Primary teacher backgrounds and ESD competencies: An exploratory study

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Abstract
Education for Sustainable Development (ESD) emphasizes the crucial role of teachers in cultivating students' sustainability competencies. However, studies on how teachers' background characteristics relate to their ESD competencies remain limited, particularly at the primary school level. This study examined whether widely assumed demographic and administrative differences among teachers including gender, years of teaching experience, and employment status are associated with their ESD competence. A quantitative correlational design was employed using the Chi-Square test to analyze the association between gender and competence, and the Kruskal-Wallis test to assess the relationship between teaching experience and employment status to examine group-based differences and associations among demographic variables. The findings indicate no statistically significant differences across all variables. Gender was not associated with teachers' ESD competence ($p = 0.102$), and competence levels did not differ significantly by teaching duration ($p = 0.740$) or employment status ($p = 0.443$). These results suggest that demographic and administrative characteristics are not decisive in shaping teachers' ESD competencies, providing a broadly inclusive teacher training and curriculum initiatives. The study contributes to the conceptual insights for framing inclusive ESD primary teacher competencies. This implies that strengthening ESD implementation at the primary level requires sustained training programs, practical teaching materials, and a supportive school culture that empowers teachers to embed sustainability concepts into early learning. Future studies are recommended to investigate systemic and school-level factors such as curriculum design, leadership practices, and community engagement that may better explain variations in ESD competence among primary school teachers.

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1. Introduction

The global concern about sustainable development has rapidly transformed the societal paradigm, leading us to put our best efforts into addressing this issue. The presence of Education for Sustainable Development (ESD) has been a crucial key to addressing concerns regarding future sustainability (Dittrich, 2025), for more socially just and equitable societies (Cebrián et al., 2020). Moreover, the United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2020) declared that ESD must be acknowledged as a pivotal part of education; therefore, educational institutions must foster competencies for sustainable development. Based on one of UNESCO's ESD agendas for 2030 (Rundgren & Yamada, 2023), education is directed toward building capacities for educators, indicating that training and strengthening pedagogical competence are necessary. Educators become key actors responsible for translating ESD policies into school and classroom-level practices (Waltner et al., 2020). Especially in Indonesian primary education, teachers have a strategic position in integrating ESD within classroom practices (Kartono et al., 2026). For this reason, teachers in this context have an essential role, not only in possessing suitable knowledge regarding ESD, but also in integrating it into their teaching practice (Asikainen et al., 2025). However, despite teachers' central role in promoting ESD, empirical evidence on how teachers' background characteristics, including gender, teaching experience, and employment status, are associated with their ESD competencies remains constrained, especially in the context of Indonesian primary education.

ESD competencies refer to the skills and knowledge educators must develop to facilitate learning (Cebrián et al., 2020). UNECE (2012) outlined key ESD competencies for educators across three pillars: a holistic approach that emphasizes systems thinking and diverse perspectives, envisioning change through critical reflection and future-oriented action and achieving transformation toward sustainability. Rieckman (2018) emphasized that ESD equips individuals including systems thinking, anticipatory, normative, strategic, collaborative, critical thinking, self-awareness, and integrated problem-solving competencies. UNESCO (2020)

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identified five competencies: systemic, reflective, collaborative, critical, and strategic action. The principles of transformative pedagogy embrace a learner-centered, contextual, collaborative, action-based, and values-based approach. These competencies highlight individuals who possess sustainability knowledge, implement sustainable pedagogical practices, educators who highly value sustainability, and community actors who take collaborative action. In this study, ESD competencies were developed by synthesizing frameworks from UNECE's Learning for the Future, Rieckmann's Key Competencies for Sustainability, and UNESCO's ESD for 2030. These frameworks were integrated into four dimensions for primary school teachers: (1) cognitive competence, reflecting knowledge of sustainability; (2) pedagogical competence, regarding the sustainable pedagogical practices; (3) affective competence, showing values on sustainability; and (4) participatory competence, reflecting engagement in collaborative-sustainability practices. Within this framework-informed knowledge for ESD competence, teacher background characteristics such as gender, teaching experience, and employment status are commonly assumed to shape how these competencies are formed and enacted. Socio-demographic factors have been shown to influence teachers' professional orientations, beliefs, and engagement with ESD implementation (Bulut & Oksuzoglu, 2025).

