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Science Based Competency of Teachers in Implementing *Tatanén di Bale Atikan*: An Analysis based on the Asia-Pacific ESD Teacher Competency Framework

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ABSTRACT
Education for Sustainable Development (ESD) serves as a strategic framework for cultivating students' character and ecological awareness from an early age. Primary school teachers hold a crucial role as change agents in embedding sustainability values within the learning process. This study aims to analyze elementary school teachers' competencies in implementing ESD through the Tatanén di Bale Atikan (TdBA) approach and to examine its alignment with the Asia-Pacific ESD Teacher Competency Framework. Employing a descriptive quantitative method, data were collected using a Likert-scale questionnaire (1–5) consisting of 15 competency indicators completed by 38 teachers from various elementary schools in Purwakarta Regency. The instrument encompassed three domains: Capacity to Create Learning, Capacity to Connect through Learning, and Capacity to Continue Learning. Data were analyzed using descriptive statistics. The findings reveal that all indicators achieved an average score above 3.5, with percentage achievements ranging from 71.58% to 92.63%. Teachers demonstrated strong performance in the domains of Capacity to Create Learning and Capacity to Continue Learning. However, the Capacity to Connect through Learning domain requires further improvement, particularly in aspects of community engagement, cross-sectoral collaboration, and sustainable professional development. These findings highlight the importance of reinforcing community-based continuous professional development to ensure a more comprehensive and sustainable integration of ESD within school practices.

Keywords: *teacher competence, ESD, basic education, TdBA, sustainability.*

INTRODUCTION

Education for Sustainable Development (ESD) has emerged as a global priority within the framework of the Sustainable Development Goals (SDGs), particularly Goal 4.7, which highlights the crucial role of education in fostering sustainable development, peace, and global citizenship (UNESCO, 2017). Achieving the SDGs requires an education system that embeds sustainability principles into the teaching and learning process, thereby enhancing the quality of human life for both present and future generations (Supriatna et al., 2018). Nevertheless, current educational practices in schools indicate that learning materials and pedagogical approaches are not yet fully aligned with environmental and sustainability oriented goals. The environment has not been optimally utilized as a primary learning resource, and the integration of local and global issues remains limited. In fact, fostering a sustainable and livable planet constitutes the core essence of ESD (Supriatna et al., 2018).

ESD serves as a transformative approach to empower individuals and communities in creating a sustainable future through informed decision-making and responsible action. Fundamentally, ESD is rooted in cultural awareness, emphasizing that there is no single universal pathway toward sustainable development (Listiawati, 2011). Within this context, teacher competence becomes a pivotal factor, as the success of ESD implementation largely depends on teachers' abilities to design, implement, and assess learning experiences that are contextually relevant and sustainability-oriented (Susanti et al., 2024). Therefore, strengthening teachers' understanding and capacity related to the concepts and practices of ESD is essential through systematic dissemination, professional development, and collaborative learning initiatives.

Prospective teachers, in particular, hold a strategic role in advancing sustainability through the integration of science, education, and community engagement (Ekahidayatullah & Uyun, 2024). Embedding SDG principles within elementary teacher education programs (PGSD) is especially critical, as primary education forms the foundation for shaping students' character, moral reasoning, and social responsibility. Elementary school teachers are therefore responsible for cultivating sustainable values and behaviors from an early age (Susanti et al., 2024). Implementing ESD at the elementary level can be realized through character-based education that promotes environmental awareness, social empathy, and holistic learning experiences (Satianingsih et al., 2024). For instance, simple daily practices such as bringing reusable tumblers instead of disposable plastic bottles, or using personal lunch containers instead of plastic packaging, can serve as practical steps toward nurturing sustainable habits among students.

One of the major breakthroughs in Indonesia's sustainability-oriented education policy is the Tatanén di Bale Atikan (TdBA) program, initiated by the Purwakarta Regency Government through the local Education Office (Drajat, 2022). This program aims to cultivate awareness, affection, and responsibility toward nature conservation through a comprehensive, integrative, and systemic educational approach. Recent studies have demonstrated that TdBA has positively influenced students' academic achievement, environmental attitudes, and practical skills (Hidayat, 2023). Moreover, it has been found to enhance ecological awareness, foster innovation, and support environmental preservation efforts (Rukajat et al., 2025). Implemented since 2021, TdBA adopts a project-based learning approach integrated across all school subjects, in which teachers serve as key facilitators and mentors throughout the learning process (Ismelani, Mahmudah, & Rosmaladewi, 2023).

