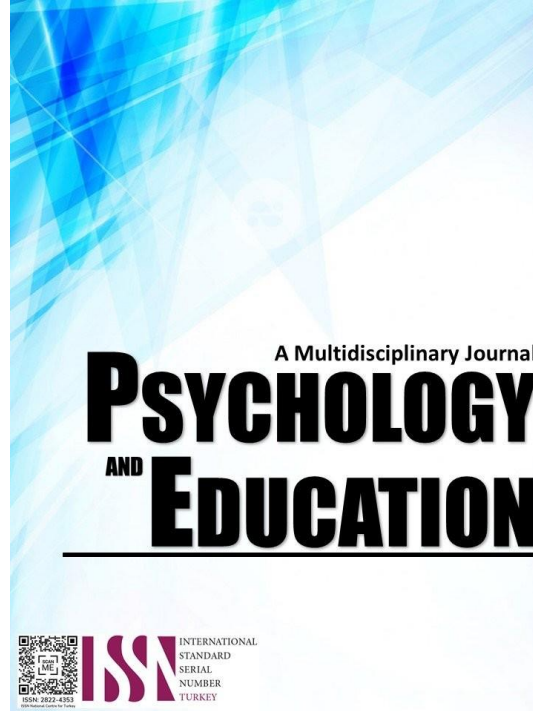


ENHANCING READING PROFICIENCY THROUGH SCIENCE-BASED INSTRUCTIONAL STRATEGIES: A LITERATURE REVIEW



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Enhancing Reading Proficiency Through Science-Based Instructional Strategies: A Literature Review

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Abstract

This study examines the implementation and sustainability of science-based reading interventions to improve literacy among secondary students. Rooted in the researchers' current teaching context in a rural public high school in the Philippines, the study addresses the observed difficulties faced by non-proficient readers who struggle to decode and comprehend academic texts. It examines explicit teaching, interdisciplinary approaches, and cognitive skill development as effective strategies for integrating literacy with content learning. This research uses current evidence through reviewing the literature available on the internet, including the use of academic databases such as Google Scholar, ResearchGate, JSTOR, and ERIC, to systematically collect peer-reviewed articles from 2018 to 2024. It includes some aspects of explicit instruction toward the development of comprehension, an interdisciplinary framework that enhances engagement with value, and metacognitive strategies that enhance learning by self-regulation. At the same time, the research emphasizes the need for teacher education, curriculum relevance, administrative support, and community involvement to make these interventions sustainable in natural classroom settings. Results from the reviewed literature show that explicit teaching, interdisciplinary approaches, and cognitive development reading strategies consistently lead to measurable improvements in comprehension.

Keywords: *explicit teaching, interdisciplinary learning, metacognitive skills*

Introduction

Improving the reading of secondary-grade students is still one of the most significant educational endeavors, especially for those struggling with reading. In the researchers' present school assigned, a public secondary high school in Southern Leyte, Philippines, the effects of learning poverty are evident. A considerable number of students—especially in Grade 7 and Grade 8—demonstrate limited ability to comprehend even short, simple passages in English, resulting in poor academic performance across content subjects. During remedial reading classes and informal diagnostic activities conducted by the school's reading coordinator, several students were found to be reading at a Grade 2 or 3 level despite being in secondary school. These real-life observations underscore the pressing need for strategic interventions tailored explicitly to non-proficient readers in secondary school settings. The most creative approach to this challenge is using science-based instructional strategies that rely on empirical research and past pedagogical practices. Research consistently emphasizes the importance of evidence-based reading interventions, particularly for students with learning difficulties, as Capin et al. (2024) highlighted, who advocate for multitiered support systems (MTSS) to improve reading outcomes. However, beyond instructional strategies, there is a need to address the deeper systemic issues that lead to reading deficiencies, including learning poverty, to make long-term improvements work.

The problem of learning poverty, otherwise known as the difficulty in reading and comprehending a simple text by age ten, is one of the major concerns in the world today. For example, 91% of elementary-aged children in the Philippines struggle with reading, a problem made worse by the recent pandemic and enduring structural issues, including poverty, hunger, and limited access to high-quality education (World Bank, 2022) and reading interventions that are both pedagogically sound and contextually appropriate to the difficulties underprivileged students face are needed because of these socioeconomic issues. In addition, the learning crisis outlined by Bautista and Aranas (2023) emphasizes the need for a comprehensive strategy addressing impediments to learning and instructional methodologies and improving education delivery systems.

