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Ecopedagogy in Physical Education, Sports, and Health: Changes in Elementary School Students' Environmental-Care Attitudes

Dede Dwiansyah Putra[1]*
Universitas Terbuka, Tangerang Selatan, Banten

dede.dwiansyah@ecampus.ut.ac.id

ABSTRAK

Pembelajaran Pendidikan Jasmani, Olahraga, dan Kesehatan (PJOK) berpotensi menjadi ruang pengalaman untuk menghubungkan aktivitas gerak dengan kepedulian terhadap lingkungan sekolah melalui pengamatan, pengambilan keputusan, dan refleksi ekologis. Penelitian ini bertujuan mendeskripsikan perubahan sikap peduli lingkungan siswa kelas V setelah empat pertemuan PJOK berbasis ekopedagogi serta menggambarkan partisipasi gerak dan indikator perilaku ekologis yang teramati selama pembelajaran. Penelitian menggunakan desain pra-eksperimental satu kelompok pretest-posttest pada 32 siswa. Sikap diukur menggunakan 12 butir skala empat poin berbasis laporan diri, sedangkan observasi kelas mencatat secara agregat partisipasi gerak aktif, kepedulian terhadap area/peralatan, dan penyampaian ide ekologis. Rerata skor sikap meningkat dari 29,50 (SD=6,71) menjadi 32,19 (SD=8,51), dengan rerata perubahan +2,69 poin. Sebanyak 24 siswa (75,0%) meningkat, 1 siswa (3,1%) tidak berubah, dan 7 siswa (21,9%) menurun. Proporsi siswa yang menunjukkan partisipasi gerak aktif berada pada 75,0-84,4%; kepedulian terhadap area/peralatan 53,1-68,8%; dan ide ekologis 31,3-53,1%. Temuan menunjukkan pola perubahan deskriptif yang positif namun heterogen, sedangkan perbedaan karakteristik tugas antarsesi membatasi perbandingan langsung indikator observasi. Karena tidak terdapat kelompok pembanding, hasil tidak ditafsirkan sebagai bukti kausal atau sebagai bukti bahwa durasi dan intensitas aktivitas fisik setara dengan pembelajaran PJOK konvensional, melainkan sebagai dasar pengembangan dan pengujian lebih kuat terhadap pembelajaran PJOK berbasis ekopedagogi.

Kata Kunci: ekopedagogi; pendidikan jasmani; sikap peduli lingkungan; perilaku pro-lingkungan

ABSTRACT

Physical Education, Sports, and Health can provide an experiential setting for linking movement activities with care for the school environment through observation, decision-making, and ecological reflection. This study aimed to describe changes in fifth-grade students' environmental-care attitudes after four ecopedagogy-based Physical Education, Sports, and Health lessons and to portray movement participation and observable indicators of ecological behavior during implementation. A one-group pretest-posttest pre-experimental design involved 32 students. Attitudes were measured using 12 four-point items based on self-report, while class observations recorded at the aggregate level active movement participation, care for play areas/equipment, and ecological ideas. The mean attitude score increased from 29.50 (SD=6.71) to 32.19 (SD=8.51), with a mean change of +2.69 points. Twenty-four students (75.0%) increased, one (3.1%) was unchanged, and seven (21.9%) decreased. The proportion of students showing active movement participation ranged from 75.0% to 84.4%, care for areas/equipment from 53.1% to 68.8%, and ecological ideas from 31.3% to 53.1%. The findings indicate a positive but heterogeneous descriptive pattern, while differences in lesson tasks limit direct comparisons of observational indicators across sessions. Because no comparison group was included, the results are not interpreted as causal evidence or as evidence that physical activity duration and intensity were equivalent to those in conventional physical education, but as a basis for further development and stronger testing of ecopedagogy-based physical education.

