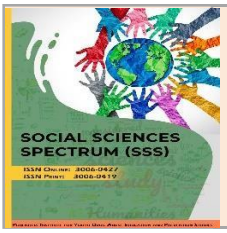

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Effects of Sustainability Practices on the Environmental Awareness's of Students in Higher Secondary Classroom

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Abstract

The paper has discussed how green practices of teachers affect the understanding environmental issues of students in higher secondary in seven divisions in the Khyber Pakhtunkhwa region of Pakistan. The study was based on the post-positivist paradigm and the survey research design. A sample of 566 teachers and 1,788 students were selected out of a total population of 1,880 teachers and 59,680 students using stratified sampling. Two Likert-scale questionnaires were used for data collection: one of them assessing green practices by teachers and the other understanding environmental issues of students. Pilot testing was done to test the reliability of both instruments, Cronbach alpha ($\alpha = 0.87$ and 0.84). Linear regression analysis was used to establish the relationship between independent and dependent variables of study. The findings have shown that the overall effect of the green practices of teachers was statistically significant yet small in influencing the environmental awareness of the students. These results aligned with the collective stewardship theory of sustainable development (CSTSD), which states that students understand environmental issues through stewardship behavior of teachers. It was concluded that environmental awareness enhanced when sustainability is introduced into the school culture and practice.

Keywords: Environmental Issues, Higher Secondary, Khyber Pakhtunkhwa Region, Sustainable Development, Linear Regression.

Introduction

There has been a shift in the focus of environmental awareness among students as a major educational goal in reaction to growing global issues of environmental harm that encompass climate change, pollution, and resource depletion (Anderson, 2012). The green practices of teachers such as integration of environmental issues in the curriculum, classroom sustainability initiatives, resource conservation practices, waste management and pro-environmental behaviour of the teacher are major contributions of the instructor that influence student attitudes, knowledge, and pro-environmental behaviours (Bibi et al., 2025; Sharmin et al., 2024). The connection between the environmental oriented behaviours of teachers and the learning performances of learners is supported by stewardship theory that the students learn and internalize environmental oriented values that have been modelled by their teachers (Ozili, 2025). Thus, teacher practices are instructional strategies in addition to behavioural indications that play a major role in creating environmental awareness and sustainability attitudes in the students.

At international level, the study is always affirmative as to the contribution of teachers in promoting environmental literacy. Research has shown that among teachers, incorporating environmental education in everyday learning experiences has a positive influence on students in terms of their environmental knowledge and in relation to their pro-environmental attitudes (Bakhati, 2015). On the same note, Lange (2023) points out that instructors have a leading role to play in institutionalizing sustainability within syllabus-based settings through modelling sustainable practices and establishing ecologically conscious classroom climates. More studies conducted in London and Japan also indicate that school-based environmental programs facilitated by teachers are also a major contributor to ecological awareness and responsible decision-making among students (Matsubaguchi et al., 2019; Abduhakimova & Islamova, 2025).

The trend is similar in other countries in Asia and other neighbouring countries. Environmental responsibility and activism among students have been linked to the involvement of teachers in environmental training programs in China and Malaysia (Xiong et al., 2025; Mahat & Idrus, 2016). Indian research discovered that the green pedagogical methods, including participatory recycling projects and outdoor learning exercises can boost the environmental ethics and ecological identity of high school students (Sah et al., 2024). These results demonstrate a rise in an understanding by regional education systems that the environmental practices of teachers play an important role in instilling sustainability in the minds of learners.

Research in Pakistan at a national level indicates that there is growing scholarly interest in the matter of understanding environmental issues in schools and colleges, but there are still inconsistencies in its practical application. Research identified that despite the recognition of the role of environmental education, most teachers do not receive training, institutional context, and classroom-based green practices (Malik et al., 2023; Zeeshan & Qureshi, 2022). Moreover, the existing literature primarily addresses the attitudes of students towards the environment instead of assessing the impact of certain teacher-led green practices on understanding environmental issues (Vare, 2021). This shows that it is a field that is under researched and needs to be investigated systematically in Pakistani context.

