based interventions for lower elementary students remains scarce. Current research predominantly emphasizes technology-enhanced learning environments, leading to a lack of understanding of the efficacy of straightforward learning tools educators can use to yield significant literacy improvements in authentic classroom contexts.

This gap becomes especially important in the early elementary grades, when few teaching materials are available, and teachers need evidence-based, easy-to-use, and effective strategies. This study underscores interventions that integrate theoretical robustness with practical applicability in the classroom. Nevertheless, empirical evidence from quasi-experimental studies investigating syllable-based instructional media in elementary school environments is limited. Consequently, additional research is required to determine whether syllable cards yield quantifiable improvements in early reading outcomes compared with traditional instructional methods.

To fill this gap, this study used a quasi-experimental non-equivalent control group design to examine how syllable cards affected first-grade students' early reading skills. This study seeks to furnish empirical evidence concerning the impact of syllable cards on the early reading skills of elementary school students. These findings enhance early literacy pedagogy, inform broader discussions on evidence-based learning innovations, and offer wide applicability in elementary education.

Method

1. Research Design

This research employed a quantitative, quasi-experimental design featuring a non-equivalent control group to evaluate the efficacy of syllable flashcards in enhancing early reading skills among first-grade elementary students. The research was conducted over four weeks during the initial semester of the 2025/2026 academic year at Lemah Abang Public Elementary School, located in the Kasemen District of Serang City, Indonesia. The researchers selected a quasi-experimental design to preserve intact class groups without random assignment, facilitate the intervention in authentic classroom settings, and enable causal comparisons among groups.

2. Participants and Sampling

There were 62 first-grade students at Lemah Abang Public Elementary School. A purposive sampling technique was utilized, predicated on analogous academic competencies and instructional viability. Class IA (n = 31) was the control group and learned to read in the usual way, using textbooks and teacher explanations. Class IB (n = 31) constituted the experimental group, engaging in learning activities utilizing syllable cards. Both groups had the same learning goals and the same instructional time to ensure equal treatment.

3. Research Instrument

We used a test of early reading skills that was based on six literacy indicators: (1) being able to recognize syllables, (2) being able to read syllables, (3) being able to combine syllables into words, (4) being able to read words, (5) being able to make simple sentences from syllables, and (6) being able to read simple sentences. The tool had structured objective-response items designed for the developmental needs of beginning readers. The test content aligned with the early literacy learning goals, ensuring validity and usefulness for classroom teaching.

4. Procedure

This study went through several steps. The researcher first worked with school administrators and teachers to ensure that the learning materials were consistent. Second, the researcher administered a pre-test to both groups to assess their reading ability. Third, the researcher carried out a learning intervention across four instructional sessions. The control group received traditional instruction, whereas the experimental group participated in organized learning activities utilizing syllable cards intended to facilitate phonological decoding. Fourth, the researcher administered a post-test to assess how the students' early reading skills had changed. Ethical considerations were upheld throughout the study, including obtaining institutional approval and safeguarding student data confidentiality. Figure 1 below shows the research procedures to make them easier to understand.

