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Implementation of the Special Science Elementary School program: A literature review on leadership, curriculum, and sustainability

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Abstract

To address learners' readiness to promote scientific literacy and STEM courses, the Department of Education of the Philippines has developed Special Science Elementary School (SSES) program. The literature study systematically reviews 42 peer-reviewed papers, policy documents, and empirical studies published between 2021 and 2026, obtained from Scopus, ERIC, Google Scholar, and JANE. Works on instructional leadership, curriculum innovation, teacher competency, institutional preparation, and sustainability were included, but non-peer-reviewed publications and studies unrelated to elementary science education were excluded. Three main themes emerged: (1) instructional leadership and curriculum implementation, (2) infrastructural and financial restrictions, and (3) stakeholder collaboration and educator development. The impacts of SSES on improving student achievement, inquiry skills, and curriculum originality have been continuously highlighted in research. But there are inequalities in the institutional ability, budgetary adequacy, and equitable deployment of resources. The problems that persist include the inadequacy of laboratory facilities, the lack of skilled scientific teachers and the dependency on contributions by stakeholders owing to lack of government support. This research shows considerable gaps in longitudinal student results, equity-driven implementation, and learner-centered perspectives, and comparatively less attention on collaborative governance models. This study contributes to national and international scholarship by positioning the SSES curriculum within worldwide dialogues on scientific education reform and sustainability. It offers specific funding instruments, increased professional development of teachers, and governance structures grounded in fairness to foster sustainable and inclusive transformations in science education.

Keywords: special science elementary school, science education, instructional leadership, curriculum innovation, sustainability

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1. Introduction

In the field of innovation and technological advancement, Science education plays a critical role worldwide for educational reform. This will open opportunities for national development and further to global competitiveness. It is very essential to prepare learners in these evolving knowledge-based societies and educational systems. Strengthening Science instruction has become one of the priority concerns in the Philippines. These will address persistent challenges in learner achievement, scientific literacy, instructional quality, and competitiveness. The Department of Education introduced the Special Science Elementary School (SSES) program as a specialized curriculum initiative designed to enhance Science education among elementary learners to address the emerging concerns.

Through DepEd Order No. 73, s. 2008, academically gifted learners were given priority in nurturing scientific literacy under the SSES program. This provides enriched curricula, inquiry-based learning, laboratory experiments, and research-oriented activities. It has a clear rationale to prepare STEM learners for early exposure to advanced science instruction cultivates curiosity, critical thinking skills, and problem-solving subsequently, it will further benefit national development. implementation of SSES reflects the Philippine educational system's broader commitment to curriculum innovation, learner-centered instruction, and educational excellence. Moreover, while preparing learners for advanced Science, Technology, Engineering, and Mathematics (STEM) education, it seeks to cultivate scientific literacy, critical thinking, creativity, innovation, and problem-solving skills. The implementation of SSES reflects the Philippine educational system's broader commitment to curriculum innovation, learner-centered instruction, and educational excellence.

The growing body of literature concerning science-focused educational programs highlights the importance of educational leadership, institutional readiness, and curriculum implementation. In the same way, strengthening collaboration is needed to achieve teacher competence based on specialized educational initiatives. However, despite increasing scholarly attention to Science education reform, research concerning the implementation of the SSES program remains fragmented. Existing studies primarily focus on isolated dimensions such as instructional leadership, teacher preparedness, science process skills, curriculum implementation, and infrastructure concerns without offering a comprehensive synthesis of these interconnected themes.

SSES program contributes positively to learner development through improved inquiry skills and school achievements in the different learning areas. Nevertheless, the literature also identifies persistent implementation challenges. Most of the implementing schools have inadequate laboratory facilities, a shortage of qualified Science teachers, insufficient funding, and disparities in institutional support across schools and regions. These implementation concerns raise important questions regarding educational equity, organizational effectiveness, and policy sustainability.

The implementation of the SSES program offers valuable insights into instructional leadership, educational governance, curriculum management, organizational development, and institutional sustainability. School administrators significantly influence the success of Science-focused educational reforms through instructional supervision, strategic planning, teacher development, stakeholder collaboration, and resource allocation. Consequently, understanding the implementation experiences of SSES schools contributes significantly to improving educational leadership practices and strengthening Science education policies.

This literature review aims to provide a comprehensive synthesis and critical analysis of scholarly works related to the implementation of the SSES program in the Philippines. Specifically, it seeks to answer the following

research questions:

- What instructional leadership practices support SSES implementation?
- What institutional and infrastructural challenges affect program sustainability?
- How does stakeholder collaboration influence teacher and learner outcomes?