According to the analysis of the literature available, there exists a research gap in terms of the empirical research on the specific role that teachers' green practices play in understanding environmental issues at higher secondary level in Pakistan (Saqib et al., 2020; Khanum et al.,

2023). Past research points out that there is a necessity to go beyond the general environmental education discourse and rather quantify the behavioural practices which are modelled by teachers and their quantifiable impacts on student awareness (Stevenson, 2007; Maxwell et al., 2017). Thus, the current research was to examine how green practices by teachers affect understanding environmental issues of students in the light of curriculum integration and teaching practices (CIPT), resource conservation practices (RCP), waste management (WM), air pollution (AP), professional development and skills training (PDST), personal commitment (PC), and school environment (SE) of teachers (Farid & Ashraf, 2025).

The concept of environmental awareness describes the knowledge, attitudes, and behaviours that people have about environmental matters and their readiness to embrace behaviours that help in protecting the environment (Ringler, 2007). The global community is also experiencing serious environmental pressures such as loss of biodiversity, air and water pollution, climatic instability and excessive exploitation of natural resources in the modern world (Singh & Singh, 2016). Schools have emerged as a key platform on which the sustainability issues can be resolved through the formulation of environmentally conscious citizens (Scott, 2013). Understanding environmental issues at school level is not only determined by what is in the curricular content, but also social interactions and modelling of behaviour especially by the teacher. Teachers are the interim between the knowledge on the environment and student behaviour since they model attitudes and values, which the students adopt by observing and participating in guided learning (Larasaty et al., 2024).

The educational theorists underline that environmental education cannot just be a conceptual knowledge but must engage in active experiences and promote individual's responsibility (Jickling & Sterling, 2017). Practically environmental awareness is formed when the learners develop an awareness of environmental issues, have an emotional appeal to ecological well-being and learners put this knowledge into practice (Ahmed et al., 2021). Hence, the behaviour of teachers such as classroom practices, school-based ecological programs, waste management habits, and observable pro-environmental behaviour are significant in the development of the student environmental orientations (Komatsu et al., 2023). Significant environmental awareness therefore arises both in systematic education and experience modelling.

Green Practices as Predictors of Students' Environmental Issues

Environmental knowledge is a type of knowledge of ecological systems, environmental concerns like pollution, climate change, and waste management as well as the effects of unsustainable human practices (Zareie & Navimipour, 2016; Erwinsyah, 2022). Emotional concern and personal rating on nature is portrayed through environmental attitudes and the attitudes determine the way people view environmental protection. Behavioural intention represents willingness to behave in a way that is responsible to the environment (i.e. conservation of resources, decreased waste, promotion of sustainability) (Khan et al., 2020).

Higher secondary students are in a developmental stage, and they can acquire abstract thinking and identity formation, which enables them to critically participate in global environmental concerns (Komatsu et al., 2023). The significance of understanding environmental issues at this stage is due to the fact that it can influence the lifelong behaviour patterns. Students need to make the environmental issues pertinent to their lives when they realize that they are part of them, and more easily translate the awareness into responsible decision-making (Arvai et al., 2004).

Nevertheless, textbooks are not enough in building awareness. It manifests itself in the form of observational learning, involvement in sustainability affairs, and exposure to environmental practices in reality (Wals, 2023).

School environment is a very sensitive factor in the process of developing such awareness and the teachers are the key players in the process. A learner not only notices behaviours of particular students but also evaluates their utility and adopts them when such behaviours seem meaningful and consistent (Porter, 2020). Thus, in the case teachers act as environmentally responsible (conserving electricity, reducing paper waste, engaging in recycling, and discussing environmental problems) and students will absorb these values and start considering environmental protection a norm that is socially desirable and personally relevant (Abduhakimova & Islamova, 2025). On the other hand, students might not be able to appreciate the practical importance of environmental awareness when it is taught as theoretical knowledge without practical demonstration (Jose et al., 2017).

The research results in Asia and Europe indicate that students in the schools with actively working teachers on green practices express a higher pro-environmental attitude and higher environmental awareness (Xiong et al., 2025; Matsubaguchi et al., 2019). These results prove the fact that environmental awareness is not just taught but is proved, seen, and internalized in society. At this, teacher behaviour serves as one of the key learning settings of students.