The implementation of ESD through TdBA extends beyond the reforestation of school environments; it also reinforces character education through the Pancaniti educational model (Alindra et al., 2025). Pancaniti encompasses five core stages nitiharti (identify), nitisurti (understand), nitibukti (verify), nitibakti (apply), and nitisajati (belief) which reflect an epistemological process consistent with the scientific approach in ESD-based learning. This pedagogical model encourages teachers to design lesson plans that meaningfully connect curricular content with environmental realities, from planning to classroom implementation (Fauziah et al., 2024).

Conceptually, the TdBA approach aligns with the Asia-Pacific ESD Teacher Competency Framework, which is grounded in UNESCO's holistic and transformational education principles. The framework emphasizes the development of lifelong learning, cross-cultural collaboration, and adaptive capacity among teachers, taking into account the unique regional challenges of the Asia-Pacific such as cultural diversity, disaster vulnerability, rapid economic growth, and socio-political dynamics. It comprises three core competency domains: (1) Facilitating Learning, which involves designing meaningful and contextually relevant learning experiences addressing sustainability issues through participatory pedagogy and the integration of cultural values and technology; (2) Continuing to Learn and Create, which highlights reflective practice, continuous knowledge renewal, and pedagogical innovation; and (3) Connecting, Collaborating, and Engaging, which

focuses on building networks and partnerships with communities and stakeholders to enhance the impact of ESD (UNESCO, 2017).

Despite the growing attention toward ESD implementation, empirical research evaluating in-service teachers' competencies in implementing ESD within specific cultural contexts remains limited. Most existing studies have primarily examined teachers' perceptions or attitudes toward ESD (Guo et al., 2024; Lee, 2025; Mulyadi et al., 2023; Satianingsih et al., 2024), often overlooking situational factors essential to holistic ESD, such as local sociocultural contexts exemplified by programs like TdBA. Furthermore, while various assessment instruments have been developed to measure teachers' ESD competencies, their applicability tends to be confined to subject specific domains and rarely considers adaptation to locally driven initiatives (Eliyawati et al., 2023; Yang et al., 2024). Consequently, there is an urgent need to evaluate teacher competence in implementing ESD that is locally contextualized and aligned with community based programs such as TdBA.

Moreover, ESD has a strong epistemological and methodological connection with science education. Scientific literacy equips students to comprehend environmental systems, critically analyze sustainability challenges, and make informed, evidence based decisions (Bybee, 2020; Holbrook & Rannikmäe, 2022). Integrating science learning within ESD fosters inquiry, experimentation, and systems thinking competencies essential for addressing real world sustainability issues. Teachers' mastery of scientific concepts thus serves as a crucial foundation for designing meaningful and contextually relevant ESD learning experiences. This scientific orientation resonates with UNESCO's (2023) call to strengthen the integration of science, technology, and innovation within sustainability education.

Accordingly, this study aims to analyze the competencies of elementary school teachers in implementing Education for Sustainable Development (ESD) through the TdBA framework and to examine their alignment with the competency domains outlined in the Asia Pacific ESD Teacher Competency Framework (Okayama University, 2025). The novelty of this study lies in its contextual exploration of local wisdom rooted in Purwakarta's educational policy innovation that has evolved into a region wide sustainability initiative spanning elementary to secondary education. This research focuses on the elementary school level, recognizing that ecological awareness and sustainability literacy must be cultivated from early childhood as the foundation for developing future generations committed to sustainability.

METHODOLOGY

This study employed a descriptive quantitative approach, selected to provide an objective overview of elementary school teachers' competencies in implementing Education for Sustainable Development (ESD) through the *Tatanén di Bale Atikan* (TdBA) approach, and to examine their alignment with the Asia-Pacific ESD Teacher Competency Framework. The use of a descriptive quantitative design enables the researcher to present numerical data while interpreting the results in light of global and regional educational policies and frameworks related to ESD. The research participants comprised 38 elementary school teachers from Purwakarta Regency, Indonesia, selected through purposive sampling. The selection criteria focused on teachers who had previously participated in TdBA training programs, ensuring that respondents possessed direct experience and practical understanding of TdBA-based ESD implementation in classroom settings. The research was conducted over a five month period, from May to September 2025.