Keywords: *ecopedagogy; physical education; environmental-care attitude; pro-environmental behavior*

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INTRODUCTION

Environmental education for children cannot stop at the mastery of knowledge; it needs to be directed toward forming attitudes, intentions, and behaviors that can be practiced in everyday life. A meta-analysis of 169 studies with 512 effect sizes and 176,007 participants from 43 countries showed that environmental education is associated with increases in environmental knowledge (g=0.953), attitudes (g=0.384), intentions (g=0.256), and environmental behavior (g=0.410) (van de Wetering et al., 2022). Among children, another meta-analysis of 76 effect sizes likewise found increases in pro-environmental behavior with Hedges' g=0.53 and indicated that effects tend to be larger when actual behavior is measured than when it is assessed through self-report alone (Świątkowski et al., 2024). These findings confirm that schools are an important arena for building environmental experiences early in life, while also showing that changes in attitudes and behavior are not always large or uniform.

In the elementary school context, internal factors such as attitudes and values interact with external factors in the form of environmental education, exposure to nature, social norms, and direct experience. Conceptually, environmental-care attitude refers to the evaluations and behavioral tendencies that students express regarding environmental responsibility, whereas pro-environmental behavior refers to observable actions. The two constructs are related but cannot be used interchangeably in measurement or interpretation. A systematic review of 76 studies of children aged 6–12 years showed that attitudes and values are the most frequently studied internal factors, while environmental education is the external factor most often examined; at the same time, measurement in this field is still dominated by self-report scales and lacks longitudinal and experimental designs (Liu & Green, 2024). A field experiment with fourth-grade students also showed that a school environmental education program can improve children's knowledge, attitudes, and practices related to plastic consumption and disposal, although changes among children do not automatically extend to parents' behavior (Jaime et al., 2023). At the school level, green structures and programs may also be related to students' pro-environmental behavior, but the pattern of the relationship is not always linear (Salazar et al., 2024).

Physical Education, Sports, and Health differs from classroom instruction because it places the body, movement, space, social interaction, and the physical environment directly within the learning experience. For this reason, Physical Education, Sports, and Health has an opportunity to integrate sustainability without sacrificing motor and fitness goals. The literature positions physical education as a space that can connect health, social, and environmental

dimensions in education for sustainability (Baena-Morales & González-Víllora, 2023). Practice models for the Sustainable Development Goals likewise emphasize that movement tasks can be modified to include experiences of environmental responsibility without replacing physical activity as the core of learning (Baena-Morales et al., 2021). The "Klima bewegt!" program was even developed systematically to integrate sustainable behavior into physical education lessons through active learning, reflection, social norms, and practical activities that remain compatible with the curriculum (Bucht et al., 2022).

This approach is relevant to the idea of ecopedagogy, that is, learning that connects learners' experiences with human–environment relations and encourages reflection on everyday actions. Within the foundations of critical pedagogy, ecopedagogy is not limited to delivering environmental knowledge or habituating environmentally friendly behavior, but also invites learners to question the reasons, consequences, and socio-ecological responsibilities of human actions (Kahn, 2010; Misiaszek, 2015). Ecopedagogy can thus be distinguished from environmental education that focuses primarily on individual knowledge and practice, and from sustainability-oriented physical education, whose scope is broader and does not always require critical reflection. In this study, the ecopedagogical orientation was applied in a limited manner and in line with the developmental level of elementary school students, through observing the condition of the play area, choosing actions, using equipment responsibly, and reflecting on the ecological consequences of those activities. The broader dimension of socio-ecological justice was not an object of measurement in this study. In physical education, concrete forms may include reusing play equipment, choosing shaded and safe activity spaces, protecting plants during play, reducing waste, or combining physical activity with ecological action. Plogging, for example, links physical activity with litter collection so that ecological behavior is practiced as part of movement rather than merely discussed in the abstract (Martínez-Mirambell et al., 2023). However, the results of brief interventions are not always uniform. Among 111 elementary school students, an eight-session, four-week intervention based on self-made equipment did not produce a significant difference in ecological awareness, although some scores related to reuse showed improvement (Botella et al., 2022). This suggests that duration, experience design, participant characteristics, and the way outcomes are measured need to be considered when assessing change after instruction.