The green practices of teachers consist of various behaviours and pedagogical practices that aim at fostering environmentalism and sustainable thinking. They usually involve integrating environmental ideas into the curriculum, environmental learning through activities, engaging in recycling or conservation activities, discussing climate and sustainability in the classroom, and modelling own pro-environmental behaviours (Bakhati, 2015). Educational institutions in which teachers set a good example of green behaviour are more likely to have students who are more conscious about the environment and care more about ecological problems, as well as are more likely to engage in environmentally responsible behaviour (Abduhakimova & Islamova, 2025).

It has been argued that teachers' green practices influence students understanding of environmental issues as students notice daily routine of teachers like saving energy or minimizing paper consumption or being involved in recycling or stewardship behaviours (Ozili, 2025). Students feel that environmental responsibility is possible and applicable when teachers demonstrate knowledge and practice. On the other hand, educators who teach environmental values but fail to exemplify them have low chances of imparting the same values to the students (Matsubaguchi et al., 2019).

Green practices by teachers are also helpful in environmental awareness through the provision of experiential learning. Composting, plantation drives, water conservation programs, and ecological campaigns enable the students to gain the ecological agency (Komatsu et al., 2023). These activities build on knowledge by involving the user hence bridging the gap that exists between knowledge and behaviour. Thus, the practices of teachers are not just instructional practices, but factors that stimulate the formation of ecological identity (Larasaty et al., 2024).

Theoretical Framework of the Research

The study is informed by CSTSD suggested by Peterson Ozili which underlines that all people are custodians of common resources and have common responsibility to behave in a manner that enhances the wellbeing of the society, the environment and future generations (Ozili, 2025).

Green practices by teachers in the present study are the active stewardship behaviours in the educational ecosystem by modeling resource conservation, introducing sustainability in the curricula (Arbuzova and Alexandrova, 2024) and influencing institutional culture where the comprehension of environmental concerns by students is the result of the active stewardship behaviour in the learning environment being manifested (Bennett et al., 2018). Therefore, when educators assume sustainable behaviour, they contribute to the culture of stewardship where students think of themselves as the keepers of the environment (Elliott & Rodenburg, 2020), thus improving their consciousness and knowledge regarding environmental problems in a culture of collective responsibility (Ashraf & Adnan, 2022).

Research Objective

The following objective was made;

i. To find out the impact of teachers' green practices on students' understanding of environment issues at higher secondary level.

Research Questions:

Based on research objective, following research questions were made;

1. Do curriculum integration and teaching practices (CIPT) have influence on understanding of environment issues of students?
2. What is the effect of resource conservation practices (RCP) on understanding of environment issues of students?
3. How waste management (WM) effect on students' understanding of environment issues?
4. Does air pollution (AP) have influence on understanding environment issues of students?
5. What is the effect of professional development and skills training (PDST) on understanding environment issues of students?
6. How personal commitment (PC) of teacher's influence understanding environment issues of students?
7. Do school environment (SE) have any influence on understanding environment issues of students?

Research Methodology

The following headings give detailed description of research methodology employed in current research;

Research Paradigm

This study is based on the post-positivist research paradigm, which assumes that social reality can be measured objectively, although such measurement may be influenced by contextual factors. Post-positivism supports the use of quantitative approaches to examine relationships between variables and relies on structured data collection and statistical reasoning to test assumptions (Creswell & Creswell, 2017). Since the study investigates the influence of teachers' green practices on students' environmental awareness using numerical data collected through structured questionnaires, the post-positivist paradigm is appropriate. This paradigm also allows the application of inferential statistics, such as regression analysis, to determine the degree to which independent variables predict the dependent variable (Cohen et al., 2002).

Research Design and its Rationale

The research design used is the survey research design and is appropriate in the gathering of quantifiable data of many people at a given point in time. Survey research will help to study the relationships between variables and outline the tendencies or traits in a population (Fowler, 2013). The survey design was helpful in the current setting since it allowed obtaining numeric data in answers to questions about green practices of the teachers and understanding environment issues of the students. This approach allows the effective collection of measurable data on a larger heterogeneous population, which is particularly effective when exploring the relationship between variables (McCombes, 2021; Ponto, 2015). Within the framework of this research, the survey design will provide a chance to identify impacts of green practices of teachers on the level of student awareness of environmental problems because such parameters can be measured with a standard measuring tool (Likert scale) in several schools, and divisions. It allows analysing the outcomes of predictors statistically (e.g., linear regression) and allows the purposeful and repeatable question that quantitative research demands (GCU, 2021). Therefore, using this design allows to generalize the findings to the broader population of higher secondary schools in the seven divisions of Khyber Pakhtunkhwa in Pakistan.