Integrating ESD into the primary school education is essential, as this stage marks the early development of students' understanding, particularly of their surroundings. The children begin to distinguish themselves from their environment, making it clear that the foundations of personality are formed during this stage (Lamanauskas, 2023). As mentioned by García-González et al. (2020), education must equip all students with both theoretical and practical knowledge to promote sustainable development by 2030; thus, ESD should begin at an early age, as this will also give children and youth more hope for the future and a sustainable world (Nguyen et al., 2022; Vesterinen & Ratinen, 2024), particularly emphasizing the development of students' connections with nature (Vesterinen & Ratinen, 2024). For instance, in hands-on activities conducted by Kadji-Beltrán (2024) for preservice teachers, they demonstrated competence in sustainable education through the living lab project. On the other hand, with the help of the latest technology, artificial intelligence such as ChatGPT can enhance pre-service teachers' understanding and their pedagogical knowledge of Sustainable development (Kayaalp et al., 2025). Since early education holds significant potential for cultivating values, behaviors, and skills that support sustainable development, it is particularly crucial for primary school teachers, who play a key role in guiding children to understand and embrace sustainable development (Lamanauskas & Malinauskienė, 2024). However, limited knowledge and misconceptions about environmental education among educators may result in disruptive attitudes and behaviors, potentially hindering students' cognitive development in understanding environmental issues (Petkou et al., 2021).

Despite the importance of sustainable development in education, challenges persist in equipping teachers with the necessary competencies for this goal. A global survey of 58,000 teachers revealed that 1 in 4 teachers do not feel ready to teach ESD-related themes. One reason is that teachers are often unaware of ESD and tend to respond inappropriately to the changing needs of education (Rundgren & Yamada, 2023). Besides insufficient awareness, a lack of professional knowledge, and underrepresentation of ESD in instruction, these factors also serve as reasons (Dittrich, 2025). As UNESCO calls for acknowledging educational programs for sustainable development literacy, many academic fields in different countries still encounter varying levels of ESD integration (Yang et al., 2024). Teacher demographics significantly influence their dedication to sustainability and mindfulness practices, shaping knowledge, attitudes, and abilities; therefore, it is essential to understand the transformative impact of these demographic variables (Işıkgöz, 2025). Several background factors, such as gender, teaching experience, and employment status, significantly influence teachers' competencies and readiness to effectively teach ESD (UNESCO, 2021). Moreover, several studies have shown that individual and professional characteristics of teachers, such as gender (Işıkgöz, 2025; Nguyen et al., 2022) and the length of teaching experience (Chowdhury et al., 2021; UNESCO, 2021), have the potential to influence the level of ESD knowledge. However, a study by Muguerza & Chalmeta (2020) found no significant difference between permanent and contract teachers in knowledge related to sustainability. Despite the variation in results, more study is needed, as it is crucial to understand whether teachers' attributes and aspects of their teaching contexts affect the development of specific competences in ESD (Corres et al., 2024). Previous studies have reported mixed findings regarding the role of teacher demographic characteristics in ESD-related competence. While some studies suggest that gender and teaching experience are associated with teachers' sustainability competence, other findings on employment status suggest no significant differences. These varied results indicate that the influence of teacher background variables remains unresolved. Moreover, those studies have focused on selected background variables, whereas multiple characteristics were not examined simultaneously.

Given this context, further investigation is needed to explore how teachers' background factors, particularly gender, teaching experience, and employment status, may relate to their ESD competencies, especially in the primary education context. While some of these variables have been studied separately, there is a lack of integrative, correlational studies examining the combined demographic factors and their effects on ESD competencies. Thus, this study aims to explore whether teachers' background, such as gender, teaching experience, and employment status, are significantly associated with primary school teachers' competencies in implementing Education for Sustainable Development (ESD) in classroom practice. By examining the relationship between those demographic variables and ESD competencies among primary school teachers, this

study contributes to the empirical literature on ESD implementation at the elementary level, especially from the teachers' perspective. The findings are expected to advocate for education policymakers, school leaders, and curriculum developers in designing more targeted professional development programs to enhance teachers' competence to integrate sustainability education from earlier phases of education.

2. Method

To illustrate the research flow of this study, Figure 1 presents the overall workflow of this correlational study, encompassing variable and instrument selection, instrument finalization, data collection, data analysis, and interpretation.