The school play environment is also more than a backdrop for activity. An experimental review of schoolyard greening found a tendency toward benefits for physical activity and socioemotional health, although only six studies met the strict criteria out of 1,843 records

screened (Bikomeye et al., 2021). Direct observation in schoolyards shows that children's physical activity is influenced by the organization of space and by supervision; organized areas had moderate-to-vigorous activity counts 2.70 times higher, and supervised areas 1.34 times higher, than comparison areas (Graham et al., 2021). Meanwhile, research with 199 students in grades III–VI showed that nature-based activities and teacher-led activities were more consistently related to positive perceptions of the schoolyard than the mere presence of natural elements (Zhang et al., 2022). This implies that the quality of experience and pedagogical interaction may matter more than the mere availability of green space.

Repeated experiences in the school environment can help children notice ecological elements that they previously paid little attention to. A nature-engagement program in the school setting with 509 children aged 8–11 years increased their awareness of local biodiversity and showed a link between changes in biodiversity perception and resilience (Montgomery et al., 2024). A systematic review of outdoor learning also shows benefits across various developmental and learning domains, but variation in study quality and forms of implementation remains large (Mann et al., 2022). For this reason, ecopedagogy research in Physical Education, Sports, and Health needs to assess not only changes in attitude scores but also to document the proportion of students actively engaged in movement tasks and whether observable indicators of ecological behavior emerge during the learning process. Documenting movement participation in this way needs to be distinguished from measuring the duration or intensity of physical activity, which requires its own measurement procedures.

The gap addressed in this study is not the absence of sustainability-oriented physical education approaches, since the integration of movement activity and environmental education has been developed in previous research, but rather the need for more contextual documentation of implementation in elementary school Physical Education, Sports, and Health. Specifically, this study examines how four Physical Education, Sports, and Health lessons in a single fifth-grade class connect movement tasks with ecological observation and reflection, while also describing changes in students' self-reported attitudes and learning-process indicators observed at the aggregate level. Relying on only one type of indicator risks oversimplifying the results, especially because actual behavior can provide different information from self-report (Świątkowski et al., 2024), while schoolyard conditions and teacher-directed activities also affect students' experience (Graham et al., 2021; Zhang et al., 2022). Combining a questionnaire with classroom observation can therefore provide a more contextual picture, although the two

must still be understood as different types of evidence and do not yet allow testing of the individual-level relationship between attitude change and observed ecological behavior.

This study aims to describe changes in fifth-grade students' environmental-care attitudes after four ecopedagogy-based Physical Education, Sports, and Health lessons and to portray the proportion of students who showed active movement participation, care for areas or equipment, and the expression of ecological ideas during instruction. The practical contribution of this study does not rest on a claim that integrating movement and environmental education is an entirely new approach, but on the contextual documentation of ecopedagogy applied across four fifth-grade Physical Education, Sports, and Health lessons. This contribution includes using school spaces as a source of movement experience and ecological reflection, together with reporting two conceptually distinct types of information: students' self-reported attitude scores and learning-process indicators based on aggregate observation. The study was not designed to establish a causal relationship because it involved only one group without a comparison group. The results are therefore interpreted as a pattern of change and classroom implementation that can serve as a basis for refining instructional design and for further research with stronger methodological control.

METHOD

The study used a quantitative approach with a one-group pretest-posttest pre-experimental design (O1-X-O2). The unit of implementation was one fifth-grade class in one elementary school. All students in the class were used as the sample (total sampling), namely 32 students consisting of 18 girls and 14 boys. Selecting one intact class constitutes sampling based on an available class and was not intended to produce a sample representative of the broader population of elementary school students. The one-group design was chosen to document changes in scores before and after the implementation of instruction in the available classroom context. Because there was no comparison group, the analysis and interpretation focused on descriptive change following implementation rather than on establishing causal effects. This design cannot fully control threats to internal validity, including the effects of repeated measurement, learner maturation, and other experiences outside the intervention that may have occurred during the study. This choice is consistent with the need for caution in research on environmental interventions for children, which shows heterogeneous results and limitations of experimental design in many studies (Liu & Green, 2024; van de Wetering et al., 2022).