Population and Sampling

The sample size included teachers (N = 1,880) who taught in the higher secondary schools in seven divisions of Khyber Pakhtunkhwa (Hazara, Malakand, Mardan, Peshawar, Kohat, Bannu and D.I. Khan). The population of study was the students (N = 59,680) who are in the higher secondary division of the divisions selected (Farid & Adnan, 2022). This group of people was chosen since higher secondary education is a formative level in which there are still some sensitization and attitude towards environmental sustainability.

The sampling method adopted was stratified so that there would be proportional representation of all the divisions and both gender groups among teachers and students. The stratified sampling method is suitable in the research that the population is heterogeneous and requires segmentation into subgroups to be represented accurately (Etikan & Bala, 2017). Moreover, a sample of 566 (Male = 359, Female = 207) was picked and 1788 students (Male = 1220, Female = 568) were picked of all seven divisions of KPK. This stratification made the sampling representative of the regions and gender which enhanced external validity of the study.

Research Tools

The research instruments in this study were two self-developed structured questionnaires that were used in the data collection. In the first questionnaire, the teacher was supposed to rate their green practices such as the level of curriculum integration of environmental material, habits of resource conservation, waste management, environmental protection programs, professional development experiences connected to sustainability, personal environmental commitment, and the overall school environmental culture. The second questionnaire was given to the students to determine the level of their environmental awareness on environmental knowledge, attitude to environmental sustainability and their readiness to follow pro-environmental behaviours. Both tools have been premised on the four-point Likert scale that starts Strongly Disagree (1), through to Strongly Agree (4), in which respondents could voice the level of their agreement with a given statement. The Likert scale form has been selected as it is one of the most common scale types used in the measurement of attitudes, perceptions, which allows quantifying the subjective

judgment in a consistent and reliable way (Joshi et al., 2015).

Variables of the Study

The following table showed variables of the study;

Table 1: *Key variables of the study*

No.	Group	Variables	Type
1	Teachers	Curriculum Integration and Teaching Practices (CITP)	Independent variable (continuous)
		Resource Conservation Practices (RCP)	
		Waste Management (WM)	
		Air Pollution (AP)	
		Professional Development and Skills Training (PDST)	
		Personal Commitment (PC)	
		School Environment (SE)	
2	Students	Understanding Environmental Issues (UEI)	Dependent variable (continuous)

Validity and Reliability

Validity of the research tools was guaranteed by the knowledge and pilot testing process. In order to determine the content validity, the two questionnaires were subjected to a review by three subject experts in the areas of chemistry who teach green education to students and educational research methodology. Such professionals assessed the clarity, relevancy, and representativeness of every item based on the goals of the study and their feedback was used to refine the wording, remove ambiguity, and properly align with constructs under measurement. A pilot study was also done to determine the appropriateness of the instruments using a sample of 25 teachers and 40 students who did not form part of the final sample (Awan et al., 2018). This pilot testing was done to test the internal consistency and reliability of the scales. After the pilot, the Cronbach alpha of the two instruments was determined and gave a coefficient of reliability of 0.87 to the teachers' green practices questionnaire and 0.84 to the environmental awareness questionnaire to students. These values are above the generally accepted value of 0.70, which is high internal consistency and indicates that the instruments could be used in a large-scale data collection (Tavakol & Dennick, 2011). In this way, the research instruments were ensured to be valid and effective in the measurement in this research of the intended constructs.

Data Collection Procedure

The distribution of instruments was done under the permission of school administration authorities. The questionnaires were also given face-to-face and at the predetermined school hours so that most of the respondents could complete the questionnaires. It was made clear to the respondents that their participation was voluntary and their answers will be kept confidential. The

questionnaires were used to collect the data to reduce the case of non-response bias.

Data Analysis

Data were entered in SPSS to be analysed. Response summarization was performed using descriptive statistics (mean and standard deviation). Linear regression analysis was employed to establish how green practices of teacher's influence students' understanding of environmental issues. Regression can be used when the impact of independent variables on a continuous dependent variable is required (Field, 2024). To use linear regression, assumptions of analysis aligned with data. Both independent and dependent variables were made continuous, have larger sample size, and independence of residuals.