Data were collected using a structured questionnaire developed based on UNESCO's (2017) ESD teacher competency guidelines and the Asia-Pacific ESD Teacher Competency Framework, which were further contextualized to the Indonesian educational setting. The questionnaire

consisted of 15 indicators of ESD teacher competence, categorized into three core domains: Capacity to Create Learning, the ability to design and facilitate meaningful, sustainability-oriented learning experiences; Capacity to Connect through Learning, the ability to establish contextual linkages among subjects, cultures, and community issues; and Capacity to Continue Learning, the ability to engage in lifelong learning, reflection, and professional growth in relation to ESD.

Each indicator was measured using a five point Likert scale, ranging from 1 (never) to 5 (always), reflecting the frequency and consistency of teachers' practices in relation to each competency. The validity of the questionnaire items was assessed through expert judgment and pilot testing, as summarized in Table 1, ensuring that each indicator adequately represented the corresponding competency domain.

Table 1. The Validity of The Questionnaire

No	Statement (Summary)	r Item–Total	Description
1	The teacher is courageous in putting forward ideas to solve problems and finding new ways to improve learning.	0.662	Valid
2	The teacher teaches enthusiastically and instills sustainable values through TdBA.	0.555	Valid
3	The teacher collaborates with other teachers to ensure that teaching aligns with the values and culture of the community.	0.415	Valid
4	The teacher adapts to challenges in implementing TdBA teaching.	0.426	Valid
5	The teacher encourages students to think and actively participate in TdBA teaching.	0.551	Valid
6	The teacher involves the surrounding community as a learning resource.	0.698	Valid
7	The teacher guides students to collaborate and help each other.	0.676	Valid
8	The teacher shares experiences with other teachers inside and outside of school.	0.661	Valid
9	The teacher utilizes online learning resources to inspire students.	0.820	Valid
10	The teacher collaborates with farmer groups or related organizations	0.619	Valid
11	The teacher follows current social and environmental issues to improve TdBA teaching.	0.729	Valid
12	The teacher facilitates students' ability to ask questions and find answers on their own.	0.729	Valid
13	The teacher continuously improves teaching methods to achieve the TdBA objectives.	0.775	Valid
14	The teacher frequently participates in TdBA competency improvement training.	0.824	Valid
15	The teacher and students are open to giving and receiving feedback.	0.763	Valid

As presented in Table 1, the questionnaire was verified to be both valid ($r \geq 0.30$) and reliable, with a Cronbach's Alpha coefficient of 0.927, indicating a high level of internal consistency. These results confirm that the instrument developed to measure teacher competence in implementing ESD is psychometrically sound and suitable for research purposes. Respondents completed the questionnaire independently, following clear instructions to ensure that their responses accurately reflected the frequency of ESD-related practices carried out in their daily teaching activities. After data collection, the responses were analyzed using descriptive statistical techniques to calculate the mean score and percentage of achievement for each competency indicator. The resulting percentages were categorized as follows: Very Often (≥ 85%), Quite Often (70–84%), Rarely (50–69%), Never (< 50%).

These categories provided a clear overview of the extent to which teachers implemented ESD competencies in their classroom practices.

To ensure the validity of the findings, teachers were reminded to provide responses based on their actual instructional experiences related to TdBA implementation. Furthermore, the quantitative results were triangulated with qualitative insights derived from international policy frameworks, particularly *Education for Sustainable Development Goals: Learning Objectives* (UNESCO, 2017) and the *Asia-Pacific ESD Teacher Competency Framework* (Okayama University, 2025). This comparative analysis aimed to evaluate the alignment between teachers' practices and globally recognized ESD competency standards, thereby identifying specific domains that require further development and professional strengthening.

RESULT AND DISCUSSION

Competence of Elementary School Teachers in the Implementation of ESD through the Tatanén di Bale Atikan (TdBA) Program

The findings of this study illustrate the competence levels of elementary school teachers in Purwakarta Regency in implementing Education for Sustainable Development (ESD) through the Tatanén di Bale Atikan (TdBA) program. The analysis was conducted based on the Asia-Pacific ESD Teacher Competency Framework, which comprises three principal domains: (1) Capacity to Create Learning, (2) Capacity to Connect through Learning, and (3) Capacity to Continue Learning (Okayama University, 2025; UNESCO, 2017). Data were obtained from 38 elementary school teachers who served as respondents. Teachers' competencies were measured using 15 indicators assessed on a five point Likert scale (1–5). The descriptive analysis revealed that all indicators had an average score exceeding 3.5, with an achievement percentage ranging from 71.58% to 92.63%, indicating a generally high level of competence among participants.