Furthermore, the study on reading comprehension requires focused instructional interventions to facilitate holistic text meaning. Their results are relevant to cognitive scaffolding, mainly applied to implementing reading in conjunction with content taught, such as science. For instance, Esparza et al. (2023) explored and unraveled the impacts of meshing science with literacy activities on enhancing students' reading abilities and fostering the critical thinking needed to improve literacy and content learning. Walldén (2022), who supports this interdisciplinary approach, points out that concentrating on content-specific tactics within discussions of academic texts might give students the skills they need to decode and understand complicated materials.

Despite the sheer magnitude of research on reading interventions, there is a gap between science-based reading strategies and systemic educational reforms tailored to secondary students in under-resourced and high-poverty environments. Although evidence shows that content-based and evidence-based practices can improve reading competence (Duke, Ward, & Pearson, 2021; Petscher et al., 2020), most studies focus on either elementary levels or controlled environments that do not fully account for the complex socioeconomic challenges students face in real-world contexts (Capin et al., 2024).

This literature review addresses these gaps by investigating the impact of science-based reading interventions within a multitiered framework designed explicitly for under-resourced educational environments. Doing so will afford a deeper understanding of how integrated instructional strategies and context-sensitive educational reforms can increase reading proficiency, particularly in extreme

learning poverty. For this reason, the present study is necessary to enlighten a comprehensive yet scalable approach to literacy development, going beyond individual classroom strategies that must overcome instructional and institutional barriers to sustained improvements in reading outcomes.

Research Questions

This research aimed to explore the effectiveness of science-based instructional strategies in improving reading proficiency among struggling secondary students and their integration into real-world classroom settings. Specifically, this research aimed to answer the following questions:

1. How do science-based instructional strategies improve reading proficiency among struggling secondary students?
2. What is the most effective science-based strategies for integrating literacy with content learning in secondary education?
3. How can schools implement and sustain science-based reading interventions in real-world classroom settings?

Literature Review

Research on reading proficiency increasingly emphasizes the significance of evidence-based instructional practices, especially science-based strategies. According to Petscher et al. (2020), reading science is critical for 21st-century education because instruction should be based on decoding and linguistic comprehension. This is in keeping with the "Simple View of Reading," which postulates that reading comprehension stems from word recognition and language comprehension (Hoover & Gough, 1990). Such core theories imply that successful reading teaching must address both components to enhance proficiency among struggling students.

According to Duke, Ward, and Pearson, technique training must be explicit to help students connect with texts powerfully (2021). The study establishes that once the learner has been instructed to analyze and evaluate the thought process when reading, he or she is made to understand better and, therefore, enhance his or her thinking about his or her thinking. It was pointed out that teaching strategies ought to surpass the dissemination of information; it should be done with a conscious purpose to make students think harder.

Capin et al. (2024) highlight how crucial multitiered support systems (MTSS) are in secondary education for providing structured help tailored to each student's needs, especially when discussing the reading crisis. According to their research, students who struggle with reading can benefit significantly from science-based reading treatments when such programs are modified to meet the demands of secondary education.

Main, Hill, and Paolino (2023) emphasize the durability and application of reading interventions in real-world educational contexts. Such methods, such as those grounded in science, improve students' reading skills. However, this increment must be maintained consistently with planned ongoing support at every stage of the learning process. The point is that these effective strategies must keep moving as time passes and attend to student needs changes as they grow.

Weaving science-driven reading and writing strategies into the curriculum, especially in STEM subjects, can produce encouraging outcomes. Esparza et al. (2023) conducted a mixed-methods study to assess the efficacy of literacy-infused scientific methodologies. Their research reveals that mixing learning about specific subjects with teaching how to read and write helps students understand texts better. This approach also helps them see how what they learn in science relates to the words we use every day.

On the other hand, improving how well students read worldwide is challenging because of the significant hurdles in the way of education everywhere. The World Bank (2022) reports that in the Philippines, 91% of students at late primary age are not proficient in reading, a crisis exacerbated by inadequate instructional resources, poverty, and the recent disruptions caused by the COVID-19 pandemic. According to Bautista and Aranas (2023), the learning crisis in the Philippines is caused by structural concerns such as malnutrition, unequal access to educational resources, and the continued use of old teaching methods that hinder active learning. However, it calls for the account of contextual factors for implementing science-based instructional strategies to promote reading competence in low- and middle-income countries.

The literature supports the view that science-based instructional strategies can improve reading skills. Effective deployment, however, has to face system-wide challenges and work towards making it more sustainable within real-world educational settings. Cognitive science combined with explicit strategy instruction and interdisciplinary approaches is a comprehensive framework for helping struggling secondary students in this present research to develop policy impacting students who need intervention.