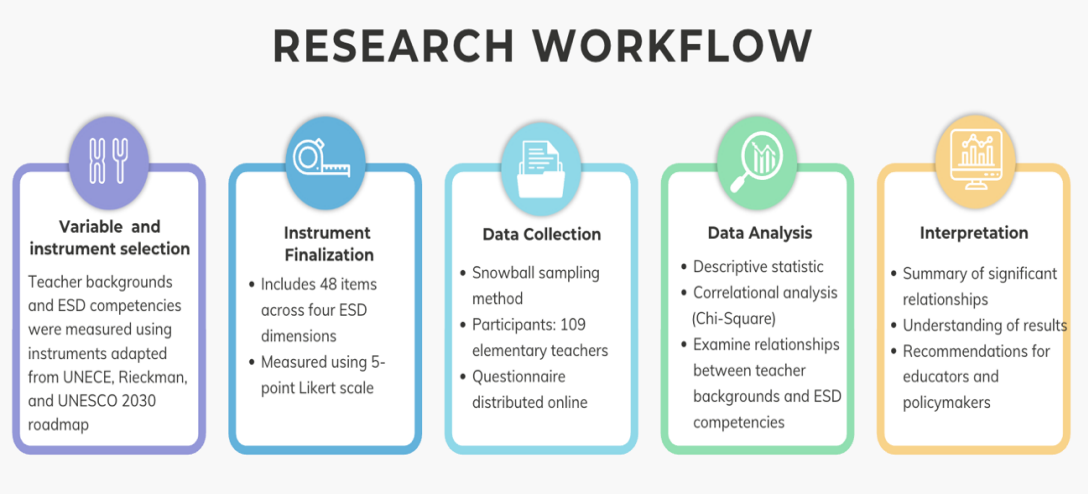

Figure 1. Research Workflow

2.1. Research Design

This study employed a quantitative correlational design to investigate the correlation between primary school teachers' backgrounds (gender, years of teaching experience, and employment status) and their ESD competencies in their teaching practices. This design was chosen, as it allows for a systematic study of naturally occurring relationships between teacher background characteristics and ESD competence, where the variables cannot be manipulated, and the research objective is to identify relational tendencies rather than causal mechanisms. The purpose of conducting correlational studies is to discover and measure relationships between two or more variables (Mertler, 2019). A survey was used to collect data and measure patterns and associations across variables. In short, this design was selected for its strength in identifying trends and testing relationships in a natural educational context without manipulating any variables.

2.2. Participants

The study involved 109 elementary school teachers selected through a snowball sampling method. The sampling technique was chosen considering accessibility and convenience for participants (Wang et al., 2025). Initial participants who met the inclusion criterion of actively teaching at the primary school level were invited to complete the survey and share it with other eligible teachers in their professional networks. The researchers distributed the questionnaires to their colleagues and invited them to share the survey with other primary school teachers via social media applications such as WhatsApp and Facebook. Participants (N = 109) from 9 provinces in Indonesia, spanning the islands of Java, Sumatra, and Papua, voluntarily completed an online structured questionnaire. Given the network-based recruitment approach, the findings aim to provide an exploratory understanding of the relationships among variables rather than broad generalizations.

2.3. Instruments

The instrument was developed using a framework-informed approach. Indicators from the UNECE (2012), Rieckmann (2018), and UNESCO (2020) ESD frameworks (Table 1) were synthesized to identify domains of teacher ESD competence, which were then translated into relevant and observable indicators for primary school education.

Table 1. Framework-Informed ESD Competence Dimensions

Dimensions	Core Competency Indicators	Framework
Knowledge	Systemic, anticipatory, normative	UNECE, Rieckmann, UNESCO
Pedagogic	Reflective, contextual, project-based	UNESCO, UNECE
Affection	Empathy, values, responsibility, integrity	UNECE, Rieckmann
Participation & Action	Collaboration, leadership, advocacy	Rieckmann, UNESCO

The research instrument was a questionnaire comprising 48 items distributed across four dimensions of ESD competencies. The instruments developed encompass the cognitive, pedagogical, affective, and participatory/active dimensions, all measured using a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The distribution of items is presented in Table 2.

Table 2. Distribution of Item According to ESD Competency

No	Dimension of ESD Competence	Description	Number of Question
1	Cognitive Dimension	Understanding of sustainability issues and ability to think systematically	7
2	Pedagogical Dimension	The ability to design, implement, and evaluate ESD learning in a contextual and transformative manner	18
3	Affective Dimension	Values, empathy, and personal responsibility for sustainability	11
4	Participatory/Action Dimension	Engagement in concrete actions, community collaboration, and change leadership	12

Content validity was established through expert-based conceptual review, in which the synthesized indicators and draft items were examined by senior academics with expertise in sustainable development and education to ensure relevance, clarity, and alignment with the intended ESD competence constructs prior to data collection.

2.4. Data Analysis

The data analysis techniques used to describe each dimension of ESD Competence are descriptive statistics. While correlational analysis was conducted to examine the relationships between background variables and teacher competencies, as follows:

a. The relationship between gender and ESD competencies was analyzed using the Chi-Square test, as the variables are categorical

b. The relationship between teaching experience (in years) and competency levels was analyzed using the Kruskal-Wallis test, as teaching experience was grouped into ordinal categories and the competence scores did not assume a normal distribution

c. The relationship between employment status and competencies was analyzed using the Kruskal-Wallis test for competence levels across independent groups with non-parametric data.