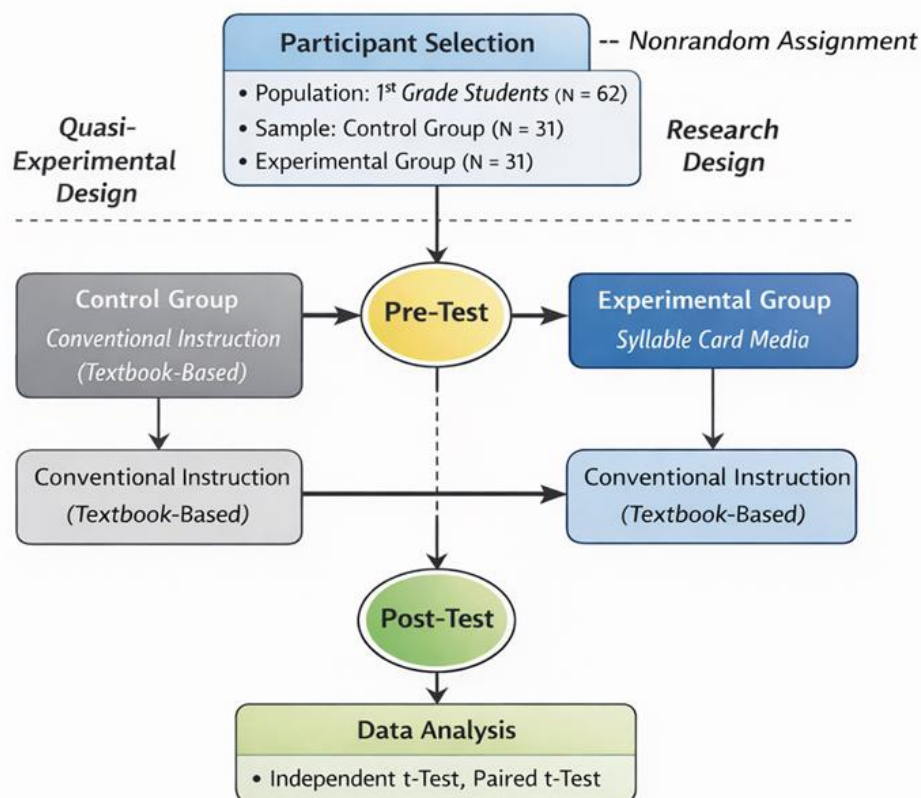


Figure 1. Research Design Methodology Flow

5. Data Analysis

We used SPSS version 22 to look at the data. Prior to testing the hypothesis, normality and homogeneity tests were employed to verify the assumptions and ensure the suitability of parametric statistical methods. We used independent-samples t-tests at the 0.05 significance level to assess differences in learning outcomes. We also used

paired-samples t-tests to determine how much better the scores were in each group from pre-test to post-test.

Result and Discussion

1. Result

a. Descriptive Statistics

To evaluate students' initial reading skills following the intervention, both the experimental and control groups underwent descriptive analysis. Table 1 below shows that both groups had the same average pre-test scores ($M = 58.68$). This shows that the students in both groups had similar reading skills before the intervention.

Table 1. Descriptive Statistics of Early Reading Scores

Group	Test	N	Mean	SD	Min	Max
Control	Pre-test	31	58.68	28.33	10	93
Control	Post-test	31	68.13	25.89	10	99
Experimental	Pre-test	31	58.68	30.24	10	93
Experimental	Post-test	31	82.32	18.05	30	100

Data processed from SPSS results

The large standard deviations in both groups ($SD = 30.24$ for the experimental group and $SD = 28.33$ for the control group) indicate substantial variation in students' reading ability at the outset. After the learning intervention, both groups got better at reading early on. Nevertheless, the two groups saw very different levels of improvement.

The experimental group, which learned with syllable cards, saw a big jump in their average score, from 58.68 to 82.32. The control group, which learned from regular textbooks, showed a smaller increase from 58.68 to 68.13. The experimental group's standard deviation also decreased on the post-test ($SD = 18.05$), indicating that students' performance was more consistent after the intervention. These descriptive results indicate that syllable cards may significantly enhance students' early reading skills in comparison to traditional teaching methods.