By integrating findings from empirical studies and policy documents, this review contributes to a deeper understanding of science-focused educational reform and provides evidence-based insights for improving the implementation and sustainability of the SSES program.

2. Review of Related Literature

The literature on the implementation of the Special Science Elementary School (SSES) curriculum emphasizes its significance in improving scientific literacy, learner achievement, and educational competitiveness. Studies repeatedly emphasize the linked features of instructional leadership, curriculum innovation, teacher competence, institutional readiness, and stakeholder collaboration, but they also highlight persisting difficulties in sustainability. Instructional leadership emerges as a critical determinant in program effectiveness, as Prado and Sabas (2023) show that effective supervision, collaborative planning, and monitoring mechanisms are substantially connected with enhanced curriculum delivery and school performance. However, most of these studies use cross-sectional designs, which limit insights into the long-term impact of leadership practices and emphasize the importance of longitudinal research to determine whether leadership strategies result in sustained improvements in learner achievement and institutional culture.

Institutional constraints, especially relating to infrastructure and funding, remain the most cited challenge. While Dedumo (2025) observed that funding shortages and laboratory defects hindered compliance with Department of Education standards, Cagas and Villocido (2024) noted poor instructional materials, time constraints, and limited financial resources as important obstacles. Few studies use comparative or longitudinal approaches to monitor how resource disparities change over time, despite these findings highlighting structural differences between urban and rural schools. With Bug-os et al. (2021) demonstrating that high self-efficacy among science teachers was linked to inquiry-based pedagogy and Vega and Orleans (2025) highlighting that Learning Action Cells (LACs) strengthened collaboration and teacher growth, teacher competence and professional development are equally important. However, depending solely on self-reported data raises questions regarding methodological rigor, indicating that mixed-methods and experimental designs are necessary to confirm the long-term effects of professional development programs.

For a program to be sustainable, stakeholder collaboration is essential. Strong support from the community and local government puts schools in a better position to fill resource gaps, but when stakeholder expectations clash with institutional aims, governance problems frequently occur. This discrepancy implies that policy mandates by themselves are inadequate; reforms necessitate collaborative governance structures and embedded accountability mechanisms that strike a balance between national directives and local realities. New research examines cutting-edge pedagogies and technology integration, including gamification (Bhakti et al., 2025), heuristic writing techniques (Kara & Kingir, 2022), and programming tools like Scratch (Liu et al., 2026). Although these methods improve scientific thinking and student engagement, their efficacy is limited by the instructor technical proficiency and infrastructural readiness. There are still a few rigorous experimental designs, which raises concerns regarding their long-term effects.

Contextualized implementation and equity are still understudied. Although there are still few localized Philippine research, De Los Reyes and Bagona (2024) discovered that translanguaging techniques increased participation in multilingual classes. Most of the research prioritizes administrative and instructor concerns over student experiences, with very little representation of learner viewpoints. Given the emphasis on inclusive, learner-

centered science education around the world, this disparity is substantial. Furthermore, inconsistent results from different studies demonstrate the unevenness of implementation: some describe good institutional preparedness and stakeholder participation, while others show inadequate support and weak governance mechanisms.

The following table summarizes key studies that illustrate these themes:

Author/Year	Method	Sample	Key Findings	Theme
Prado & Sabas (2023)	Correlational	Public elementary schools	Leadership effectiveness linked to curriculum delivery and school performance	Instructional leadership
Cagas & Villocido (2024)	Case study	Special Science schools	Resource gaps and time constraints hinder implementation	Institutional constraints
Dedumo (2025)	Survey	Caraga Region divisions	Funding and laboratory shortages limit compliance	Resource gaps
Bug-os et al. (2021)	Self-efficacy survey	Science teachers	High self-efficacy linked to inquiry-based teaching	Teacher competence
Vega & Orleans (2025)	Qualitative	Remote regions	LACs strengthen collaboration and teacher growth	Professional development
Kara & Kingir (2022)	Experimental	Elementary learners	Heuristic writing improved inquiry and reasoning	Innovative pedagogy
De Los Reyes & Bagona (2024)	Classroom study	Multilingual schools	Translanguaging enhanced participation and learning	Equity and contextualization

Taken together, the literature shows that the SSES program's longevity is dependent not on single elements, but on the interplay of leadership, curricular innovation, teacher development, and institutional support. However, methodological limitations, unequal resource distribution, and a lack of learner-centered views restrict the strength of current findings. Future research should highlight longitudinal studies on learner outcomes, equity-focused investigations in various Philippine contexts, and thorough evaluations of professional development and governance structures. By filling these gaps, scholarship can provide a more nuanced understanding of how systemic alignment across leadership, curriculum, teacher competence, and stakeholder collaboration can support scientific education reform in the Philippines.

