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STEAS-Based Educational Leadership in Teacher Professional Development: A Literature Study for Sustainable Transformation

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Abstract

This study focuses on analyzing the role of educational leadership within the STEAS framework (Social, Technology, Ecology, Awareness, and Science) as a strategic approach to strengthening teacher professional development in the era of Society 5.0 while supporting the achievement of the Sustainable Development Goals (SDGs). This issue is relevant since teachers serve as the primary agents of educational transformation, and their professional capacity is largely determined by the quality of school leadership. The study employs a qualitative approach through a systematic literature review of reputable national and international scholarly publications issued between 2020–2025, focusing on educational leadership and teacher competence development. Data were collected from academic documents, research reports, and educational policies, and analyzed using thematic analysis to identify patterns, categories, and key issues. The findings highlight that STEAS-based leadership emphasizes social collaboration, ethical use of technology, ecological awareness, critical capacity building, and scientific orientation as pillars of learning innovation. Three major themes emerged: (1) visionary and adaptive leadership, (2) integration of teacher professionalism with the sustainable development agenda, and (3) the formation of a collaborative, reflective, and innovative school culture. Overall, this study enriches the theoretical discourse on holistic leadership models while offering practical contributions to designing teacher development strategies responsive to global challenges. The implications underscore the importance of sustainability-oriented leadership policies and training programs, as well as opportunities for further research to test the validity of the STEAS conceptual framework in diverse educational contexts.

Keywords: *educational leadership, teacher professional development, STEAS, sustainability, Society 5.0*

INTRODUCTION

The transition toward the era of Society 5.0 and the global agenda of the Sustainable Development Goals (SDGs) demands that education systems move toward a more holistic, adaptive, and sustainable orientation. At both national and international levels, the need for digital literacy, ecological awareness, social justice, and scientific approaches to learning has become increasingly urgent. The *Teacher Professional Development in Indonesia: A Comparative Study with Global Practices* report reveals that Indonesian students' performance in PISA has remained stagnant for two decades, indicating that the increasing quantity of teacher training has not been matched by

improvements in educational quality [1]. Meanwhile, the study *High Participation, Low Impact: The Challenge for Teacher Professional Development in Indonesia* emphasizes that the high participation of teachers in training has not had a significant impact on classroom practices [2]. These findings underline the need for educational leadership capable of bridging programmatic efforts with tangible transformation in teacher professionalism.

At the implementation level, structural, cultural, and capacity-related barriers still limit educational innovation within schools. The study *Exploring the Outside-the-Box Leadership of an Indonesian School Principal* illustrates how a school principal in Eastern Indonesia interprets innovative leadership by transcending formal procedures to foster creative learning [3]. However, teachers' interpretations of such leadership often remain confined to administrative and motivational aspects, without comprehensively addressing social, value-based, ecological, and scientific dimensions. Moreover, teacher professional development continues to face non-technical constraints, such as resistant school cultures and insufficient structural support. This is reinforced by the meta-study *Professional Development Barriers of Teachers: A Qualitative Review*, which identifies barriers at individual, institutional, and systemic levels in optimizing teacher professional growth [4].

To address these challenges, the STEAS framework—encompassing Social, Technology, Ecology/Environment, Awareness, and Science—offers a comprehensive paradigm shift. This framework emphasizes the importance of social sensitivity (justice and inclusivity), technological literacy (effective digital media use), ecological awareness (environmentally conscious educational practices), ethical and moral reflection (spiritual and moral awareness), and scientific literacy (research-based learning). In the national context, the study *Empowering STEAM Learning Implementation through Investigating Indonesian Teacher Experts' Views* using the Delphi method found that technology, contextualization, and STEAM integration are key dimensions in learning [5]. However, this study focused mainly on the design of teacher learning, without exploring the broader role of leadership in internalizing the STEAS framework as a strategy for teacher professional development.

From this preliminary review, several research gaps become evident. First, studies on educational leadership remain fragmented across transformational, instructional, and pedagogical models and rarely integrate social, ecological, ethical, and scientific aspects simultaneously. Second, research on teacher professional development tends to focus on technical aspects—such as pedagogical training and ICT usage—while paying limited attention to teachers' lived experiences of leadership that instill value reflection and ecological awareness. Third, few qualitative literature-based studies have sought to synthesize the connection between STEAS-based leadership and teacher professional transformation within a sustainability framework, including the dynamics of teachers' transformative experiences and meanings.

This study is crucial because teachers are the frontline actors in implementing educational innovation. When school leadership fails to integrate social, moral, and scientific dimensions alongside technology, the vision of intelligent and sustainable education risks remaining rhetorical. From a socio-cultural perspective, inclusive and reflective leadership strengthens the relevance of education to local contexts. From an educational standpoint, STEAS integration bridges theory and sustainable innovative practice. By exploring teachers' transformative processes and meanings through a qualitative literature review, this study aims to propose a conceptual framework applicable in both school leadership and educational policy contexts.