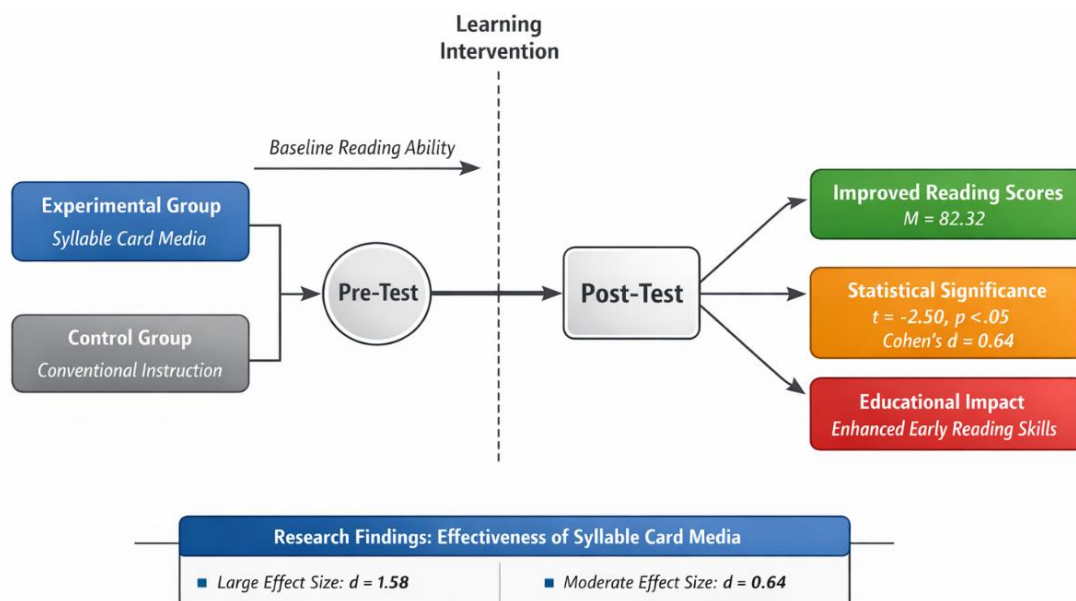


Figure 2. Visual Framework Model of the Use of Syllable Card Media to Improve Elementary School Students' Beginning Reading Skills

Figure 2 shows that both the experimental and control groups had about the same reading skills at the start of the study, as shown by a pre-test. The experimental group used syllable cards to learn, while the control group used traditional textbook-based methods. A post-test was given after the learning process to see how students' reading skills had changed. The analysis indicated that the experimental group showed a greater improvement in reading scores than the control group, as evidenced by a higher average post-test score and a statistically significant difference ($t = -2.50$, $p < 0.05$), along with a moderate effect size (Cohen's $d = 0.64$). The increase in the experimental group also had a very large effect size ($d = 1.58$), indicating that using syllable cards has a strong effect on students' initial reading performance.

b. Testing Assumptions

Before conducting the inferential analysis, the researchers assessed the assumptions of normality and homogeneity of variance. The Kolmogorov–Smirnov and Shapiro–Wilk tests showed that most of the data was normally distributed ($p > 0.05$). The analysis included the control group's pre-test and post-test scores, as well as the experimental group's pre-test scores. Because the sample sizes across groups were fairly even and parametric tests are robust to moderate violations of normality, the analysis continued using parametric methods. The researchers applied Levene's test to assess the homogeneity of variance and obtained a p-value of 0.038 ($p < 0.05$). This outcome indicates that the groups violated the assumption of homogeneity of variance. Consequently, the researchers used an independent t-test with unequal variances.

c. Effect of Intervention in Groups

A paired-samples t-test was used to determine whether the learning intervention significantly affected students' reading performance in the experimental group. The results indicated a substantial improvement in students' reading scores following the intervention. The mean difference between pre-test and post-test scores was -23.65 (SD = 14.96), indicating that using the syllable cards made a significant difference. The paired t-test yielded a statistically significant result ($t(30) = -8.80$, $p < 0.001$).