The intervention was carried out in four lessons, each lasting 2 × 35 minutes. The first lesson combined locomotor movement, coordination, and brisk walking with the exploration of three locations in the school environment. Students observed shaded, clean, and safe areas for play and then reflected on the importance of access to healthy play spaces. The second lesson used short sprints and changes of direction through relay activities while choosing play routes that took into account heat, tree shade, and safety. The third lesson combined manipulative movement and team games using traditional games and reusable equipment; students were guided to look after the equipment and plants and to discuss the relationship between reusing equipment and reducing waste. The fourth lesson used locomotor movement and group coordination to design an environmentally friendly play route and to propose one feasible improvement to the play environment. This sequence of activities integrated motor experience with observation of environmental conditions, decision-making about the use of space and equipment, and reflection on ecological responsibility. However, task characteristics were not identical across lessons. In particular, the fourth lesson explicitly asked students to present improvement proposals, so opportunities to express ecological ideas were not fully equivalent to those in the earlier lessons. This difference needs to be considered when interpreting the observation percentages. The development of sustainability education programs in physical education does emphasize combining behavioral goals with activities that remain compatible with the movement curriculum (Bucht et al., 2022).

Environmental-care attitude was measured using a 12-item questionnaire with a four-point scale: 1=strongly disagree, 2=disagree, 3=agree, and 4=strongly agree. Total scores ranged from 12 to 48; higher scores indicate more positive self-reported environmental-care attitudes. Four items represented concern for the condition of the play environment, four items responsibility during play, and four items ecological action. These three item groups were used as content coverage of the instrument and cannot yet be presented as a validated factor structure. Measurement was conducted anonymously at pretest and posttest. The literature on instrument development for elementary school students emphasizes the importance of construct validation and reliability for measuring environmental attitudes; as a point of comparison, Tan and Demirci Güler (2024) developed a 17-item, three-factor scale with 948 students, with KMO=0.837 and internal consistency coefficients of 0.76–0.91. Evidence of construct validity and internal reliability coefficients for the 12-item instrument used in this study have not been reported. Interpretation of score changes must therefore take into account limitations in the precision and

consistency of measurement. In this study, questionnaire scores were treated as students' self-reported attitudes, not as direct evidence of actual behavior.

To complement the questionnaire, aggregate observation was conducted in each lesson, recording attendance, active movement participation, care for areas or equipment, and the expression of ecological ideas. Active movement was defined as involvement in the core part of the lesson for most of the activity time; care meant correct actions toward equipment or the environment; and ecological ideas meant the expression of proposals relevant to caring for the play environment. Operationally, care for areas or equipment includes actions such as using and returning equipment responsibly and avoiding damage to plants or play areas. Ecological ideas refer to proposals related to cleanliness, use of space, or improvement of the play environment. These examples clarify the scope of the indicators and are not evidence that each action was recorded separately. The strategy of combining self-report and observation is supported by findings that measures of actual behavior often show patterns different from self-report measures (Świątkowski et al., 2024) and that direct observation can capture variation in activity that depends on spatial context and the organization of instruction (Graham et al., 2021; van Dijk-Wesselius et al., 2022). Observations were recorded at the class level and were not linked one-to-one with the anonymous identities in the questionnaire. The movement participation percentage represents the proportion of students who met the observation criteria, not the percentage of time spent moving or the intensity of physical activity.

The analysis was descriptive, covering pretest scores, posttest scores, and difference scores, including the number of cases, mean, standard deviation, median, and range. In addition, students were grouped by the direction of score change (increased, unchanged, or decreased). The difference score was calculated as posttest minus pretest for each student, provided that individual measurement pairs could be verified. Change classification was determined by a positive difference (increased), zero (unchanged), and a negative difference (decreased). Individual change statistics cannot be maintained if the data pairs cannot be validly identified. Observation data were calculated as frequencies and percentages based on the number of students present at each lesson. The percentage for each indicator was obtained by dividing the number of students recorded as meeting the indicator by the number of students present in the corresponding session, then multiplying by 100%. Because task demands differed, these percentages were used as descriptions of each lesson and were not assumed to be fully comparable measures of behavioral development across sessions. This analytic focus was chosen so that the outputs match the available evidence and do not exceed the capacity of a one-

group design. The activities were designed with attention to safety, including avoiding extreme weather, slippery or sharp areas, and hazardous waste, and adjusting the intensity of movement to the condition of the students and the school environment.

