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Analysis of sustainability literacy and behavior among pre-service teachers: informing the development of edutourism-integrated learning resources in higher education

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ABSTRACT

This study aimed to examine the sustainability literacy and behavior profiles of pre-service teachers and to identify the potential of educational tourism as an integrated learning resource for supporting their development. The study involved 298 pre-service teachers from natural and social science disciplines. Data were collected using a sustainability literacy test covering three domains—environmental, economic, and social—a sustainability behavior questionnaire, a questionnaire assessing students perceived needs for sustainability-oriented learning resources, and an analysis of existing learning materials. Focus group discussions (FGDs) involving relevant stakeholders were also conducted to explore the learning needs and opportunities for integrating educational tourism into sustainability education. The findings showed that pre-service teachers demonstrated a high level of overall sustainability literacy, although performance varied across the environmental, social, and economic domains. In contrast, their sustainability behavior was moderate, indicating a gap between sustainability knowledge and its application in everyday life. Analysis of students' perceptions and FGD findings further revealed a need for learning resources that provide authentic learning experiences, integrate relevant Sustainable Development Goals (SDGs), and facilitate the development of communication skills and the application of sustainability knowledge in real-world contexts. These findings suggest that educational tourism has considerable potential to serve as an integrated, context-based learning resource for bridging the gap between sustainability literacy and behavior and for fostering sustainable practices among pre-service teachers.



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Introduction

Education has become a strategic instrument for addressing a wide range of global challenges, including climate change, environmental degradation, and the depletion of natural resources (UNESCO, 2020). Young people need to be equipped with competencies that promote a deeper understanding of sustainability-related issues. Beyond acquiring knowledge, they are expected to implement concrete actions and make responsible decisions that contribute to sustainable development (Brundi et al., 2021; Li, 2025). This objective is embodied in the

framework of Education for Sustainable Development (ESD), which seeks to ensure a sustainable future (Amthor & Heilman, 2010).

Sustainability literacy is one of the key indicators used to assess the effectiveness of ESD. It is defined as an individual's ability to understand the interrelationships among the environmental, social, and economic dimensions as an integrated system for effectively addressing sustainability challenges (Décamps et al., 2017). Recent developments indicate that sustainability literacy extends beyond knowledge to encompass attitudes and behaviors, which collectively foster sustainability awareness. These dimensions serve as important indicators for evaluating individuals' readiness to address future sustainability challenges (Gong et al., 2026).

As agents of change, teachers play a crucial role in instilling sustainability values in future generations (Wals, 2014). Therefore, pre-service teachers should possess a high level of sustainability literacy to effectively integrate environmental, social, and economic issues into classroom instruction, thereby fostering students' awareness of and responsibility for sustainable development. This underscores the importance of assessing sustainability literacy among pre-service teachers (Li, 2025).

Assessing sustainability literacy has become increasingly important across all levels of education, including among pre-service teachers (Núñez et al., 2024). The results of such assessments can inform the development of curricula, learning materials, instructional strategies, and assessment tools that support the development of sustainability competencies (Corres et al., 2020; Redman et al., 2021; Scharenberg et al., 2021; Sposab & Riekman, 2021). However, existing studies on the sustainability literacy of pre-service teachers continue to report considerable variation in their findings (Li, 2025). Furthermore, instructional practices have largely focused on the cognitive dimension, while the affective and behavioral dimensions have received comparatively less attention (Marcos-Merino et al., 2020). Consequently, pre-service teachers need learning experiences that not only strengthen their cognitive understanding but also cultivate sustainability behavior and long-term commitment to sustainability (Bibi et al., 2026).

Another important factor influencing the success of ESD is environmental attitude. It reflects an individual's tendency to demonstrate concern, care, and commitment toward environmental conservation (Wallnoefer & Riefler, 2022). Environmental attitude has been identified as a significant predictor of individuals' sustainability-oriented behaviors (Rau et al., 2022). Therefore, strengthening environmental attitudes is essential for achieving the primary goals of education for sustainable development.