Among the three domains, the Capacity to Create Learning demonstrated the highest average achievement score of 88.11%, categorized as frequent. This suggests that teachers are highly capable of designing and facilitating learning experiences that integrate sustainability concepts into classroom practices. The Capacity to Continue Learning domain followed with an achievement level of 80.26%, while the Capacity to Connect through Learning domain obtained 78.74%, both categorized as quite frequent. These results indicate that elementary school teachers in Purwakarta have actively incorporated sustainability-oriented pedagogical strategies through the TdBA framework. However, there remains potential for further enhancement in competencies related to collaboration, contextual integration, and continuous professional development. A summary of teacher competency achievements by domain and indicator is presented in Table 2.

Table 2. Competency Analysis of Teacher ESD Implementation within the Asia-Pacific ESD Teacher Competency Framework

Domain	Indicator	Average	Achievement Percentage	Category
Capacity to Create Learning	Agency	4.29	85.79%	Quite often
	Commitment	4.45	88.95%	Quite often
	Collegiality	4.63	92.63%	Often
	Flexibility	4.45	88.95%	Quite often
	Student-Oriented	4.55	91.05%	Often
Capacity to Connect through Learning	Connection	3.71	74.21%	Quite often
	Collaboration	4.61	92.11%	Often

Domain	Indicator	Average	Achievement Percentage	Category
	Sharing	3.84	76.84%	Quite often
	Technology	3.95	78.95%	Quite often
	Action	3.58	71.58%	Quite often
Capacity to Continue Learning	Open Eyes on Society	3.82	76.32%	Quite often
	Inquiry-Based	4.26	85.26%	Quite often
	Self-Improvement	3.89	77.89%	Quite often
	Capacity Building	4	80.00%	Quite often
	Learning Together	4.34	86.84%	Quite often

Based on the results presented in Table 1, the Collegiality indicator achieved the highest mean score of 4.63 (92.63%), indicating that teachers are able to establish cross disciplinary collaborative networks with colleagues to support joint learning initiatives. Similarly, the Collaboration indicator obtained a high score of 4.61 (92.11%), reflecting that teachers actively facilitate collaborative learning among students to foster mutual understanding and shared inquiry (Kohl & Hopkins, 2022). The Student-Oriented indicator also demonstrated a strong result of 4.55 (91.05%), suggesting that teachers consistently prioritize students' needs through exploratory, participatory, and inquiry based learning approaches. Collectively, these three indicators illustrate that participatory, reflective, and inclusive pedagogical practices have been well integrated into teachers' daily teaching activities within the ESD framework (Susanti et al., 2024). Such practices are aligned with the principles of transformative learning, which emphasize learner engagement, critical reflection, and co-construction of knowledge as key components of sustainability oriented education.

Conversely, the Action indicator recorded the lowest mean score of 3.58 (71.58%), which measures the extent to which teachers collaborate with external partners such as non governmental organizations (NGOs), business entities, or government agencies to extend the broader impact of sustainability learning. This relatively low score suggests that cross sector collaboration is still limited and not yet embedded as a dominant practice among teachers. In addition, the Connection (74.21%) and Sharing (76.84%) indicators also exhibited comparatively lower results. The Connection indicator assesses teachers' ability to link classroom learning with local community contexts, utilizing environmental and cultural settings as meaningful learning resources (Fatimah, 2024). Meanwhile, the Sharing indicator measures teachers' tendency to exchange ideas, experiences, and reflective practices with peers to strengthen professional learning communities.

These findings indicate that while teachers demonstrate strong pedagogical and reflective competencies, the social dimension of ESD competence particularly in terms of network-building, knowledge sharing, and institutional collaboration still requires further enhancement. This is consistent with Yu et al. (2025), who emphasize the importance of systemic collaboration between educational institutions, policymakers, and community stakeholders to reinforce ESD implementation. Strengthening these aspects could empower teachers to play a more active role as agents of change, promoting sustainable practices beyond the classroom level..