Methodology

Research Design

This research will use a literature review approach to examine existing studies on integrating science-based strategies for reading instruction.

To ensure a comprehensive literature review, this study will source peer-reviewed articles by global authors from 2018 to the present, using databases specializing in education, cognitive science, psychology, and language studies. Key databases include ERIC, PsycINFO, JSTOR, PubMed, Google Scholar, ProQuest Education Database, SpringerLink, ScienceDirect, and SAGE Journals. These

platforms provide access to high-quality research on reading interventions and strategies in secondary education.

Synthesize the extracted data to show a holistic view of how science-based instructional strategies will improve reading proficiency. Specific attention will be paid to the gaps in the literature and successful strategies that can be applied across diverse contexts in the education sphere.

Results and Discussion

Science-Based Instructional Strategies for Improving Reading Proficiency

Science-based instructional strategies that apply systematic, explicit, and evidence-based approaches have continuously been demonstrated to improve the reading proficiency of struggling secondary students. Such strategies highlight developing core reading skills, integrating content knowledge, and considering individual learning needs, especially in diverse educational settings.

One of the key elements of science-based instructional strategies is that they are based on foundational skills: phonemic awareness, phonics, fluency, vocabulary, and comprehension. According to Petscher et al. (2020), systematic and explicit instruction in these areas will constitute the backbone of a strong reading intervention program so that struggling readers can start developing essential decoding and linguistic comprehension skills. Similarly, Capin et al. (2024) suggest that MTSS offers tiered interventions depending on students' proficiency level. Since targeted deficits are systematically treated within MTSS, particular support offered to struggling readers will significantly improve outcomes.

Another important component is content-specific literacy instruction within the context of science and mathematics. According to Esparza et al. (2023), infusing science into literacy strategies engages students meaningfully and enhances their reading skills. Such an interdisciplinary approach helps the students apply reading strategies to understand complex texts and, therefore, enhances not only subject-specific understanding but also overall literacy. Further, Duke, Ward, and Pearson (2021) emphasize the role of explicit strategy instruction in encouraging deep engagement with texts and supporting the development of metacognitive skills critical for reading comprehension.

The application of real-world contexts in literacy instruction is also a significant feature. According to Main et al. (2023), reading interventions implemented in practical settings close the gap between the theoretical and the practical aspects. It enhances student engagement while preparing them for the practical application of solving real-life problems, thus making learning relevant and effective.

Effective Science-Based Strategies for Integrating Literacy

Cognitive and metacognitive strategies are crucial in promoting reading proficiency and linking literacy with content learning in secondary education. This is done by teaching the child to understand his or her thought processes, monitor comprehension and employ appropriate reading techniques. Weinstein et al. (2018) emphasize the importance of explicitly teaching strategies such as summarizing, questioning, and visualizing, enabling students to engage with texts and actively improve comprehension of complex content.

Developing metacognitive skills also involves facilitating students' self-monitoring of their understanding and changing their reading strategies. According to Duke, Ward, and Pearson, "metacognitive practices empower students to control cognitive demands better when reading complex texts, which will support independence and deeper engagement with texts" (p. 2021). Such an approach is potent in content-intensive disciplines such as science and mathematics, where students must assimilate textual information with conceptual knowledge.

Another important aspect is the role of control networks in the brain, which regulate cognitive resources while reading. As Church's article (2023) points out, such networks allow attention shifting, inhibit irrelevant information, and help maintain focus on readers' main ideas. Interventions that strengthen such networks, for instance, goal setting and reflective thinking, might further reading performance and assist the student in processing content complexity more efficiently.

Cognitive stimulation programs have been shown to enhance reading comprehension and engagement, particularly when integrated with content learning. Conesa and Duñabeitia (2023) conclude that focused cognitive training, in which children are engaged with activities designed to develop working memory and executive functions, dramatically improves the ability to understand and analyze complex texts. This intervention develops cognitive abilities and keeps students interested and motivated, which is important for successful long-term literacy development.

Real-life applications and interactive learning environments can also engage students' cognitive processes. According to Malanchini et al. (2020), problem-solving tasks, collaborative activities, and inquiry-based learning stimulate the cognitive processes that promote active participation. Such approaches are most effective in secondary education because they connect abstract concepts with practical scenarios students encounter. Besides, interactive multimedia resources such as pictorial materials, computerized tools, and simulative activities provoke multiple pathways in cognition. This, in turn, increases the opportunities for literacy and content retention. Wu et al. (2020) point out that these methods scaffold students who must learn higher-order thinking skills to operate more confidently and competently with complex academic texts.