Theoretically, a sound understanding of sustainability literacy can enhance individuals' awareness of the consequences of human activities for environmental conservation (Brundiers et al., 2021; Hammer & Lewis, 2023). Recently, the relationship between sustainability literacy and environmental attitude has become an important focus of educational research. However, empirical evidence on this relationship remains limited, particularly among pre-service teachers (Sanchez et al., 2025). Such evidence is essential for ensuring that pre-service teachers not only improve their sustainability literacy but also develop greater environmental concern and a stronger readiness to engage in sustainability initiatives that can be passed on to future generations (Karvonen et al., 2023).

Experiential learning has strong relevance in environmental education. This approach enables students to connect theoretical concepts with real-life situations, thereby enhancing both conceptual understanding and problem-solving skills (Kolb, 2015). Direct learning experiences that provide opportunities for students to observe the interactions among environmental, social, and economic systems are particularly important in the context of education for sustainable development, as they help overcome the limitations of classroom-based learning (Wiek et al., 2011).

In recent years, educational tourism (edu-tourism) has attracted increasing attention as a promising learning resource for fostering sustainability competencies. Ritchie et al. (2003) defined educational tourism as an activity that integrates tourism with educational experiences, allowing students to learn through observation, exploration, and direct interaction with the natural and social environment. Previous studies have reported that educational tourism enhances student engagement, environmental awareness, reflective skills, and critical thinking abilities (Khuadthong et al., 2025a; Pantaruk et al., 2026; Marini et al., 2026). These competencies are believed to mediate the development of sustainability awareness and sustainability behavior (Khuadthong et al., 2025b).

The use of educational tourism (edu-tourism) as a learning resource for pre-service teachers offers significant strategic value by providing authentic learning experiences. Experiential learning bridges the gap between theoretical concepts and real-world practice, enabling students to deepen their understanding of sustainability issues through direct observation, critical reflection, and interaction with social and environmental contexts. Moreover, the integration of educational tourism into the learning process can enhance pre-service teachers'

pedagogical readiness to design contextual, environment-based, and problem-oriented learning experiences (Brundiers et al., 2021; Saiful & Setyorini, 2022; Chen et al., 2022).

Research on sustainability literacy and educational tourism has grown steadily in recent years. However, studies examining the profile of sustainability literacy and its relationship with the potential of educational tourism as a learning resource remain limited (Ortiz-Martínez et al., 2026). This gap is particularly significant in Indonesia, which possesses abundant educational tourism resources that could effectively support education for sustainable development. Furthermore, few studies have simultaneously investigated sustainability behavior and sustainability literacy in relation to the use of educational tourism as a means of promoting sustainability education, particularly among pre-service teachers.

Current research has highlighted a gap between students' knowledge of sustainability and their actual sustainability behavior (Redman & Wiek, 2021). This gap suggests the need for learning experiences that help students connect sustainability concepts with real-world issues and apply what they learn when making decisions in their everyday lives. requires learning experiences that enable students to connect sustainability concepts with real-world problems and make decisions based on the context of their lives. Educational tourism offers promising opportunities in this regard because it can provide direct and meaningful learning experiences related to sustainability practices in local communities. Through visits to educational tourism sites, students can observe real sustainability practices, interact with local communities, and reflect on how sustainability principles are applied in everyday contexts. However, learning resources that systematically integrate educational tourism into sustainability education are still limited. Therefore, there is a need to develop educational tourism-integrated learning resources that can help bridge the gap between students' sustainability literacy and their ability to translate sustainability knowledge into sustainability behavior.

The preceding discussion highlights two research gaps that establish the novelty of the present study. First, this study simultaneously examines the sustainability literacy and sustainability behavior of pre-service teachers. Second, it explores the potential of educational tourism as a learning resource for enhancing sustainability literacy and strengthening sustainability behavior. Accordingly, this study contributes to the growing body of literature on the integration of Education for Sustainable Development (ESD) in higher education by providing empirical evidence on the implementation of sustainability principles among pre-service teachers.