Based on this, the study is directed toward three objectives: (1) to describe the concept of STEAS-based educational leadership, (2) to analyze the relationship between educational leadership and teacher professional development within the STEAS framework, and (3) to formulate a conceptual model of sustainable transformation that can serve as a reference for empirical research and school practice. The main focus is on the meaning and process of leadership as found in academic literature, particularly from the perspectives of teachers and school leaders. Thus, the study offers dual contributions: theoretically enriching the literature on the relationship between leadership and teacher professionalism within the STEAS framework, and practically providing strategic recommendations for school principals, education authorities, and teacher training institutions in designing sustainable leadership strategies.

METHOD

This study employed a qualitative literature review method using a thematic synthesis or *evidence synthesis* approach. The choice of this method was based on the research objective—to understand the meaning, processes, and conceptual relationships between STEAS-based educational leadership and teacher professional development through an in-depth examination of relevant literature. The qualitative literature review approach enables the researcher to collect, evaluate, interpret, and synthesize data from both empirical and conceptual articles without direct field research, making it suitable for a *desk-based research* design.

To ensure transparency, the study conducted a systematic literature search across major databases, including Scopus, Web of Science, Google Scholar, and SINTA, using the main keywords: *educational leadership*, *teacher professional development*, and *STEAM/STEAS*. Inclusion and exclusion criteria were applied during the selection process following a systematic qualitative review protocol [13]. Screening was carried out through a step-by-step process (title → abstract → full text) to ensure that only relevant and reputable sources were included.

The research subjects consisted of scholarly documents, with the "informants" being the perspectives of authors as recorded in the texts. The sampling technique utilized purposive sampling (to select the most relevant and representative literature) and snowball sampling (to trace key references from selected studies). Data were collected through text extraction, which involved coding quotes, theories, concepts, and findings into analytical units. Data validation employed source triangulation, an audit trail (systematic documentation of selection and analysis processes), and peer debriefing or member checking with academic peers to ensure the credibility of interpretations [14].

Data analysis followed an inductive–deductive thematic analysis procedure. Initial codes were derived from the STEAS framework and educational leadership theories, followed by iterative reading, open coding, grouping of codes (axial coding), and the formation of central themes (selective coding). The analytical process followed the model proposed by Miles and Huberman—data reduction → data display → conclusion drawing/verification. The final outcome produced a relational thematic map and a conceptual framework illustrating how STEAS-based educational leadership influences teacher professional development across diverse educational contexts.

RESULTS AND DISCUSSION

The literature review of articles published between 2020 and 2025 reveals three major findings that explain the strong relationship between STEAS-based educational leadership and

teacher professional development processes. From this synthesis, it becomes evident that leadership is not merely managerial but functions as a transformative force connecting social values, technology, ecology, and science with collaborative teacher practices**.**

First, the findings emphasize that transformative leadership combined with social awareness serves as a critical catalyst for fostering professional collaboration. Nearly all reviewed studies underscore how a clear vision, teacher empowerment, and active participation in school communities create a conducive environment for the formation of *Professional Learning Communities* (PLCs). Roesminingsih and Windasari (2025) demonstrate that principals who embed social values and nurture community awareness successfully broaden teacher engagement across disciplines. Consequently, teacher professionalism develops not only in pedagogical domains but also within sociocultural dimensions that enrich collective experiences [8].

Second, the findings highlight the role of technology and science integration as the primary instruments of educational leadership in the digital era. The reviewed literature shows that leaders' capacity to guide the ethical use of digital technologies and scientific approaches has a direct impact on teacher professionalism. For instance, Murphy et al. (2023) describe how school principals in rural Australia leveraged community relations and simple technologies to support STEM education. In Indonesia, Laksmiwati et al. (2024) found that leadership responsive to technological developments encouraged teachers to explore more innovative and contextually relevant STEAM-based teaching methods for the 21st century [5].

Third, the findings emphasize the importance of ecological leadership that cultivates environmental awareness within sustainable educational practices. Recent literature confirms that the ecological dimension is an integral and inseparable part of the STEAS framework. Wibowo and Santosa (2025) demonstrate that leaders who foster ecological awareness and environmental responsibility inspire teachers to design learning activities centered on ecosystem-based issues [15]. This orientation not only enriches learning content but also aligns with the Sustainable Development Goals (SDGs), particularly those related to quality education and environmental sustainability.

Overall, these three findings illustrate that STEAS-based leadership cannot be detached from the integration of social, technological, scientific, and ecological values. The role of educational leaders in building transformative visions, managing science and technology, and nurturing environmental consciousness acts as a vital bridge in sustaining teacher professionalism. This demonstrates that the future direction of teacher development must not only focus on enhancing individual competencies but also strengthen collaborative networks and socio-environmental responsibility as part of a holistic educational ecosystem.