Effects of Teachers' Activities on Students' Environmental Awareness

Table 1: *ANOVA table depicting effects of teachers' activities on students' environmental awareness*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.537	7	.077	.606	.000[b]
	Residual	70.695	558	.127		
	Total	71.232	565			

a. Dependent Variable: UEI

b. Predictors: (Constant), SE, CITP, AP, PDST, WM, PC, RCP

The table 1 demonstrated ANOVA analysis to depict significance of model. A weak significant regression was found as (F (7, 558) = .606, p < .05).

Table 2: *Coefficient table depicting regression by each predictor of teachers' activities on students' understanding of environmental issues*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.868	.178		16.125	.000
	CITP	.024	.033	.320	.724	.040
	RCP	.033	.038	.440	.869	.003
	WM	.008	.042	.310	.202	.042
	AP	.016	.040	.418	.390	.006
	PDST	.005	.035	.306	.133	.017
	PC	.016	.045	.317	.356	.027
	SE	.047	.035	.467	1.320	.003

a. Dependent Variable: UEI

The table 2 measures marginal effect size of independent variable (CITP, AP, SE, PDST, WM, PC and RCP). Curriculum integration and teaching practices of teachers about green skills predicted students' environmental awareness (UEI) which is equal to 2.868 – .024. The awareness of students about green skills improved as .024 units of CITP increased β = .320, *t* (7, 558) = 0.724 and $p < .05$ depicted weak significant effect. In addition, resource conservation practices of teachers about green skills predicted students' environmental awareness (UEI) which is equal to 2.868 – .033. The awareness of students about green skills improved as .033 unit of RCP increased β = .440, *t* (7, 558) = 0.869 and $p < .05$ depicted weak significant effect. Furthermore, waste management practices of teachers predicted students' environmental awareness (UEI) which is equal to 2.868 – .008. The awareness of students about green skills improved as .008 unit of WM increased β = .310, *t* (7, 558) = 0.202 and $p < .05$ depicted weak significant effect. Moreover, air population control practices of teachers predicted students' environmental awareness (UEI) which is equal to 2.868 – .016. The awareness of students about green skills improved as .016 unit of AP increased β = .418, *t* (7, 558) = 0.390 and $p < .05$ depicted weak significant effect.

Professional development and skill training of teachers about green skills predicted students' environmental awareness (UEI) which is equal to 2.868 – .005. The awareness of students about green skills improved as .005 units of PDST increased β = .306, *t* (7, 558) = 0.133 and $p < .05$ depicted weak significant effect. Moreover, personal commitment of teachers about green skills predicted students' environmental awareness (UEI) which is equal to 2.868 – .016. The awareness of students about green skills improved as .016 unit of RCP increased β = .317, *t* (7, 558) = 0.356 and $p < .05$ depicted weak significant effect. Lastly, school environment predicted students' environmental awareness (UEI) which is equal to 2.868 – .047. The awareness of students about green skills improved as .047 unit of SE increased β = .467, *t* (7, 558) = 1.320 and $p < .05$ depicted significant effect.

Discussion

The linear regression analysis based in this study showed that the green practices of teachers were found to have an overall predictive effect on the environmental awareness of students, but the effect size of most predictors was weak with some being more influential than others (especially the school environment). The provided analysis shows that the overall model is statistically significant, and the regression coefficients of the curriculum integration (CITP), resource conservation practices (RCP), and waste management (WM), air-pollution control (AP), teacher professional development (PDST), personal commitment (PC), and school environment (SE) are small but significant. The reported standardized coefficients and t-values indicate that the growth in green practices by teachers was correlated with slight progressive gains in students' awareness; school environment had the biggest relative impact in comparison with the predictors.