Accordingly, this study addresses the following research questions: (1) What are the levels of pre-service teachers' sustainability literacy across the environmental, economic, and social domains, and what are the characteristics of their sustainability behaviors? (2) What learning needs and opportunities for integrating educational tourism into learning resources can be identified based on pre-service teachers' sustainability literacy and behavior profiles?

Method

Research Design

This study employed a descriptive quantitative research design to examine the sustainability literacy and behavior of pre-service teachers enrolled in two academic disciplines, namely Language Education and Science Education. No experimental intervention was administered. Instead, the study aimed to capture the participants' current levels of sustainability literacy and behavior, enabling the identification of similarities, differences, and achievement characteristics across these two variables. Furthermore, a descriptive exploratory approach was employed to identify opportunities for developing educational tourism (edu-tourism)-integrated learning resources.

Participants

The study involved 298 pre-service teachers from the Language Education and Science Education programs. Participants from each program were recruited from the second, fourth, and sixth semesters. A summary of the participants' characteristics is presented in Table 1.

Table 1. Characteristics of the study participants (N = 298)

Characteristics	Number of Samples	Proportion (%)
Field of Study Program		
Mathematics and Science Education	143	47.99
Social education	155	52.01
Gender		
Male	107	35.90
Female	191	64.09

Characteristics	Number of Samples	Proportion (%)
Semester		
2	107	35.90
4	95	31.88
6	96	32.22
Age		
19y	93	31.21
20y	101	33.89
21y	104	34.90

Instruments

Sustainability literacy was assessed using a multiple-choice test developed based on the *United Nations Framework Convention on Climate Change* (2015). The test comprised items covering three sustainability domains: environmental, economic, and social. Sustainability behavior was measured using a questionnaire adapted from Salahange et al. (2024). Each instrument includes 10 literacy test items and 10 questionnaire statements. To identify opportunities for developing learning resources, an exploratory questionnaire (11 statements) and a learning document analysis instrument modified from Hauer and Quill (2011) were employed.

Prior to data collection, all research instruments were validated using the Delphi technique to achieve expert consensus regarding the relevance and clarity of each item (Chan, 2022). A panel of five experts evaluated all instruments using a five-point rating scale (1 = very low validity, 5 = very high validity). Instrument reliability was assessed using percentage agreement (PA) as an indicator of inter-rater agreement, with a PA value of $\geq 75\%$ indicating acceptable consistency (Emmer & Millett, 1970). A summary of the validity and reliability results is presented in Table 2.

Table 2. Validity and Reliability of the Research Instruments

Instrument	Content Validity		Reliability		Construct Validity		Reliability	
	Mean	Criteria	PA	Criteria	Mean	Criteria	PA	Criteria
Sustainability Literacy Test	3.64	Valid	92.10	Reliable	4.00	Valid	92.60	Reliable
Sustainability Behavior Questionnaire	3.82	Valid	92.10	Reliable	3.98	Valid	90.00	Reliable
Learning Resource Development Opportunity Questionnaire	3.86	Valid	94.00	Reliable	3.88	Valid	90.00	Reliable
Learning Document Analysis Instrument	3.86	Valid	94.00	Reliable	3.82	Valid	90.60	Reliable

Data Collection

Data were collected through online surveys administered using Google Forms. Before completing the surveys, participants were informed about the purpose of the study, the voluntary nature of their participation, and the confidentiality of their responses. Participants first completed the sustainability literacy test, followed by the sustainability behavior questionnaire. One week later, the same participants completed a questionnaire assessing their needs for sustainability-oriented learning resources. The surveys were distributed with the assistance of faculty members and with the approval of the respective faculties.

Data Analysis

The scores obtained from the sustainability literacy test and the sustainability behavior questionnaire were tabulated and analyzed using descriptive statistics, including the mean and standard deviation. For the sustainability literacy test, each correct response was scored as 1, whereas each incorrect response was scored as 0. The sustainability behavior questionnaire employed a five-point Likert scale.

The levels of sustainability literacy were classified according to the criteria adapted from Chou and Vun (2025), as presented in Table 3. The classification of sustainability behavior was based on the criteria proposed by Guo and Asmawi (2024), as shown in Table 4.