Explicit teaching is one of the most successful science-based strategies for implementing literacy with content learning, particularly in secondary education. This method refers to teaching systematically and structured steps to guide students to understand and apply reading comprehension strategies. In this light, it reduces cognitive loads and supports struggling readers in mastering knowledge in literacy and content. Explicit teaching emphasizes clearly defining learning objectives and systematically guiding students through mastering reading strategies. According to Vaughn and Fletcher (2021), explicitly explicit instruction forms part of the foundational tool that may help carry out science for reading. Such training might incorporate summarizing, forecasting, questioning, direct explanation, and exemplar explanations. Donegan and Fluhler (2024) point out that greater explicitness in instruction adds much stronger effectiveness in reading-based intervention, most noticeably when learners need greater intensity. Explicit teaching equips students with the tools for self-regulated learning by focusing on the deliberate application of strategies. Sins et al. (2024) note that professional development programs promoting explicit instruction of reading strategies significantly improve teachers' ability to foster student self-regulation. These strategies enable students to take ownership of their learning, apply comprehension techniques independently, and monitor their progress, particularly in content-heavy subjects such as science and social studies.

The explicit teaching of reading strategies improves comprehension, particularly for English as a Second Language (ESL) learners. Elston, Tiba, and Condy (2022) demonstrate that structured, explicit instruction allows ESL students to overcome language barriers by breaking complex texts into manageable components. Similarly, Brevik (2019) emphasizes the need for consistent, explicit strategy instruction over relying solely on daily strategies, suggesting that targeted teaching leads to better comprehension outcomes.

Explicit teaching also enhances motivation and self-efficacy among students. Li et al. (2022) found that strategy instruction delivered explicitly improves reading comprehension and students' motivation and confidence in their ability to understand texts. When students see strategies' direct application and benefits, they are more likely to engage actively with the learning process, which is critical for success in secondary education.

In content-based literacy instruction, explicit teaching ensures students can navigate subject-specific texts effectively. Magnusson et al. (2019) demonstrate that explicit strategy instruction in language arts classrooms helps students acquire transferable skills that improve their ability to understand content across disciplines. According to Twyman (2021), evidence-based explicit models of instruction ensure consistent performance across applications and scalability, thus making it convenient and practicable for any classroom setup.

Combining various disciplines into a singular teaching framework, the approach promotes the development of essential thinking, problem-solving, and literacy skills in secondary schools. This is helpful while incorporating literacy with content study and, at the same time, making connections between subjects because a connection builds greater understanding and involvement from students.

Interdisciplinary teaching practices will help students understand the significance of literacy skills in other subjects, making them better readers and students. According to Kanmaz (2022), interdisciplinary education inspires students to use literacy strategies outside of content areas, furthering their understanding of complex concepts. For instance, students can improve their scientific literacy by analyzing texts in science classes, which enhances their ability to decode and comprehend content-specific vocabulary and concepts.

Zhang et al. (2023) demonstrate the mediating effect of interdisciplinary literacy on learning outcomes, emphasizing that combining content learning with literacy instruction improves critical thinking and active learning behaviors. When students engage with interdisciplinary content, they develop the ability to synthesize information from multiple sources, an essential skill for navigating complex texts in secondary education.

An interdisciplinary thematic curriculum encourages the "4C skills" of creativity, critical thinking, collaboration, and communication. According to Ye and Xu (2023), interdisciplinary learning inspires students to work in teams on projects that require them to combine knowledge from various disciplines. This process develops literacy skills and prepares students for solving real-world problems by promoting active engagement and collaborative learning.

Effective interdisciplinary instruction requires teachers to possess strong interdisciplinary teaching abilities. Wu et al. (2024) point out the relevance of professional development training involving teachers in designing and using interdisciplinary curricula. Training develops teachers' capacities to apply literacy instruction across the learning content areas, which allows students to learn from all disciplines in an integrated, coherent way to develop their knowledge.

Despite having numerous benefits, interdisciplinary design presents challenges, mainly when educators are not oriented toward integrating literacy with any content area. Daniel et al. (2022) point out challenges, such as limited experience with interdisciplinary teaching and poor alignment of instructional goals between subjects. Solving these issues will require educators to collaborate, workshops, and the institution's support to implement interdisciplinary approaches successfully.

Interdisciplinary approaches have been proven to enhance student engagement and learning outcomes by making instruction relevant and meaningful. Oudenampsen et al. (2023) have found that students exposed to interdisciplinary teaching are more interested and motivated as they can see the real-world applications of their learning. Furthermore, Zhao (2023) notes that interdisciplinary teaching models in English reading instruction improve students' ability to analyze and synthesize information, leading to higher literacy and content mastery.