The results are generally consistent with recent international research that has indicated that teacher-led and school-based sustainability practices are associated with higher levels of student environmental awareness but the extent of effects varies depending on context and fidelity to implementation. In a range of studies and reviews (2020-2025) positive correlations have been found between teacher practice/leadership and student environmental literacy and the importance of the effect size is emphasized on the intensity of the program, teacher training, and schoolwide coherence (Imran & Almusharraf, 2024; Husin et al., 2025). Indicatively, quantitative studies and systematic reviews have shown that the outcomes of students are more significantly increased in cases where the teachers adopt curriculum integration in conjunction with visible and consistent

modelling and institutional supports compared to instances where environmental themes are presented intermittently or as curricular supplements. That is why the current research reveals statistically significant yet small coefficients: teacher practices by themselves enhance awareness, although the power of the latter effect is enhanced with the introduction of the practices being sustained, school-wide programs and with the teachers being provided with specific professional training. (Imran & Almusharraf, 2024; Husin et al., 2025; Zhang, 2025)

The trend on the regional and national level (Pakistan and localized circumstances) also conforms to the empirical results of the positive yet often limited effects of teacher practice on environmental awareness of students. In multiple articles and reports by Pakistani scholars and practitioners, it is stated that teachers favour environmental education but lack the resources, time, and training to implement them due to inconsistent school policies curtailing the effectiveness of classroom greening (Khanum et al., 2023). Pilot interventions and program reviews of neighbour countries also indicate measurable student awareness improvements after program scales and teacher support of visible thinking routines (school projects), but authors focus on the fact that small gains are characteristic of where the program scale and teacher support are low (Martínez-Salinas & de María Sánchez-Aguirre, 2024). The comparatively low effect sizes of the current study are thus reflective of an even larger regional trend: teacher behaviours do have an impact but without systemic reinforcement (training on the needs of comprehensive curriculum integration, routine professional development (Alam et al., 2020), and culture change in the school) their impact on student awareness is measurable but minimal.

Conclusion

This study shows that the green practices of teachers affect the knowledge of the higher secondary students about environmental concerns in Khyber Pakhtunkhwa in a significant yet a small extent. The linear regression analysis revealed that despite the fact that all the dimensions of teachers' green practices curriculum integration, resource conservation, waste management, environmental protection activities, professional development, and personal commitment had positive relationship with the student environmental awareness, the effect of each of the individual predictor did not tend to be strong. However, the school environmental climate was the most impactful of all the predictors, which means that the sustainability as a visible and shared school norm makes the awareness of students stronger. Such findings confirm that although the practice of teachers is indeed important in influencing the environmental knowledge of the students, the level of effect is higher when such practices are instilled within the school culture as opposed to being practiced in isolation.

These results also support the point that sustainable education is not only realized through classroom teaching, but a culture of collective stewardship whereby teachers set a good example of responsible environmental behaviour and students observe and adopt these behaviours. The small effect sizes depict that teachers are trying to be sustainable, but those practices might not be reflected yet in their routine teaching sessions or supported in the overall school organization. It follows that student environmental awareness can be enhanced through better organizational commitment to sustainability backed by administrative policy, organizing professional development of teachers and involving students in significant environmental activities on a regular basis.

Recommendations

Environmental education may be enhanced on a larger scale beyond classroom education to cover school wide systematic practices. Schools may include practical sustainability programs like recycling movements, plantation movements, water conservation programs and student initiated eco-clubs to establish visible contexts of environmental learning. The teachers may be placed under the continuous professional development where they are taught practical environmental teaching strategies that will help them to incorporate sustainability topics effectively in most of the subjects they are teaching specifically in chemistry. It is suggested that curriculum planners and policymakers may incorporate sustainability content in various disciplines. In addition, administrative leaders may promote and lead through example of green behaviour such that the culture of environmental responsibility is one that is practiced within the school instead of being an ideal which is only welcomed in theory.

Study limitations and Future directions

The research was confined to the extent of assessing the understanding environment issues amongst the students and there was no study on how the environmental awareness is converted into real pro-environmental behaviour, which limits the interpretation level. The study was confined to higher secondary schools in seven divisions of Khyber Pakhtunkhwa and this may not be generalizable to other provinces and levels of education. In addition, the research used self-reported data, which could be influenced by the social desirability bias. Future studies may focus on such direct behavioural outcomes as the involvement of students in concrete sustainability activities and may step in mixed-method or longitudinal designs to monitor variations across time. The comparative research on the region or on the public and private institutions can also explain the influence of contextual factors on the development of environmental awareness. Lastly, the role of digital learning, community relations, and blended environmental education programs should be examined in the future as the way to research the innovative methods of enhancing sustainability education.

Conflict of Interest

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