Table 3. Categories of the Sustainability Literacy

Classification for level of knowledge	Score
Poor level	0%-50%
Intermediate level	51%-79%
Good/High level	80%-100%

Table 4. Categories of the Sustainability Behavior

Mean	Interpretation
1.00-2.33	Low
2.34-3.66	Moderate
3.67-5.00	High

Results and Discussions

Research Question 1

Overall, the sustainability literacy of the pre-service teachers was classified as high, with a mean score of 81.65 (SD = 0.387). This profile was evaluated across three domains: environmental, social, and economic. In general, the participants demonstrated a high level of sustainability literacy. The proportions of pre-service teachers with high, moderate, and low levels of sustainability literacy were 70.81%, 17.45%, and 11.74%, respectively. Among the three domains, the environmental domain achieved the highest mean score, whereas the economic domain recorded the lowest. A descriptive summary of the pre-service teachers' sustainability literacy is presented in Table 5.

Table 5. Descriptive Analysis of Pre-Service Teachers' Sustainability Literacy

Component	Mean	Minimum	Maximum	SD	Category
Sustainability literacy	81.65	0	100	0.387	High
Environmental domain	84.90	0	100	0.358	High
Social domain	83.11	0	100	0.375	High
Economic domain	76.96	0	100	0.421	Moderate

A comparison of sustainability literacy scores across the two academic programs revealed that pre-service teachers enrolled in the Science Education program achieved slightly higher overall scores than those in the Social Science Education program (Table 6). The mean overall sustainability literacy score was 81.90 for students in the Science Education program and 81.43 for those in the Social Science Education program. In both programs, the environmental domain recorded the highest mean score, whereas the economic domain had the lowest mean score.

Table 6. Sustainability Literacy Profile of Pre-Service Teachers by Field of Study

Domain	Science Education	Social Science Education
Environmental	84.62	85.16
Social	83.22	83.01
Economic	77.86	76.13

Table 7 presents the sustainability literacy profile of pre-service teachers by gender. Female pre-service teachers demonstrated higher sustainability literacy scores than their male counterparts. The overall mean sustainability literacy scores were 83.25 for female students and 78.82 for male students. Consistent with the previous findings, the environmental domain recorded the highest mean score for both gender groups.

Table 7. Sustainability Literacy Profile of Pre-Service Teachers by Gender

Domain	Male	Female
Environmental	82.24	86.39
Social	79.44	85.17
Economic	74.77	78.18

The sustainability literacy profile by academic semester revealed that pre-service teachers in the fourth semester achieved the highest overall mean score (M = 88.30). The overall mean score of second-semester students (M = 79.65) was slightly higher than that of sixth-semester students. Table 8 presents the mean sustainability literacy scores across academic semesters.

Table 8. Sustainability Literacy Profile of Pre-Service Teachers by Academic Semester

Domain	Second Semester	Fourth Semester	Sixth Semester
Environmental	84.42	90.18	80.90
Social	80.69	89.47	79.51
Economic	73.83	85.26	72.57

Table 9 presents the sustainability literacy profile of pre-service teachers by age. Students aged 19 obtained the lowest overall sustainability literacy score ($M = 77.54$) compared with those aged 20 and 21. The highest overall mean score was recorded among students aged 20 ($M = 88.12$), whereas students aged 21 obtained a mean score of 79.06. Consistent with the previous findings, the environmental domain achieved the highest mean score across all age groups.

Table 9. Sustainability Literacy Profile of Pre-Service Teachers by Age

Domain	19y	20y	21y
Environmental	81.00	89.77	83.65
Social	78.85	90.10	80.13
Economic	72.76	84.49	73.40

In contrast to sustainability literacy, the sustainability behavior of pre-service teachers was classified as moderate, with an overall mean score of 3.65 ($SD = 1.29$). The proportions of students exhibiting high, moderate, and low levels of sustainability behavior were 50.33%, 49.33%, and 0.34%, respectively. The three behavioral indicators with the lowest mean scores were separating waste according to its type, adopting lifestyle changes to reduce waste generation, and modifying consumption patterns to become more sustainable. A descriptive summary of sustainability behavior and the mean scores for each behavioral indicator are presented in Tables 10 and 11, respectively.