3. Results and Discussion

The purpose of this study is to investigate teachers' demographic backgrounds, especially gender, teaching experience, and employment status, and their competencies in implementing Education for Sustainable Development (ESD) in classroom practice. This research further examines the relationship between these demographic factors and the ESD competencies of primary school teachers.

3.1. Respondents' Demographic Profile

To facilitate an accurate interpretation of the research findings, this section begins with a description of the respondents' demographic profile. Data regarding the distribution of gender, type of employment status, and range of teaching experience among participants serve as a crucial contextual foundation. The distribution of respondents by gender is presented in Figure 2.

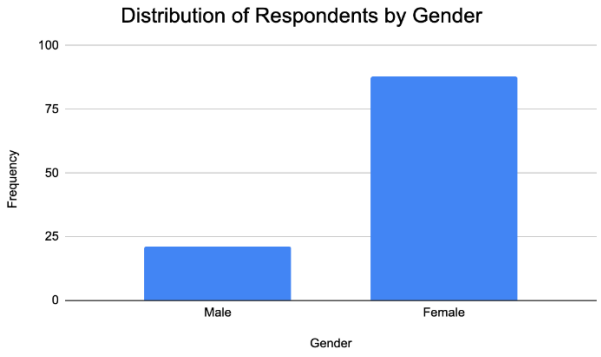

Figure 2. Distribution of Respondents by Gender

Based on Figure 2, this study involved a total of 109 teachers as participants, with a gender distribution of 21 male teachers and 88 female teachers. This composition reflects that the majority of respondents in this study were female teachers, a dominating demographic characteristic in the primary school environment targeted by the research. Furthermore, to provide a more comprehensive overview of the respondents' background, this study also identified their employment status. The participants' profiles concerning their employment status are illustrated in Figure 3.

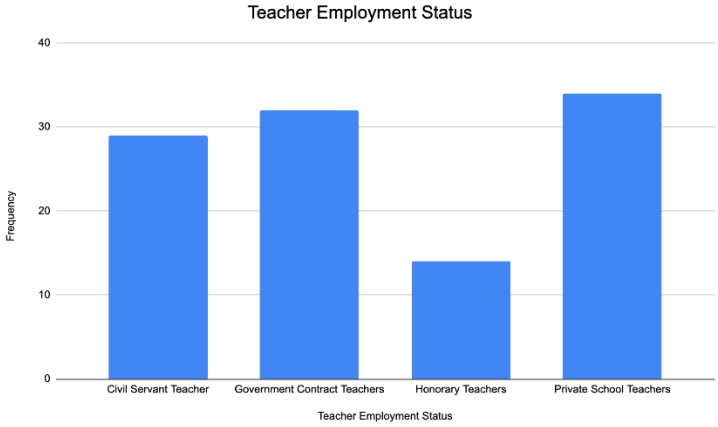

Figure 3. Employment Status of Participants

The distribution of respondents by type of employment status reveals significant diversity among the research participants. Out of a total of 109 teachers, Private school teachers constitute the largest group with 34 respondents. This is followed by the Government Contract Teacher with 32 respondents. Meanwhile, a Civil Servant teacher contributed 29 respondents. The smallest group is Honorary Teachers, numbering 14 respondents. To complete the demographic profile of the respondents, this study also identified their range of teaching experience. The participants' profiles regarding their teaching experience (in years) are outlined in Figure 4.

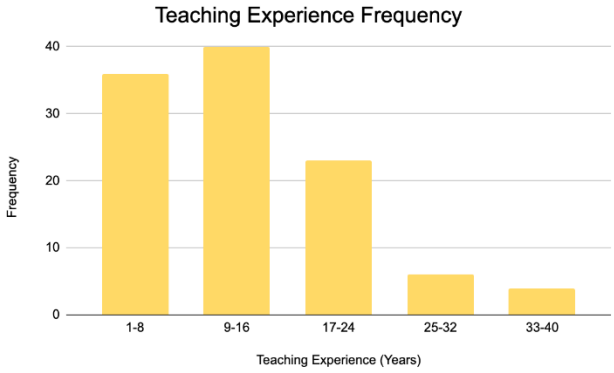

Figure 4. Teaching Experience Frequency

The analysis of teaching experience among the 109 participating teachers reveals a wide variation in years of service. The highest proportion of respondents (40 teachers; 36.7%) reported having 9-16 years of teaching experience, followed closely by those in the 1-8 years category (36 teachers; 33%). Meanwhile, 23 teachers (21.1%) had been teaching for 17-24 years, while only 6 teachers (5.5%) reported teaching experience of 25-32 years. The smallest group comprised teachers with 33-40 years of experience, represented by 4 teachers (3.7%). Overall, the data suggest that the majority of respondents fall within early to mid-career stages (1-16 years), accounting for 69.7% of the sample. In contrast, relatively few teachers have more than 25 years of experience. Table 3 shown a descriptive analysis of teachers' esd competencies.