RESULTS AND DISCUSSION

Results

The reported data include pretest and posttest scores from each of the 32 students. However, the status of these data as individual pairs requires verification of the matching mechanism used. The mean environmental-care attitude score before instruction was 29.50, with a standard deviation of 6.71, a median of 31.00, and a range of 15–42. After four lessons, the mean score was 32.19, with a standard deviation of 8.51, a median of 33.50, and a range of 15–47. Based on the reported individual change statistics, the mean individual difference was +2.69 points, with a standard deviation of 5.46 and a median of +4.00. The range of individual change was very wide, from −10 to +10 points, so the change following instruction was not uniform across all students. Interpretation of these individual change statistics can be maintained only if the match of each pretest–posttest pair has been confirmed against the source data.

Table 1. Descriptive statistics of environmental-care attitude scores

Statistic	Pretest	Posttest	Change
N	32	32	32
Mean	29.50	32.19	+2.69
Standard deviation	6.71	8.51	5.46
Median	31.00	33.50	+4.00
Range	15–42	15–47	−10 to +10

Note. Score change was calculated as posttest minus pretest for each student. The standard deviation, median, and range in the Change column refer to the distribution of individual difference scores, not to the difference between descriptive statistics of the two measurement occasions. Paired change statistics are valid only if the pretest–posttest matching at the student level has been verified.

Based on the reported classification of individual change, 24 of 32 students (75.0%) showed an increase in score, one student (3.1%) showed no change, and seven students (21.9%) showed a decrease. The proportion of students who increased was larger than that of students who were unchanged or decreased, but the larger posttest standard deviation relative to the pretest (8.51 versus 6.71) and the change range of −10 to +10 indicate important heterogeneity. The increase in the class mean therefore cannot be used to conclude that every student responded to the instruction in the same way. This classification by direction of change also remains dependent on the validity of the individual data pairing. In addition, the observed

differences in response cannot be attributed directly to the intervention because the study did not include a comparison group.

The observation data show that the integration of ecological content took place alongside the involvement of a number of students in movement activities in every lesson. Active movement participation was recorded for 24 of 32 students (75.0%) in the first lesson, 26 of 31 students (83.9%) in the second lesson, 25 of 32 students (78.1%) in the third lesson, and 27 of 32 students (84.4%) in the fourth lesson. Thus, the proportion of students classified as actively moving did not fall below 75.0% in any lesson. However, these percentages describe only participation based on the observation category and do not indicate the duration, intensity, or level of moderate-to-vigorous physical activity. Without comparison data from conventional Physical Education, Sports, and Health instruction, these findings also cannot be used to conclude that the level of physical activity was maintained at an equivalent level.

Table 2. Aggregate observation across four ecopedagogy-based Physical Education, Sports, and Health lessons

Lesson	Present	Active movement n (%)	Care for areas/equipment n (%)	Ecological ideas n (%)
1	32	24 (75.0)	17 (53.1)	10 (31.3)
2	31	26 (83.9)	21 (67.7)	13 (41.9)
3	32	25 (78.1)	20 (62.5)	12 (37.5)
4	32	27 (84.4)	22 (68.8)	17 (53.1)

Note. n indicates the number of students recorded as meeting the indicator in each lesson. Percentages were calculated from the number of students present in the corresponding session. Active movement is an observed participation classification, not a percentage of duration or a measure of physical activity intensity. Care for areas/equipment reflects responsible actions toward play space and equipment, whereas ecological ideas are relevant proposals regarding the maintenance of the play environment. Because learning tasks differed across sessions, especially the explicit demand to present ideas in the fourth lesson, the observation percentages are not treated as fully equivalent measures of behavioral development across lessons. Evidence of observer reliability and consistency in applying the rubric also needs to be verified.