Table 10. Descriptive Statistics of Sustainability Behavior among Pre-Service Teachers ($N = 298$)

Statistic	Value
Mean	3.65
Standard Deviation	1.29
Maximum	4.90
Minimum	1.90

Table 11. Sustainability Behavior Scores of Pre-Service Teachers

No	Item	Mean	SD	Category
B1	I separate waste such as plastic, glass, and other recyclables from food waste before disposing of them in recycling bins.	2.15	1.52	Moderate
B2	I support environmental organizations.	4.29	0.83	High
B3	Acting sustainably is part of my personality.	3.90	1.06	High
B4	I recycle everything that I can.	3.70	1.26	High
B5	I avoid purchasing products from companies with poor environmental reputations.	4.18	0.96	High
B6	I usually consume environmentally friendly products.	3.92	1.06	High
B7	I change my lifestyle to reduce waste.	3.30	1.29	Moderate
B8	I am willing to participate in activities that promote environmental sustainability.	4.00	0.97	High
B9	I make greater efforts to preserve the environment.	3.75	1.24	High
B10	I am willing to change my consumption habits to become more sustainable.	3.27	1.12	Moderate

Sustainability behavior scores by field of study, gender, academic semester, and age are presented in Table 12. In contrast to the sustainability literacy findings, pre-service teachers enrolled in the Social Science Education program demonstrated higher levels of sustainability behavior than those in the Science Education program. Consistent with the sustainability literacy results, female students obtained higher sustainability behavior scores than male students. Furthermore, second-semester pre-service teachers and students aged 19 years exhibited higher levels of sustainability behavior than the other semester and age groups included in this study.

Table 12. Sustainability Behavior Scores by Field of Study, Gender, Academic Semester, and Age

Variable	N	Score	Category
<i>Field of Study Program</i>			
Mathematics and Science Education	143	3.49	Moderate
Social education	155	3.79	High
<i>Gender</i>			
Male	107	3.48	Moderate
Female	191	3.74	High
<i>Semester</i>			
2	107	3.86	High
4	95	3.45	Moderate
6	96	3.62	Moderate
<i>Age</i>			
19y	93	3.84	High
20y	101	3.46	Moderate
21y	104	3.66	Moderate

Research Question 2

Pre-service teachers' perceptions of the current learning practices are presented in Table 13. Most participants perceived that the learning process was student-centered and provided opportunities for active participation. They also reported that the learning activities promoted critical thinking and collaborative skills. In addition, the majority of participants indicated that learning frequently involved the surrounding environment. However, many students perceived that the learning resources were not sufficiently innovative, did not adequately integrate technology, and rarely utilized real-world cases from the local environment. Furthermore, the current learning practices were perceived as providing limited opportunities to develop oral and written communication skills and were primarily focused on knowledge acquisition. Sustainability and educational tourism (edu-tourism) were also reported to be insufficiently integrated into the learning process.

Table 13. Pre-Service Teachers' Perceptions of Current Learning Practices

No.	Statement	N	Yes	No
1	The learning process is student-centered.	298	80.87%	19.13%
2	The learning process provides opportunities for students to actively participate.	298	80.20%	19.80%
3	The learning process promotes critical thinking in problem solving.	298	83.22%	16.78%
4	The learning process encourages student collaboration.	298	74.50%	25.50%
5	The learning process involves the surrounding environment.	298	80.87%	19.13%
6	The learning process promotes students' oral and written communication skills.	298	52.35%	47.65%
7	The learning process is primarily focused on knowledge acquisition.	298	76.51%	23.49%
8	The learning process integrates sustainability concepts.	298	52.35%	47.65%
9	The learning process utilizes innovative learning resources and technology.	298	40.94%	59.06%
10	The learning process uses cases from the local environment as learning resources.	298	44.97%	55.03%
11	The learning process uses educational tourism (edu-tourism) as a learning resource.	298	37.25%	62.75%

Approximately 80% of the participants indicated the need for learning resources that provide more authentic learning experiences and real-world visualization. They also expressed the need for learning resources that better connect course content with real-life contexts, thereby fostering their critical thinking and collaborative skills.