Overall, eight (8) indicators fall into the "frequently" category (achievement percentage ≥ 85%), while the remaining seven (7) indicators are classified as "fairly frequent" (70–84%). Among the high performing indicators, Commitment (88.95%) reflects teachers' strong sense of purpose and dedication in achieving clearly defined teaching goals. The Flexibility indicator (88.95%)

demonstrates teachers' ability to respond proactively to challenges through inquiry based learning approaches, while the Agency indicator (85.79%) indicates that teachers are capable of viewing challenges as opportunities for personal and professional growth, exhibiting autonomy and responsibility in their practices.

In the domain of sustainable self development, the Self-Improvement indicator (77.89%) shows that teachers have made efforts to enhance their teaching strategies continuously, though these efforts have yet to reach an optimal level. The Capacity Building indicator (80.00%) suggests that participation in training and peer-learning activities is relatively strong, supporting the enhancement of pedagogical competence. Meanwhile, the Open Eyes on Society indicator (76.32%) illustrates that teachers have begun integrating current social and environmental issues into classroom learning, and the Learning Together indicator (86.84%) signifies the progressive establishment of a collaborative learning culture between teachers and students.

The analysis across the three domains of the Asia-Pacific ESD Teacher Competency Framework Capacity to Create Learning, Capacity to Connect through Learning, and Capacity to Continue Learning reveals that elementary school teachers in Purwakarta demonstrate a generally good level of competence in implementing Education for Sustainable Development (ESD) through the Tatanén di Bale Atikan (TdBA) program. Each domain reflects teachers' ability to design meaningful learning experiences, build connections with communities and external institutions, and sustain continuous professional growth (Susanti et al., 2024).

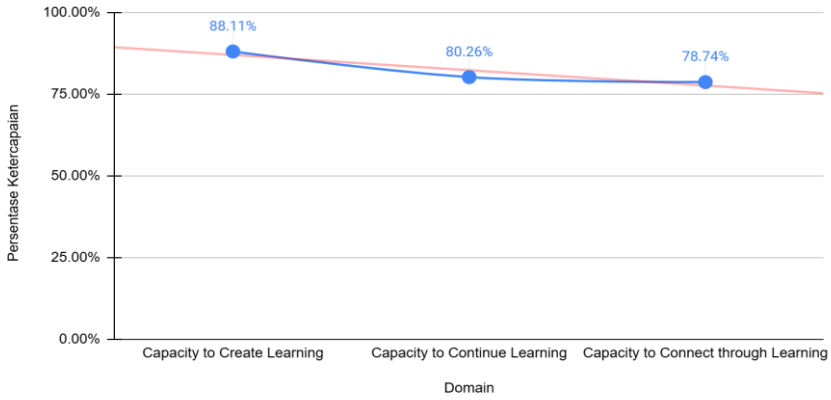

Figure 1. Percentage of Teacher ESD Competency Implementation in the Asia-Pacific ESD Teacher Competency Framework

Based on Figure 1, it can be observed that the competence of elementary school teachers in Purwakarta in implementing Education for Sustainable Development (ESD) through the Tatanén di Bale Atikan (TdBA) approach demonstrates relatively high achievements across the three main domains of the Asia-Pacific ESD Teacher Competency Framework. The Capacity to Create Learning domain recorded the highest achievement at 88.11%, followed by Capacity to Continue Learning at 80.26% and Capacity to Connect through Learning at 78.74%.

These variations in domain performance indicate that teachers' primary strengths lie in their ability to design and facilitate meaningful learning experiences. However, the capacity to establish connections with communities and to leverage external networks for learning still requires further enhancement. This finding aligns with UNESCO's (2017) assertion that effective ESD implementation requires a balanced development among three dimensions: the creation of quality learning experiences, social connectedness, and continuous professional growth. Similarly, Stouthart et al. (2023) emphasize that teachers regardless of their disciplinary background must continuously enhance their competencies to effectively design and implement learning activities that address sustainability issues.

Capacity to Create Learning

The Capacity to Create Learning domain demonstrated the highest achievement percentage (88.11%) compared to the other two domains. This result indicates that teachers have consistently designed meaningful, contextual, and sustainability oriented learning experiences (UNESCO, 2021; Fischer et al., 2024). This domain reflects teachers' ability to design, facilitate, and manage participatory, contextual, and student centered learning processes (Vilmala et al., 2022). Through such approaches, students become actively engaged in learning while connecting instructional content to real life contexts. Within the ESD framework, this capacity is essential for fostering environmental awareness and critical thinking from an early age by integrating sustainability themes into classroom activities (UNESCO, 2017).