Implementing and Sustaining Science-Based Reading Interventions

Effective implementation and sustainability of science-based reading interventions in real-world classroom settings require a combination of evidence-based instructional practices, teacher training, administrative support, and community engagement. Schools must create a structured framework integrating research-driven strategies into daily teaching while addressing contextual challenges and resource limitations.

Teacher expertise is crucial for implementing science-based reading interventions effectively. Professional development programs are one of the means through which instructors are adequately prepared to provide explicit instruction, interdisciplinary approaches, and cognitive-based strategies. According to Wu et al. (2024), training should emphasize combining literacy teaching and other disciplines in a way that they run side by side. Along these lines, Sins et al. (2024) indicate professional development workshops that enhance the explicit instruction of self-regulated learning, thus making both content and literacy learning.

Reading interventions should align with existing school curricula and standards. According to Kanmaz (2022), integrating literacy instruction into subject-specific teaching practices, such as reading comprehension strategies in STEM lessons, will ensure sustainability. Because literacy interventions are part of the curriculum and standards, the risk of them being seen as add-ons is much reduced, which would encourage long-term adoption by teachers and administrators.

Interdisciplinary teaching encourages the infusion of literacy skills across disciplines, which makes them more relevant and impactful. Ye and Xu (2023) have shown that thematic, interdisciplinary curricula promote collaboration and critical thinking, making literacy instruction more engaging and effective. Schools can apply science-based reading interventions by creating collaborative projects using literacy skills in real-world applications, such as analyzing scientific texts or interpreting historical documents.

There are core support elements: administrative and policy. The significant constraints Daniel et al. (2022) have identified concern institutional issues, like the lack of resources and time to plan interdisciplinary lessons. To overcome such problems, schools need to find proper funding, time, and resources for teachers to collaborate, prepare lessons, and have professional development. This would be coupled with a clear policy and guidelines on implementing reading interventions, which is essential for consistency and accountability.

Ongoing assessment and data analysis are very important for monitoring the effectiveness of reading interventions. Donegan and Fluhler (2024) stress the importance of using data-driven approaches to understand students' needs, which can be tailored to intervention. Schools should conduct regular formative and summative assessments to monitor students' progress and modify their instruction according to the outcomes.

Sustaining reading interventions involves the role of families and communities. According to Zhang et al. (2023), community engagement promotes student involvement and leads to better literacy results in school. Schools can train parents on reading strategies so that they are motivated to help their children at home improve their literacy skills.

Conclusions

This study implies that science-based reading can improve students' literacy outcomes. This research will influence schools to arrange workshops and events where they can tell parents about the reading strategy and encourage them to assist their children in developing literacy skills at home. They are founded on explicit teaching, interdisciplinary approaches, and cognitive development, with content comprehension and focusing on foundational skills requiring critical thinking. Research has proven that explicit instruction involving modeling and guided practice significantly prepares students to read more meaningfully and effectively, especially within content-based subjects like mathematics and science (Vaughn & Fletcher, 2021; Donegan & Fluhler, 2024).

Integrating literacy into interdisciplinary frameworks enhances understanding and engagement as readers apply reading skills in meaningful, real-world contexts. Ye and Xu (2023) show that thematic, interdisciplinary curricula foster "4C skills"—critical thinking, communication, collaboration, and creativity—which are defined as essential for 21st-century learning. Furthermore, cognitive and metacognitive strategy development, as discussed by Weinstein et al. (2018), enables learners to monitor their understanding and apply strategies independently, meaning they can engage more deeply with texts.

However, a systematic and collaborative process is needed to implement these strategies effectively. As Sins et al. (2024) emphasized, teacher capacity building in professional development ensures that teachers are competent in science-based intervention provision. Coordination of literacy instruction with the goals of the curriculum and the use of interdisciplinary teaching practices ensure sustainability (Kanmaz, 2022; Wu et al., 2024). Furthermore, assessment at all times and data-informed decision-making are essential for making the interventions appropriately respond to different students' needs (Donegan & Fluhler, 2024).

Systemic barriers are just as important. Administrative support, adequate resources, and community engagement provide an enabling environment for sustainable literacy improvement. According to Zhang et al. (2023), family and community involvement can reinforce reading interventions beyond the classroom.

The convergence of explicit teaching, interdisciplinary integration, and cognitive skills provides a robust framework for literacy advancement in secondary schools. Implementing such evidence-based approaches would ensure that schools increase reading

proficiency and develop skills necessary for students' academic and later life. This requires a harmonized role between educators, administrators, and policymakers to deliver equitable, impactful education.

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