The analysis of learning documents revealed that the intended learning outcomes were clearly formulated and aligned with the Program Learning Outcomes (PLOs). The instructional strategies encouraged active student participation and collaboration. However, the integration of course content with the Sustainable Development Goals (SDGs) and broader sustainability issues remained limited. Although the learning resources and instructional media were diverse and supported the achievement of the intended learning outcomes, they were primarily limited to textbooks, learning documents, and instructional videos. Technology had been

integrated into the learning process and was readily accessible to students. In terms of assessment, the instruments measured knowledge, attitudes, and skills while providing opportunities for feedback. A summary of the learning document analysis is presented in Table 14.

Table 14. Results of the Learning Document Analysis

No.	Aspect	Score	Remarks
1	Intended Learning Outcomes	4.75	The learning outcomes are clearly formulated, aligned with the Program Learning Outcomes (PLOs), and supported by course content that promotes the expected competencies.
2			The instructional strategies primarily employ Problem-Based Learning (PBL) and Project-Based Learning (PjBL), providing students with authentic learning experiences.
3	Integration of SDGs and Sustainability into Course Content	2.60	The course content remains predominantly knowledge-oriented, with limited integration of the SDGs, sustainability concepts, and local environmental issues.
4			Learning resources are varied and incorporate technology; however, they are mainly limited to textbooks, learning documents, and instructional videos.
5	Assessment	4.50	Assessment instruments are available and aligned with the intended learning outcomes. Nevertheless, assessment continues to emphasize knowledge and skills, while some assessment activities provide limited feedback to students.

The focus group discussions (FGDs) involving faculty members, educational experts, and student representatives identified five major themes. First, the findings highlighted a gap between pre-service teachers' sustainability literacy and their sustainability behavior. Second, participants emphasized the need for learning experiences that foster students' oral and written communication skills. Third, they underscored the importance of developing innovative learning resources that effectively utilize the local environment. Fourth, participants recommended strengthening the integration of the Sustainable Development Goals (SDGs) and sustainability concepts into learning content. Finally, they highlighted the need for learning resources that provide students with more authentic, hands-on learning experiences.

The assessment of sustainability literacy has been widely reported as an important strategy for advancing education for sustainable development. Previous studies have examined sustainability literacy across various levels of education. Novietasi et al. (2022) reported findings consistent with those of the present study, indicating that university students generally demonstrate a high level of sustainability literacy, with 76.8% of participants achieving a high level of sustainability literacy. Similar findings have also been reported in Africa, the Middle East, Asia, and Europe, where university students have demonstrated a high level of knowledge regarding the Sustainable Development Goals (SDGs) (Elamin, 2025).

The present study found that the environmental domain achieved the highest mean score, whereas the economic domain recorded the lowest. Similar findings have been reported in several studies conducted in higher education institutions. Students' understanding was strongest in the environmental domain compared with the economic domain, although the differences were not statistically significant (Belinda, 2026; Erguvan, 2024). In contrast, Chen et al. (2022) reported relatively low mean scores for the environmental domain. Furthermore, Chou and Vun (2025) found that some university students were not even familiar with the term Sustainable Development Goals (SDGs).

The differences in scores across the three sustainability domains may be attributed to curricula that emphasize only a single dimension of sustainability (Bui et al., 2024; Suklun & Bengu, 2024). In the present study, the curriculum analysis and course syllabi indicated that environmental issues receive greater emphasis, particularly in Science Education programs. This emphasis may explain the relatively high performance observed in the environmental domain. These disparities in sustainability literacy across domains suggest the need for curriculum development that provides a more balanced integration of environmental, economic, social, and global partnership dimensions of sustainability (Chen et al., 2022).