Table 3. Descriptive Analysis of Teachers' ESD Competencies

No	ESD Dimension Competency	Std	Mode	Mean
1	Cognitive Dimension	10.33	100	86.60
2	Pedagogical Dimension	9.29	100	87.67
3	Affective Dimension	10.05	100	87.36
4	Participatory/Action Dimension	10.08	80	85.21
	Average of Dimension ESD			86.71

The descriptive analysis of teachers' competencies in implementing Education for Sustainable Development (ESD) reveals relatively high average scores across all four measured dimensions. The pedagogical Dimension showed the highest mean score (87.67), followed closely by the Affective Dimension (87.36) and the Cognitive Dimension (86,60). The Participatory/Action Dimension had the lowest mean (85.21), though still indicating a strong level of competency. The overall average across dimensions was 86.71, suggesting that primary school teachers demonstrate a consistently good level of ESD competency in classroom practice. The data also show high mode values, mostly 100 across three dimensions, indicating a concentration of responses at the highest level on the scale.

Following the descriptive analysis of ESD competencies across various demographic groups, further statistical tests were conducted to examine whether there were significant relationships between demographic variables and the levels of competency. In this study, Chi-Square Analysis was employed to assess the association between gender, and Kruskal-Wallis was employed to assess the association between teaching experience and the teachers' competencies in implementing Education for Sustainable Development.

3.2. The Relationship Between Gender and ESD Competence Level

The first analysis focused on investigating the association between gender and teachers' competency levels in implementing ESD. By categorizing competency into three levels: High, Medium, and Low. This test aimed to determine whether gender plays a statistically significant role in shaping ESD-related competencies among primary school teachers. To facilitate the Chi-Square analysis, a coding scheme was applied to both the gender variable and the ESD competency levels. Gender was dichotomously coded, while competency levels were categorized based on individual average scores. The details of the coding are presented in Table 4.

Table 4. Distribution of Respondents by Gender and Level of ESD Competence

Gender	Level of ESD Competence			Amount
	High	Medium	Low	
Male	10	6	5	21
Female	38	42	8	88
				109

To examine the relationship between gender and teachers' competencies in Education for Sustainable Development (ESD), a Chi-Square test of independence was conducted. The analysis was based on categorized competency levels (High, Medium, Low) and gender classifications (Male, Female). The results yielded a Chi-Square statistic of 4.568 with 2 degrees of freedom. When compared with the critical value of the Chi-Square distribution at $\alpha = 0.05$ ($\chi^2 = 5.991$), the computed value was found to be lower. This finding indicates that there is no statistically significant association between gender and ESD competency levels among the respondents. The statistical analysis yielded a p-value of 0.102, which is greater than the conventional significance threshold of 0.05, thereby supporting the decision not to reject the null hypothesis. This finding demonstrates that gender does not significantly influence the competency levels of primary school teachers in implementing ESD. In practical terms, both male and female teachers demonstrate relatively similar levels of competency in incorporating sustainability principles into their teaching practices. This suggests that gender differences are not a determining factor in shaping teachers' ability to advance sustainability-oriented education. The absence of significant differences between genders in ESD competencies is likely related to the homogeneity of training exposure and the relatively uniform professional development opportunities among teachers. This situation has the potential to create development opportunities for teachers. This condition has the potential to minimize variations in competencies across demographic groups. Furthermore, standardized curricula and widely applicable educational policy frameworks enable more structured and consistent implementation of ESD practices, thereby reducing individual differences.

This outcome aligns with Ichinose (2017) , who emphasizes that the core function of ESD within the action competence framework lies in cultivating students' willingness, motivation, and skills to engage democratically in societal transformation toward sustainability. From this perspective, teacher competence in ESD is less about personal attributes such as gender and more about their ability to design pedagogical practices that empower students' action competence. This perspective aligns with Ghamrawi et al. (2025), emphasizing that ESD practices develop through teacher professional agency, supported by a reflective institutional culture and ongoing capacity-building. Therefore, ESD competency development should be directed toward strengthening systemic capacity and designing integrated professional development rather than segmenting interventions by demographic characteristics. Thus, the absence of gender differences in this study reinforces the view that the transformative potential of ESD depends on pedagogical engagement rather than demographic characteristics.