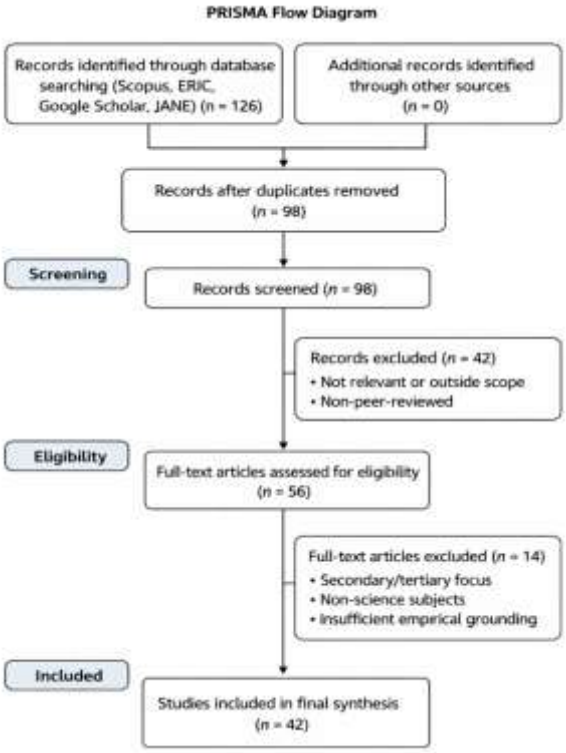
3. Methodology

This study employed a systematic literature review design guided by the PRISMA framework to ensure transparency, replicability, and methodological rigor. The review focused on the implementation of the Special Science Elementary School (SSES) program in the Philippines, emphasizing leadership, curriculum innovation, and sustainability. No human participants were directly involved in this study; hence, consent to participate was not applicable. A comprehensive search strategy was conducted across four major academic databases—Scopus, ERIC, Google Scholar, and JANE—covering publications from 2021 to 2026. The search utilized the following keywords: *Special Science Elementary School, Science education, instructional leadership, curriculum innovation, sustainability,* and *educational equity.* Boolean operators (AND/OR) were applied to refine combinations of these terms and maximize the retrieval of relevant studies.

Inclusion criteria: peer-reviewed studies published between 2021–2026 focusing on elementary science education, instructional leadership, curriculum innovation, teacher competence, and sustainability. Exclusion criteria: non-peer-reviewed works, studies on secondary/tertiary education, non-science subjects, and reports lacking empirical grounding. The screening process followed four PRISMA stages: identification, screening, eligibility, and inclusion. Initially, 126 records were identified. After removing duplicates, 98 records remained for

title and abstract screening. Studies outside elementary science education, non-peer-reviewed reports, and those not addressing leadership, curriculum, or sustainability were excluded, leaving 56 full-text articles for eligibility assessment. Fourteen articles were excluded for focusing on secondary or tertiary education, non-science subjects, or lacking empirical grounding. The final synthesis included 42 peer-reviewed studies.

Each study was coded using a structured matrix categorizing author, year, method, sample, key findings, and thematic focus. Coding was conducted independently and cross-verified to minimize bias. Thematic analysis was then applied to identify recurring patterns and divergences across the literature, clustering findings under five domains: instructional leadership, institutional constraints, teacher competence, stakeholder collaboration, and equity-driven implementation. The PRISMA flow diagram (Figure 1) illustrates the systematic process: from 126 records identified to 42 studies included in the final synthesis. This structured approach ensured methodological transparency and strengthened the validity of the review. By explicitly detailing the databases searched, keywords used, inclusion and exclusion criteria, and coding procedures, the study provides a robust foundation for synthesizing evidence on the sustainability and effectiveness of the SSES program within the broader discourse on science education reform.



4. Discussion

The analysis of 42 peer-reviewed studies indicates that the efficacy of the Special Science Elementary School (SSES) program is contingent upon the dynamic interaction of instructional leadership, curriculum innovation, teacher proficiency, institutional preparedness, and stakeholder participation. Rather than functioning as isolated factors, these dimensions reinforce one another, which explains why reforms thrive in well-resourced schools with strong governance but falter in contexts where institutional capacity is weak.

Instructional leadership regularly emerges as a critical determinant of program sustainability. Studies such as Prado and Sabas (2023) demonstrate that effective supervision, collaborative planning, and monitoring systems are strongly associated with improved curriculum delivery and school performance. However, the lack of longitudinal research restricts our understanding of whether these leadership techniques result in long-term benefits in learner attainment and institutional culture.