The findings of this study underline that STEAS-based educational leadership introduces a new paradigm for viewing teacher professional development comprehensively. Unlike previous studies that have largely focused on transformational or instructional leadership within partial frameworks (Grogan, 2024), this review emphasizes the need to expand leadership orientations to simultaneously encompass the social, technological, ecological, awareness, and scientific dimensions. Within this framework, leadership is no longer perceived merely as an instrument for managing learning strategies but as the foundation for building an intelligent, inclusive, and sustainable educational ecosystem.

This conclusion reinforces the argument that while transformational leadership is essential, it remains insufficient to address the complexities of 21st-century educational challenges. The study by Roesminingsih and Windasari (2025), which highlights the role of transformative leadership in

strengthening *Professional Learning Communities* (PLCs), remains relevant; however, the present findings extend this by showing that the inclusion of STEAS dimensions acts as an enabling component that ensures the long-term sustainability of teacher collaboration. Therefore, STEAS-based leadership can be understood as a conceptual expansion that unites individual, social, and ecological transformation.

The current findings also extend the scope of the study *How STEAM Professional Development Shapes Teacher Growth* (2025). Whereas that research emphasized the impact of professional development interventions on teachers' competencies, the present study adds a crucial layer by establishing that leadership serves as the central catalyst ensuring that teacher professionalism does not stop at the level of training outcomes but becomes deeply rooted within a sustainability-oriented school culture. In other words, STEAS-based leadership functions as the bridge between technical competency development and the cultivation of a collective ethos within educational settings.

From a social perspective, the relevance of this study becomes increasingly significant. Teachers in Indonesia often experience fragmented professionalism, as noted by Handayani and Rahardjo (2023). This situation demonstrates that teacher professionalism does not always evolve consistently or holistically. Through STEAS-based leadership, teacher development is directed not only toward improving technical skills but also toward internalizing social values, ecological awareness, and critical consciousness. These aspects are vital for shaping teachers as transformative agents capable of preparing future generations to confront global social and environmental complexities.

The theoretical contribution of this study lies in its enrichment of the discourse on educational leadership. While classical theories have primarily emphasized instructional or transformational aspects, this study introduces new perspectives through *ecological leadership* and *awareness-based leadership*. These two dimensions have rarely been highlighted in prior literature, yet both hold high relevance for the paradigm of sustainable education and the growing need for reflective ethics in leadership practice.

From a practical standpoint, the findings call for the design of educational leadership development programs that explicitly integrate the STEAS framework. Training for school principals and aspiring educational leaders, for instance, should not be limited to curriculum management, supervision, and instructional governance. Instead, it should also include capacity-building for developing technology-based school ecosystems, nurturing social awareness, and promoting environmental responsibility. In this way, leadership can become proactive in anticipating global challenges while reinforcing local resilience.

Finally, future research should move toward empirical field-based approaches. Phenomenological or case study designs are needed to explore the lived experiences of teachers and school leaders in applying STEAS leadership principles. Such approaches will enable a more contextual understanding of how leadership can transform teacher professionalism in real settings, while also providing a stronger foundation for the development of educational theory and policy in the future.

CONCLUSION AND RECOMMENDATIONS

This study confirms that educational leadership grounded in the STEAS framework (Social, Technology, Ecology, Awareness, and Science) occupies a strategic position in directing teacher

professional development, particularly within the context of the Society 5.0 era and the global Sustainable Development Goals (SDGs) agenda. The literature review shows that visionary, collaborative, and adaptive leadership styles are capable of shaping innovative yet sustainable learning ecosystems. The integration of social values, critical awareness, digital technology utilization, ecological responsibility, and scientific foundations positions educational leadership not merely as an administrative task but as the driving force behind transformation toward intelligent and competitive education.

Conceptually, this study enriches the body of knowledge by offering a new perspective on educational leadership through a holistic STEAS-based approach—a perspective still rarely explored in existing literature. Consequently, this research broadens the theoretical horizon of leadership models suitable for 21st-century education while clarifying the close relationship between teacher professionalism and the sustainability of educational systems.

From a practical dimension, the findings highlight the importance of strengthening leadership capacity—both among school principals and teachers—to effectively respond to the complexities of rapid technological, environmental, and sociocultural change. The implementation of the STEAS framework provides a foundation for schools to design more relevant, innovative, and sustainable teacher development programs.

At the policy level, these findings imply the need for public policy and regulations that emphasize transformative leadership and sustainability orientation. Governments, educational institutions, and teacher training bodies may use this study as a reference for developing human resource strategies aligned with SDG goals, particularly those related to quality education and environmentally conscious development.

Furthermore, this study opens pathways for future exploration through empirical and mixed-methods research to examine the real-world application of the STEAS conceptual framework in diverse educational leadership contexts. Future studies may investigate teachers' subjective experiences and the effectiveness of leadership practices in improving professional competencies and learning quality. Thus, the contribution of this study is both theoretical and strategic—providing a foundation for designing sustainable, adaptive, and future-oriented educational development.

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