Table 2. Paired Sample t-Test Results for the Experimental Group

Comparison	Mean Difference	SD	t	df	p	Cohen's d
Pre-test vs Post-test	-23.65	14.96	-8.80	30	< .001	1.58

Data processed from SPSS results

Additionally, the computed Cohen's d effect size was 1.58, regarded as a substantial effect size by standard metrics. These results show that the intervention not only made a statistically significant difference but also had a large effect on how well elementary school students learned to read early on.

d. Intergroup Comparison

An independent-samples t-test was conducted to assess whether the experimental group outperformed the control group after the intervention. Table 3 shows that the experimental group had a higher mean post-test score ($M = 82.32$, $SD = 18.05$) than the control group ($M = 68.13$, $SD = 25.89$). The independent t-test demonstrated a statistically significant difference between the two groups ($t = -2.50$, $p < 0.05$).

Table 3. Independent Sample t-Test Results (Post-Test Scores)

Group	N	Mean	SD	t	p	Cohen's d
Control	31	68.13	25.89			
Experimental	31	82.32	18.05	-2.50	< .05	0.64

Data processed from SPSS results

To assess the extent of the difference, Cohen's d effect size was computed ($d = 0.64$). This value is considered a medium effect size by standard effect size standards. The results indicate that syllable flashcards improve students' reading skills more effectively than traditional methods.

2. Discussion

This research provides robust empirical evidence that syllable flashcards markedly enhance early reading proficiency among first-grade students. While extensive research has underscored the importance of phonological awareness and systematic decoding instruction in early literacy development, few studies have examined the implementation of structured, cost-effective instructional tools that embody these principles in actual classroom settings. Consequently, this study fills a significant void by demonstrating that pedagogically sound instructional tools, rather than technologically intricate interventions, can yield substantial literacy gains when aligned with cognitive learning processes (Ehri, 2020; Goldenberg, 2020; Hattie & Zierer, 2024).

Comparable pre-test early reading skills between the experimental and control groups strengthen causal interpretations by confirming that their baseline literacy abilities are equivalent. Such equivalence is crucial in quasi-experimental literacy research because early reading outcomes are highly sensitive to prior phonological exposure and linguistic readiness, as noted by Woolley (2011) and Hogan et al. (2005). The significant post-intervention improvements noted in the experimental group result from instructional variations rather than pre-existing learning attributes. The findings align with recent experimental literacy studies (Finlayson & McCrudden, 2020; Weiser, 2013), which highlight instructional design as a primary determinant of students' initial reading achievement.

The efficacy of syllable flashcards can be analyzed through the lens of phonological processing theory and cognitive load theory (Hughes et al., 2021; Kalyuga, 2011). Beginning readers must simultaneously coordinate visual recognition, phonemic decoding, and semantic processing, which creates high intrinsic cognitive demands (Leibnitz et al., 2017; Shapiro et al., 2013). An instructional framework that segments words into syllable units diminishes extraneous cognitive load and promotes schema development (Çeken & Taşkın, 2022; Mayer, 2002; Sweller et al., 2019). Recent research by Hall (2013) and Hassler et al. (2025) validates that structured segmentation strategies improve decoding automation and expedite the attainment of reading fluency in early childhood education.

The substantial within-group effect size ($d = 1.58$) identified in this study signifies a transformative instructional impact. Educational interventions conducted in genuine classroom environments seldom attain such scales. The findings indicate that the interventions modify students' learning trajectories rather than yield gradual improvements. Meta-analytic evidence demonstrates that structured phonics-based interventions consistently yield superior literacy outcomes compared with implicit or exposure-based methodologies (Edwards, 2008; Justino & Barrera, 2012; Lindström-Sandahl et al., 2023). Bingham et al. (2010) also showed that teaching students to

decode words clearly leads to long-term improvements in early literacy development across all types of schools.

The moderate between-group effect size ($d = 0.64$) further emphasizes the educational benefits of syllable flashcards compared to traditional textbook instruction. Conventional literacy instruction frequently prioritizes passive text interaction, potentially constraining students' chances for repetitive phonological manipulation and active involvement (Wenren et al., 2024). Conversely, interactive learning media can foster learner engagement, facilitate immediate corrective feedback, and promote repeated exposure factors closely linked to enduring educational outcomes (Darling-Hammond et al., 2020; Schindler et al., 2017). Tactile and visual manipulatives can enhance attention regulation and working memory in the context of early literacy education (Heled et al., 2022; Solichah & Fardana, 2024).