The findings reveal that Capacity to Create Learning represents the primary strength of elementary school teachers in Purwakarta. The Collegiality indicator achieved the highest score (92.63%), followed by Student Oriented (91.05%), Commitment (88.95%), and Flexibility (88.95%). These achievements demonstrate that teachers have established strong professional collaboration, prioritized student centered learning, and adapted effectively to the dynamic nature of ESD based education. These results are consistent with the report by Okayama University (2025), which highlights that teachers' capacity to foster collaborative learning is a critical factor in the successful implementation of ESD in primary education. Furthermore, teachers' collaboration and adaptability are vital for advancing transformative pedagogical practices within sustainability education (Imara & Altinay, 2021).

Moving forward, this strength can be sustained and enhanced through the development of teaching modules rooted in local wisdom, inquiry based approaches, and interschool collaborative training. Such initiatives can help maintain the consistency and quality of sustainability oriented learning. In the context of science based learning, teachers who can effectively connect sustainability concepts with natural phenomena, environmental data, and experimental inquiry tend to demonstrate higher levels of ESD competence (Figueirô & Raufflet, 2023). This integration enables students to engage in evidence based discussions on ecological and social challenges, thereby enhancing both scientific literacy and sustainability awareness. The TdBA approach, which emphasizes contextual learning through local environmental exploration, offers a practical framework for integrating scientific processes such as observation, data collection, and analysis into everyday classroom practices, as illustrated in Figure 2.

Figure 2. Integration of Ecological Awareness and Sustainability Literacy in Several Elementary Schools

Figure 2 illustrates that each school integrates sustainability values into TdBA activities through diverse and context specific approaches, reflecting their unique environmental conditions and available resources. For example, School A transforms its schoolyard into a living laboratory,

enabling students to observe ecological processes directly and to comprehend the interdependence within environmental systems. Schools B and E focus on cultivating and harvesting vegetables as well as rosella tea plants, thereby equipping students with practical agricultural skills while fostering independence, responsibility, and stewardship in managing natural resources. In contrast, School C implements eco printing activities using papaya leaves to substitute synthetic materials. This initiative not only enhances students' creativity and appreciation for natural materials but also promotes environmentally conscious innovation. School D employs the Pancaniti approach to integrate reflective learning that links sustainability concepts with moral, social, and cultural values. Meanwhile, School F institutionalizes regular TdBA practices, allowing sustainability oriented habits to become an inherent part of students' daily behavior.

The diversity of these practices demonstrates that the integration of sustainability literacy within TdBA extends beyond conceptual knowledge. It cultivates ecological awareness, practical life skills, and tangible pro environmental behaviors. These varied implementations affirm that sustainability education in primary schools can be effectively contextualized according to local wisdom and school culture, while maintaining alignment with the fundamental principles of ESD.

Capacity to Continue Learning

The Capacity to Continue Learning domain achieved an overall score of 80.26%, ranking second after the Capacity to Create Learning domain. This domain reflects teachers' ability to continuously update their pedagogical knowledge and professional skills through reflection, lifelong learning, and adaptation to emerging educational and societal developments (Purnamasari & Nurawaliyah, 2023). In the context of Education for Sustainable Development (ESD), this competency is essential for maintaining the relevance of classroom practices by integrating the latest advancements in science, technology, and sustainability issues (UNESCO, 2017; Okayama University, 2025). Strengthening this capacity enables teachers to align their instructional practices with contemporary educational needs and both local and global sustainability challenges (Jaya et al., 2023).

The analysis revealed that the highest indicator within this domain was Learning Together (86.84%), followed by Inquiry Based Learning (85.26%). These results indicate that teachers have begun fostering a culture of collaborative learning with students and are increasingly applying inquiry based approaches to enhance student engagement and active participation. However, the relatively lower scores in Self Improvement (77.89%) and Open Eyes on Society (76.32%) suggest that, while collective learning practices are emerging, teachers' awareness of socio environmental issues and their efforts toward continuous professional development require further reinforcement.