Furthermore, Sinakou et al (2022) found that teachers often exhibit low interest and limited action-oriented instructional practices in ESD, regardless of personal background factors. This finding resonates with the current study, suggesting that systemic challenges such as limited professional training or lack of institutional support may have a stronger influence on ESD implementation than gender distinctions. In this

sense, the low uptake of ESD-oriented teaching practices appears to be a shared challenge across teacher groups, highlighting the need for broader structural and pedagogical interventions rather than focusing on gender-based differences.

Additionally, Evans et al (2017) and Susanti et al (2024)highlight the crucial role of pedagogical approaches in fostering students' action competence and deepening their internalization of sustainability concepts. Active learning strategies such as case studies, community-based projects, and reflective discussions are identified as effective mechanisms for bridging theoretical comprehension with authentic application. These perspectives underscore that teacher competence in ESD is best understood through their pedagogical strategies and professional skills, rather than their gender. The findings of this study and prior research suggest that enhancing ESD implementation requires strengthening teachers' pedagogical capacities and providing supportive learning environments, rather than attributing differences to demographic variables.

3.3. The Relationship Between Teacher Experience and ESD Competence Score

As part of the effort to understand the factors influencing teachers' competence in implementing Education for Sustainable Development (ESD), a statistical test was conducted to examine the relationship between teaching experience and the level of ESD competence among teachers. The initial assumption was that the longer a teacher has been teaching, the higher their potential competence in ESD gained either through direct experience or the accumulation of knowledge from training and practice. To test this assumption statistically, the Chi-Square test was used, as both variables are categorical.

In distributing the data, the respondents' mean scores were grouped into three ranges, from which the following data distributions were obtained. Table 5 presents an illustration of the data distribution.

Table 5. Distribution Teaching Experience and Score of ESD Competence

Teaching Experience	Level of ESD Competence			Amount
	High	Medium	Low	
High	5	4	0	9
Medium	18	17	1	36
Low	30	29	5	64
				109

Based on the data above, it was found that there are cells with an actual frequency of 0. This condition violates the general rule of the Chi-Square test, which states that no cell should have a frequency of 0, and at least 80% of the cells must have an expected count of ≥5. Such circumstances make the result of the Chi-square test less valid for analysis. Therefore, to examine the difference among groups, the analysis was continued using the non-parametric Kruskal-Wallis test, which is more appropriate for data with non-normal distributions and frequency conditions that do not meet the requirements of the chi-square test. Therefore, before conducting the difference test, a normality test was performed on the teachers' data based on teaching duration (3 intervals) and the score data to determine whether the difference test would be carried out using an ANOVA test or a Kruskal-Wallis test.

Based on the Kolmogorov-Smirnov normality test with a total sample of 109 respondents, the group with a high score (N = 8) obtained a significance value of 0.200 (> 0.05), indicating that the data were normally distributed. The medium-score group (N = 36) also showed a significance value of 0.200 (> 0.05), indicating that the data were normally distributed. However, the low score group (N = 65) had a significance value of 0.009 (< 0.05), indicating that the data were not normally distributed. Therefore, the difference test was conducted using the Kruskal-Wallis test with SPSS 25. The results of the Kruskal-Wallis test are presented in Table 6 below:

Table 6. Kruskal-Wallis Test Result of Teaching Experience and ESD Competence

	Score
Kruskall-Wallis	0.602
df	2
Asymp. Sig	0.740

The result of the Kruskal-Wallis test showed no statistically significant differences in ESD competence scores across the teaching-duration groups (p = 0.740). These findings suggest that the length of teaching experience is not necessarily associated with higher or lower levels of competence in implementing ESD. In other words, teachers with longer teaching experience do not automatically demonstrate stronger competencies in ESD compared to those with fewer years of service. This indicates that teaching experience alone may not be a decisive factor for teachers' ability to effectively apply ESD principles in their educational practice.

The result resonates with UNESCO (2020), which emphasizes that the effective implementation of a competence-based approach in ESD requires educators to deliberately cultivate competencies that are directly aligned with authentic challenges in teaching and learning. Thus, the development of ESD-related competencies is more dependent on targeted professional development and meaningful engagement with sustainability issues rather than on the accumulation of teaching years. Without intentional efforts to strengthen ESD competencies, teaching experience may not translate into enhanced readiness for sustainability-oriented education.