The indicator of care for areas or equipment was shown by 17 students (53.1%) in the first lesson, rising to 21 of 31 students (67.7%) in the second lesson, 20 students (62.5%) in the third lesson, and 22 students (68.8%) in the fourth lesson. Meanwhile, the number of students who expressed ecological ideas was 10 students (31.3%), 13 of 31 students (41.9%), 12 students (37.5%), and 17 students (53.1%), respectively. The highest percentages for all three observation indicators occurred in the fourth lesson: active movement 84.4%, care for areas/equipment 68.8%, and ecological ideas 53.1%. However, these percentage differences cannot be interpreted directly as a consistent increase in ecological behavior over time. Differing task characteristics affected students' opportunities to display particular indicators. In particular, the fourth-lesson activity explicitly asked students to produce proposals for environmental improvement, so the

high percentage of ecological ideas in that session may be related to the demands of the assigned activity.

The observation pattern shows that ecological indicators can emerge alongside motor activity, but these data are aggregate and cannot be matched individually with changes in questionnaire scores. Accordingly, the score increase of a particular student cannot be directly linked to a particular observed behavior. In addition, the limited information on observer reliability, rubric consistency, and task equivalence across lessons requires that the observation results be interpreted cautiously. The observation results mainly serve to illustrate the character of the implementation process and to provide context for interpreting class-level attitude change, not as evidence of a causal relationship among the intervention, attitude change, and individual ecological behavior.

Discussion

The change in the mean from 29.50 to 32.19 indicates a descriptive shift toward students' self-reported environmental-care attitude scores after four lessons. The magnitude of the mean change, +2.69 points on a 12–48 scale, needs to be read together with the heterogeneity of individual responses reported on the basis of paired data. According to the classification of individual change in the study data, seven students decreased and one student did not change, while 24 students increased. Interpreting this individual change requires verification of the mechanism used to match pretest and posttest scores. This pattern is consistent with the literature showing that environmental education in children is related to changes in attitudes and behavior, but that the magnitude of change can vary across individuals and learning contexts. The meta-analysis by van de Wetering et al. (2022) found small-to-medium effects on attitudes (g=0.384) and behavior (g=0.410), far smaller than the effect on knowledge (g=0.953). Attitude change is thus a realistic outcome to observe, but the score shift in this study cannot be causally attributed to the intervention because no comparison group was available.

Heterogeneity is also evident in the meta-analysis of pro-environmental behavior interventions in children, which found Hedges' g=0.53 but emphasized differences in effects by form of measurement and participant age (Świątkowski et al., 2024). This effect size provides literature context but cannot be compared directly with the raw score difference in this study because of differences in outcome measures and analytic methods. The standard deviation increased from 6.71 at pretest to 8.51 at posttest, and the reported individual change statistics show a 20-point difference range from −10 to +10. This condition may reflect differences in learning experience, understanding of the items, engagement during activities, measurement

uncertainty, or other contextual factors not controlled by the one-group design. These possibilities were not tested directly, so they cannot be established as causes of the score variation. The review by Liu and Green (2024) also affirms that children's pro-environmental behavior is shaped by a combination of internal and external factors, so a single classroom intervention cannot be assumed to be the only source of change.

The short duration of the intervention is an important context. Botella et al. (2022) reported that eight sessions over four weeks with 111 elementary school students did not produce a significant difference in overall ecological awareness, although some scores related to reuse increased. Compared with that study, the present study lasted only four lessons, so it is more appropriate to regard the observed change as an initial indication rather than as evidence of attitude stability. Moreover, this study did not conduct follow-up measurement, so the sustainability of score changes after the activities ended is unknown. Environmental attitudes may require repeated reinforcement, consistent opportunities for action, and social-norm support in order to become embedded in habit. Liang et al. (2022) showed that teacher and peer role models play a part in children's pro-environmental behavior in public school spaces. Accordingly, the sustainability of practices after the intervention may depend on whether the norm of caring for the environment continues to be upheld by teachers and peer groups.