To address these gaps, several strategies can be employed. The establishment of cross school professional learning communities can facilitate shared reflection and exchange of best practices. Additionally, providing training programs based on local case studies and organizing reflective workshops can help teachers strengthen their competencies across all indicators in a more balanced manner. As emphasized by Vičič Krabonja et al. (2024), professional learning communities play a crucial role in sustaining teacher development through collaborative learning contexts. Similarly, Scheie et al. (2025) highlight that teachers who engage in the design and implementation of interdisciplinary, self-developed ESD curricula enhance their adaptive and collaborative learning capacities, thereby fostering a culture of continuous professional growth..

Capacity to Connect through Learning

The Capacity to Connect through Learning domain obtained the lowest achievement percentage among the three domains, with a score of 78.74%. This domain emphasizes teachers' ability to link classroom learning with real-world contexts through community engagement, the use of technology, and cross-sectoral partnerships. Within the framework of Education for Sustainable

Development (ESD), this capacity is crucial, as it enables students to recognize the interconnectedness between academic knowledge and its practical application in everyday life, both locally and globally (UNESCO, 2017; Fischer et al., 2024).The findings indicate that the Collaboration indicator achieved the highest score (92.11%), reflecting teachers' ability to facilitate effective cooperation among students. However, the indicators of Action (71.58%), Connection (74.21%), and Sharing (76.84%) demonstrated lower levels of achievement. These results suggest that cross-sectoral collaboration, engagement with local communities as learning resources, and the dissemination of best practices have not yet become well-established practices among teachers (Vilmala et al., 2022).

To strengthen this capacity, teachers require institutional support in establishing strategic partnerships with external organizations, expanding the utilization of community resources, and integrating digital literacy into learning activities. This recommendation aligns with the perspective of Okayama University (2025), which emphasizes that the success of ESD relies on multi-stakeholder collaboration and the optimal use of technology to broaden the impact of learning. Furthermore, reinforcing the connection between classroom-based science learning and community-centered sustainability issues is essential. Wals and Corcoran (2022) highlight that ESD should encourage teachers to design science inquiries that utilize real data from local ecosystems, community experiments, or citizen science initiatives. Through such approaches, students can perceive science as a means to understand and improve their environment, while teachers assume the role of facilitators who bridge scientific inquiry with social realities. In addition, the integration of Pancaniti a framework relevant to scientific approaches within ESD can enhance elementary students' ecological awareness, sustainability literacy, and scientific literacy.

Overall, the findings reveal that elementary school teachers in Purwakarta Regency involved in the implementation of Tatanén di Bale Atikan (TdBA) demonstrate commendable competence in applying ESD principles based on the Asia-Pacific ESD Teacher Competency Framework. Teachers performed well in the Capacity to Create Learning and Capacity to Continue Learning domains. However, the Capacity to Connect through Learning domain requires further improvement, particularly in aspects related to community engagement, cross sector partnerships, and sustainable professional development. These improvements can be achieved by expanding training programs that integrate local case studies and sustainability practices, thereby enabling teachers to connect learning processes more effectively with social and environmental realities.

CONCLUSION

This study demonstrates that elementary school teachers in Purwakarta Regency who are involved in the implementation of Tatanén di Bale Atikan (TdBA) possess a strong level of competence in implementing Education for Sustainable Development (ESD) based on the Asia-Pacific ESD Teacher Competency Framework. Among the three domains, the Capacity to Create Learning achieved the highest score, reflecting teachers' ability to design and facilitate meaningful, participatory, and sustainability oriented learning experiences. The Capacity to Continue Learning and Capacity to Connect through Learning domains were also categorized as relatively high, yet these areas still require reinforcement particularly in indicators related to community engagement, cross-sectoral collaboration, and sustainable professional development. To address these aspects, it is recommended that training programs be expanded to incorporate local case studies and sustainability practices, enabling teachers to more effectively relate classroom learning to social and environmental realities. Furthermore, collaboration in developing teaching modules that integrate local wisdom and global sustainability issues should be strengthened. Enhancing teachers' digital literacy is also essential to support the use of technology for expanding professional networks, accessing global learning resources, and disseminating innovative pedagogical practices. The integration of science within ESD teacher competencies underscores the vital role of scientific

literacy in advancing sustainability-oriented education. Through science-based inquiry, contextual learning, and environmental observation, students can deepen their understanding of sustainability concepts while teachers enhance their ability to bridge theoretical knowledge with real-world environmental and societal challenges.

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