In the present study, sustainability literacy varied according to field of study, gender, academic semester, and age. Previous studies have reported that students in science-related disciplines tend to demonstrate higher levels of sustainability literacy than those in the social sciences. This difference may be attributed to the stronger systems thinking skills typically exhibited by science students, which contribute substantially to their sustainability literacy. Female students have also been reported to possess stronger systems thinking and interpersonal competence than their male counterparts, resulting in higher levels of sustainability literacy, consistent with the findings of the present study (Remington-Doucette & Musgrove, 2015; Tawok & Saidin, 2025).

Sustainability literacy also varied across academic semesters and age groups. In the present study, the highest sustainability literacy scores were observed among fourth-semester students and those aged 20 years, suggesting that higher academic standing and older age do not necessarily correspond to higher levels of sustainability literacy. This finding contrasts with previous studies reporting that students' cognitive abilities generally improve with increasing academic level and age, thereby contributing to higher sustainability literacy (Feucht et al., 2025; Padial-Ruz et al., 2025; Valderrama-Hernández et al., 2025). However, this relationship is not always consistent. Although students in more advanced semesters and older age groups often demonstrate higher sustainability literacy due to their accumulated learning experiences, curriculum design and instructional practices may exert a more substantial influence on the development of sustainability literacy (Badrudin, 2024; Castaño et al., 2025; Padial-Ruz et al., 2025).

In contrast to sustainability literacy, which was found to be at a high level, the sustainability behavior of pre-service teachers remained at a moderate level. This discrepancy has been reported in several previous studies. Although students may possess high levels of sustainability knowledge and literacy, these do not necessarily translate into corresponding sustainability behaviors (Thomaes, 2026; D'Acunto et al., 2025). The gap between sustainability literacy and sustainability behavior may be explained by several factors, including limited opportunities for experiential learning, low self-efficacy in adopting sustainable practices, insufficient participation in sustainability-related programs, and inadequate opportunities to repeatedly observe and practice sustainability behaviors in authentic contexts (Badrudin, 2024; Teather & Etterson, 2023).

In the present study, another important gap identified, in addition to the discrepancy between sustainability literacy and sustainability behavior, was the limited availability of learning resources that provide authentic learning experiences and incorporate comprehensive SDG-related content. This finding highlights the need to develop learning resources that offer direct experiential learning while integrating the Sustainable Development Goals (SDGs) into the learning process. Such learning resources are expected not only to strengthen sustainability literacy but also to promote behavioral changes that support sustainable development.

The findings of this study suggest that educational tourism (edu-tourism) has considerable potential to be developed as a learning resource in higher education. Previous studies have shown that educational tourism is consistent with the principles of experiential learning by providing authentic experiences that enhance students' knowledge, attitudes, and behaviors (Chen et al., 2025; Wang & Dolah, 2024). Furthermore, the evidence obtained from the literature and the focus group discussions (FGDs) provides a strong foundation for developing educational tourism-integrated learning resources for pre-service teachers.

Conclusions

The findings indicate that the sustainability literacy of pre-service teachers was at a high level, with the environmental domain achieving the highest mean score among the environmental, social, and economic domains. The demographic analysis revealed that students enrolled in Science Education programs, female students, fourth-semester students, and those aged 20 years demonstrated higher sustainability literacy than their counterparts. In contrast, sustainability behavior was classified as moderate. Furthermore, students enrolled in Social Science Education programs, second-semester students, and those aged 19 years exhibited higher levels of sustainability behavior than the other demographic groups. The analysis of students' perceptions and the focus group discussions (FGDs) indicated that addressing the gap between sustainability literacy and behavior requires learning resources that provide authentic learning experiences, integrate the Sustainable Development Goals (SDGs), foster oral and written communication skills, and make greater use of the surrounding environment as a learning context.

The findings also suggest that educational tourism (edu-tourism) has considerable potential to be developed as a learning resource for pre-service teachers. In addition to supporting the principles of experiential learning, educational tourism can provide students with greater opportunities to observe and practice sustainability behaviors in authentic settings. More broadly, the integration of educational tourism into learning has the

potential to benefit not only pre-service teachers but also learners at other educational levels, thereby contributing to the development of sustainability competencies across the education system.

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