Curriculum innovation, particularly inquiry-based science instruction, is largely regarded as effective in increasing learner engagement and scientific thinking. However, its effectiveness is hampered by systemic disparities in resource allocation. Schools in urban areas benefit from improved infrastructure and competent people, but poor schools continue to experience shortages of laboratory facilities, instructional materials, and specialist teachers. This disparity highlights the importance of equity-based policies that favor underrepresented groups.

Teacher competency and professional growth remain critical to program effectiveness. Bug-os et al. (2021) and Vega and Orleans (2025) provide evidence that self-efficacy and collaborative learning communities are important in enhancing inquiry-based education. Collaboration among stakeholders is also crucial to the SSES program's sustainability. Schools with strong community and local government support are better positioned to resolve resource gaps (Cagas & Villocido, 2024; Dedumo, 2025). However, poorer governance systems indicate conflicting stakeholder expectations and institutional agendas. This disparity implies that policy mandates alone are insufficient; reforms necessitate embedded accountability mechanisms and collaborative governance frameworks that balance national directives with local realities.

Despite these significant gains, numerous research gaps remain. First, there is a lack of longitudinal data on the long-term effects of SSES participation on learners' scientific literacy, STEM career goals, and professional accomplishment. Second, contextualized applications are underexplored, particularly in multilingual and socioeconomically diverse Philippine settings. Third, learner perspectives are underrepresented, with most research emphasizing administrative and teacher concerns over student outcomes. Finally, distributed leadership and collaborative governance frameworks have not gotten significant attention, leaving open questions about how shared leadership models can increase institutional sustainability.

Overall, the literature shows that, while the SSES program has a high potential for improving scientific literacy and educational competitiveness, its long-term success is dependent on systemic alignment across leadership, curriculum, teacher development, resource allocation, and stakeholder collaboration. Addressing the highlighted shortcomings through equity-driven policies, longitudinal research, and collaborative governance is critical to ensuring that scientific education reform in the Philippines is both inclusive and sustainable.

Implications - For teachers: emphasizes the need for continuous professional development in inquiry-based pedagogy and technology integration. For students: highlights the importance of equitable access to laboratory facilities and innovative science instruction. For schools: underscores the role of leadership and stakeholder collaboration in sustaining science-focused programs.

5. Conclusion

This systematic literature review synthesized 42 peer-reviewed studies published between 2021 and 2026, retrieved from Scopus, ERIC, Google Scholar, and institutional repositories, with supplemental references from DepEd and UNESCO sources. Guided by PRISMA principles, the review highlighted the interconnected dimensions of instructional leadership, curriculum innovation, teacher competence, institutional readiness, and stakeholder collaboration in sustaining the Special Science Elementary School (SSES) program. This study is novel in synthesizing recent (2021–2026) literature on the Special Science Elementary School program, highlighting gaps in equity-driven implementation, learner-centered perspectives, and collaborative governance. Unlike prior fragmented studies, it integrates leadership, curriculum, teacher competence, and sustainability into a unified framework.

Findings confirm that although enriched curricula and inquiry-based teaching methods improve student performance and scientific literacy, ongoing obstacles—such as insufficient laboratory facilities, a lack of qualified science educators, limited financial resources, and unequal distribution of resources—persistently impede sustainability. These barriers underscore the need for systemic alignment across governance, resource allocation, and professional development.

The synthesis generates unambiguous policy and practice recommendations. First, the Department of Education should create dedicated funding models to ensure equal resource distribution, particularly in poor schools. Second, teacher professional development must be institutionalized through ongoing programs that promote inquiry-based pedagogy, technological competency, and collaborative learning communities. Third, leadership training for school administrators should prioritize instructional supervision, strategic planning, and collaborative governance frameworks to improve institutional preparation. Finally, resource allocation rules should emphasize laboratory facilities, instructional materials, and science professionals to ensure that all students have access to experiential learning opportunities.

At the same time, the assessment recommends key areas for future investigation. Longitudinal research is required to investigate the long-term benefits of SSES participation on students' scientific literacy, STEM career goals, and professional success. Prioritize learner-centered evaluations to capture student views, motivations, and lived experiences in science classrooms. Equity-focused research must examine how multilingual, socioeconomically diverse, and geographically distant circumstances influence program implementation. Additionally, research on distributed leadership and collaborative governance can shed light on how shared leadership models improve institutional sustainability.

In conclusion, the viability of the SSES program rests not just on curriculum innovation but also on systemic reforms in funding, leadership, teacher development, and equity-driven governance. By addressing these problems through effective policy measures and rigorous future research, the Philippines can ensure that the SSES program makes a significant contribution to inclusive, high-quality, and long-term science education reform.

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