Similarly, Corres et al (2024) highlight educators often perceive limitations in their competence to implement innovative and varied pedagogical approaches, as well as insufficient knowledge of specific sustainability issues. This insight reinforces the current finding, suggesting that the number of years spent in teaching does not guarantee mastery in addressing ESD content and methods. Instead, gaps in pedagogical innovation and sustainability-related knowledge persist among teachers, regardless of their experience level, highlighting the need for continuous capacity building.

Furthermore, Lamanauskas & Malinauskienė (2024) underscore that early-stage ESD, which historically received less attention, is now recognized as a critical phase in shaping values, attitudes, and skills that underpin sustainable development. This perspective implies that building competence for ESD should not be expected to emerge naturally over time but must be systematically developed through structured interventions starting from early stages of education and teacher training. These findings and supporting literature suggest that professional development initiatives and structured competence-building programs are more crucial drivers of ESD readiness than the length of teaching experience.

3.4. The Relationship Between Teacher Employee Status and ESD Competence Level

As part of the analysis to explore the factors that may contribute to teachers' competency levels in implementing Education for Sustainable Development (ESD), the data used were based on respondents' scores and classified into four categories (PNS, PPPK, honorary, and private). To examine these four employment status categories and teachers' competence score, a normality test was first conducted to determine the appropriate statistical test to be applied.

Based on the Kolmogorov-Smirnov normality test, the significance value obtained was 0.08. Since this value is greater than the threshold of 0.05, it can be concluded that the data are normally distributed. However, before conducting the difference test, it is necessary to examine the assumption of homogeneity of variances. This step is essential to determine whether the appropriate test for comparing groups should be the parametric ANOVA or the non-parametric Kruskal-Wallis test. Since the data consisted of more than 30 samples, normality was examined using the Kolmogorov test. The obtained significance value was 0.08, which is greater than 0.05, indicating that the data were normally distributed. The result of the homogeneity test showed a significance value of 0.013 (based on mean), which is less than 0.05. This indicates that the data do not meet the assumptions of homogeneity of variances. Therefore, the ANOVA test cannot be applied, and the appropriate test for analyzing the differences between groups is the nonparametric Kruskal-Wallis test (Table 7).

Table 7. Kruskal-Wallis Test Result of Teacher Employee Status and ESD Competence

	Score
Kruskall-Wallis	2.686
df	3
Asymp. Sig	0.443

The Kruskal-Wallis test resulted in a significance value of 0.443, which is greater than 0.05. This indicates that there is no statistically significant difference in ESD scores among the groups of teachers based on their employment status. In other words, whether teachers are civil servants (PNS), government contract teachers (PPPK), honorary teachers, or private teachers, their ESD competency levels appear to be relatively similar, despite differences in employment status. The absence of significant differences in ESD competency scores by employment status indicates that ESD competency is not directly influenced by employment status but rather by the professional ecosystem in which the teacher is located.

These findings align with Liu & Green (2024), who emphasize that a comprehensive understanding of children's environmental experiences, attitudes, and behaviors is essential for supporting a sustainable future. From this perspective, formal differences such as employment status do not necessarily serve as the main differentiating factor in teachers' competencies. Rather, it is their deep understanding of environmental context and how they shape students' learning experience that matters. Furthermore, Alifa et al. (2025) provide insight into effective teaching strategies that support ESD implementation. These strategies include integrating environmental education, applying transformative sociocritical approaches, conducting outdoor learning through social sustainability projects, and fostering transdisciplinary learning with a global dimension. Practical

strategies, such as demonstration, visual aids, field trips, and strengthening ocean literacy, highlight that teachers' competence in implementing ESD is more influenced by their application of innovative pedagogical methods than by their employment status. Additionally, Assefa (2024) underscores the role of quality education as a driver of sustainable development, preparing learners to address complex global challenges through interdisciplinary problem-solving approaches. This supports the interpretation that teachers' competence in ESD is more related to their readiness to integrate future-oriented skills and problem-solving capacities rather than their administrative employment category.

Based on several previously reviewed studies, it theoretically confirms that there is a need for a distinction between structural factors, such as employment status and systemic professional factors, in the formation of ESD competencies, and confirms that these ESD competencies will be more likely to increase with the teacher being supported by a professional learning ecosystem that systematically helps teachers to improve their ESD competencies.

3.5. Theoretical Implications and Study Limitations

The research result clarified that the ESD competency framework used in this study, namely the indicators formulated by UNECE (2012), Rieckmann (2018), and UNESCO (2020), encompasses cognitive, affective, pedagogical, and action dimensions. Nearly all aspects achieved relatively high scores. This indicates that the multidimensional ESD competency structure is relevant to the teacher population studied. Thus, ESD competency can be understood as an integrated construct that connects knowledge, values, pedagogical strategies, and actions in teacher professional practice.