An additional contribution of this study is evidence that syllable flashcards can reduce variability in students' reading skills. The decrease in standard deviation observed in the experimental group indicates increased learning equity. This suggests that structured learning support can benefit both high- and low-achieving students. This aligns with inclusive education research conducted by Vaughn and Wanzek (2014), Vaughn et al. (2012), and Petscher et al. (2020), which found that explicit and visually supported instruction provides greater benefits for struggling readers and students with limited prior literacy exposure.

The proposed visual framework model further advances literacy research by linking learning processes to measurable learning outcomes. While many literacy studies report statistical effectiveness, few explicitly model the mechanisms linking intervention design, learner interactions, and cognitive development. Model-based explanations are increasingly emphasized in high-impact education research because they bridge empirical findings with theoretical advances and enhance replicability (Bond et al., 2021; Zawacki-Richter et al., 2019).

This study significantly contributes to the ongoing discourse in contemporary educational research regarding technological versus pedagogical innovation. Zawacki-Richter et al. (2019) focus on digital literacy and AI-powered tools, but they often ignore learning methods that many people can use and that cost little. The present findings indicate that teaching efficacy is less contingent upon technological sophistication and more reliant on adherence to cognitive learning principles. The findings bolster the assertion that evidence-based pedagogy remains a principal catalyst for learning enhancement across technological platforms (Dunn et al., 2013; Meylani, 2024; Ortega-Alvarez et al., 2025).

From an educational standpoint, these results indicate that early reading instruction should emphasize structured phonological interactions and multisensory engagement rather than passive exposure to reading. Using syllable-based manipulatives in everyday classroom activities can help students learn to decode words automatically during the early stages of reading. Modern reading science emphasizes that educators should use systematic and clear instruction in the early grades (Bowey, 2006; Keen, 2014).

Although this study made important contributions, it presents several issues that warrant consideration. The researchers conducted the study with novice readers in the lower grades, which may limit its applicability across different orthographic systems. Consequently, subsequent research should investigate longitudinal retention effects, hybrid digital adaptations of syllable cards, and moderating variables, including learner motivation, phonological awareness, and instructional fidelity. Mixed methods investigations could also be a possibility for future research.

Conclusion

This study shows that using syllable flashcards is an effective way for first graders to improve their reading. The results show not only statistically significant improvements but also substantial differences in education, as evidenced by large and meaningful effect sizes. The structure of linguistic information during learning has a big effect on how quickly students learn to read and write, not just how much they read. The learning intervention aids students' grapheme-phoneme mapping by segmenting words into cognitively manageable syllable units, thereby diminishing cognitive processing demands and facilitating a more efficient acquisition of decoding skills. This study theoretically integrates phonological processing principles with cognitive load theory in an applied classroom context, illustrating how structured learning media can implement reading science principles in genuine learning environments.

From a practical and policy standpoint, these findings indicate that successful literacy innovations do not inherently depend on advanced technology, but rather on pedagogically coherent learning frameworks that promote active participation and organized phonological interactions. Using syllable-based learning media can be a scalable, inclusive way to close performance gaps among early readers while also improving basic literacy skills. These findings prompt educators, curriculum designers, and policymakers to incorporate evidence-based phonological instruction for early-grade students. Subsequent research should examine longitudinal learning outcomes, investigate digital or hybrid adaptations of syllable-based media, and analyze moderating factors, such as learner motivation and instructional fidelity, across various educational contexts. This study supports the overarching notion that enduring improvements in early-grade reading acquisition arise from pedagogical strategies that synchronize instructional methods with children's cognitive processes of reading.

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