Regarding the relative position of the dimensions, the pedagogical dimension ranked highest, followed by the affective and cognitive dimensions, while the action dimension ranked lowest, although still within the high-average category. This pattern reinforces the theoretical understanding that mastery of concepts and a sustainable value orientation are not automatically realized in learning practices. Within the ESD framework, the action dimension is positioned as a concrete manifestation of the cognitive and affective dimensions. Therefore, the relative variation between these dimensions indicates that ESD competency development does not occur linearly from understanding to implementation.

To clarify the relationship between the research findings and the competency framework used, an interpretative synthesis is presented in the following Table 8.

Table 8. Interpretative Synthesis

Dimension of Competency ESD	Description	Research findings	Theoretical Implication
Cognitive Dimension	Understanding of sustainability issues and ability to think systematically	Has a relatively high mean, but is lower than pedagogical and affective dimensions	Indicates that conceptual mastery is well developed, but is not the most dominant aspect in the competency structure
Pedagogical Dimension	The ability to design, implement, and evaluate ESD learning in a contextual and transformative manner	Has the highest mean compared to other dimensions	Confirms the pedagogical dimension as the strongest aspect in the ESD competency structure in the context of this study
Affective Dimension	Values, empathy, and personal responsibility for sustainability	Has a relatively high mean and is second only to pedagogical	Strengthens the position of sustainability values as central component in ESD competencies
Participatory/Action Dimension	Engagement in concrete actions, community collaboration, and change leadership	Has a relatively high mean, but is the lowest compared to other dimensions	Indicates that implemented capacity is not as strong as the conceptual and pedagogical dimensions

Furthermore, no differences in competency were found based on key demographic characteristics. This suggests that the development of ESD competency is likely more influenced by systemic factors than by inherent individual attributes. In this context, school leadership, institutional support, and exposure to professional development programs may serve as alternative determinants in shaping teachers' ESD competency. This is reinforced by the research conducted by Ghamrawi & Shal (2025), which showed that leadership that prioritizes sustainability can create an institutional environment conducive to integrating ESD into learning practices while simultaneously strengthening teachers' roles as agents of change in the school context. This aligns with research on pre-service and in-service teachers in Australia conducted by Albion et al. (2025), which indicates that although teachers have a positive orientation toward ESD, limitations in practical knowledge and confidence in implementation become major obstacles when professional and institutional support are not optimal. These findings reinforce the interpretation that strengthening ESD competency depends not only on personal characteristics but also on the professional ecosystem, particularly the one in which the teacher works.

However, this study has a limitation. Regarding sample size, respondents come from three Indonesian islands: Java, Sumatra, and Papua. Therefore, generalizing the result to the national level requires caution. Second, due to the cross-sectional nature of the research design, the results reflect the state of teachers' ESD competency at a specific point in time and cannot yet describe its dynamics or long-term development. Furthermore, the use of a self-report instrument introduces subjective bias, so the results of this study do not fully reflect teachers' perceptions of ESD competency or actual classroom practice. Therefore, further research is recommended to use a multi-method approach to obtain a more comprehensive assessment of ESD competency.

4. Conclusion

This study indicates that demographic factors such as gender, teaching duration, and employment status do not significantly influence the level of ESD competency among elementary school teachers. This finding indicates that the teacher's ESD competency is not determined by individual attributes (gender and teaching duration) or employment status, but rather by the professional context and institutional environment in which the teacher practices. Theoretically, the results of this study enhance our understanding of the relationship between demographic variables and ESD competency development by emphasizing that formal structural factors are not the primary determinants of teacher sustainability. Thus, this study clarifies that ESD competency development is better understood as a process heavily influenced by organizational dynamics and by professional development opportunities offered by institutions and the government. Accordingly, policymakers and educational institutions should prioritize continuous training, contextually relevant resources, and active learning pedagogies to strengthen ESD implementation in schools. This research has several limitations that should be considered when interpreting its results. First, the cross-sectional design only captures competency levels at a specific point in time and does not reflect the dynamics of competency development over time. Second, the sample was limited to elementary school teachers from three Indonesian islands, thereby reducing its representativeness of the national teacher population. Third, the competency measurement used a self-perception-based survey instrument, which potentially contains subjective bias in competency reporting. Therefore, interpretation of the findings requires consideration of the context and these methodological limitations.

Author Contributions

All authors have equal contributions to the paper. All the authors have read and approved the final manuscript.

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Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

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