One relevant aspect of implementation is the integration of Physical Education, Sports, and Health movement goals with ecological experience within a single sequence of lessons. The proportion of students classified as showing active movement participation ranged from 75.0% to 84.4% across the four lessons. These data indicate that students remained engaged in movement tasks when ecological content was included in instruction. However, this indicator does not measure the duration or intensity of physical activity and does not prove that opportunities to move were equivalent to those in conventional Physical Education, Sports, and Health instruction. This perspective is consistent with Baena-Morales and González-Víllora (2023), who position physical education as a space for connecting health, social learning, and sustainability. Baena-Morales et al. (2021) also emphasize the importance of practice-based models that make physical activity a vehicle for sustainability learning, while Bucht et al. (2022) show that sustainable-behavior goals can be designed to be integrated with the physical education curriculum through activities, reflection, and real application.

The fourth lesson offers an illustration of how task design provides opportunities to display movement and ecological indicators simultaneously. In this session, students performed locomotor movement and group coordination while designing an environmentally friendly play

route and proposing realistic improvements. The active movement percentage reached 84.4%, care for areas or equipment 68.8%, and the expression of ecological ideas 53.1%, all of which were the highest values among the four lessons. This pattern does not prove that the fourth-lesson activity caused behavior change, but it shows that tasks that combine ecological decisions with group work and movement allow two learning goals to emerge at the same time. However, because the fourth lesson explicitly asked students to propose environmental improvements, the high proportion of ecological ideas may also reflect greater opportunity to respond compared with the other sessions. This idea is consistent with plogging, which directly combines physical activity and environmental action (Martínez-Mirambell et al., 2023), as well as with physical education intervention models that emphasize identity, social norms, collective action, and behavior change in sustainability learning (Baena-Morales et al., 2024).

The context of the play space also has the potential to shape engagement. Graham et al. (2021) showed that physical activity in schoolyards differs according to the organization and supervision of the area, with moderate-to-vigorous activity counts 2.70 times higher in organized areas and 1.34 times higher in supervised areas. These findings provide a basis for considering spatial organization and supervision as contextual factors in designing movement tasks, but they cannot be used to conclude that students' physical activity in this study had the same intensity. On the other hand, Zhang et al. (2022) found that the presence of natural elements alone is not sufficient; nature-based activities and teacher-led activities were more consistently related to students' perceptions of the benefits of the schoolyard. Ecopedagogy in Physical Education, Sports, and Health therefore requires not merely green space but task designs that direct students to notice, use, and reflect on that space.

The difference in the proportion of students expressing ecological ideas, from 31.3% in the first lesson to 53.1% in the fourth lesson, describes variation in the verbal engagement observed during implementation but does not yet prove the development of attitudes or behavior at the individual level. The percentage fell from 41.9% in the second lesson to 37.5% in the third lesson. This pattern needs to be interpreted by considering differences in the response opportunities provided by each learning task. The third lesson focused on traditional games and the reuse of equipment, whereas the fourth lesson explicitly asked groups to produce improvement proposals. Because task demands differed, the frequency of ecological ideas does not merely represent the level of attitude. Comparisons of percentages across lessons are therefore better used to explain the character of implementation than to infer sustained behavioral development.

Measurement is the next important issue. The questionnaire in this study captured students' self-reported attitudes, whereas the observation captured indicators of participation and ecological behavior at the aggregate class level. The two cannot be treated as a single construct. The meta-analysis by Świątkowski et al. (2024) found larger intervention effects when actual behavior was measured than when only self-report was used, while Liu and Green (2024) highlight the dominance of self-report scales in the literature on children's pro-environmental behavior. The use of observation in this study is therefore a relevant addition, but the limitations of aggregation mean that the observation cannot yet be used to test whether students with the largest score gains also showed ecological actions most often. The two sources of information provide complementary pictures at the class level but do not yet allow examination of the correspondence between attitude and behavior at the individual level. In future research, individual observation with coded identities and a reliable rubric could strengthen triangulation.

The use of attitude instruments with elementary school students also requires attention to developmental characteristics and psychometric evidence. Tan and Demirci Güler (2024) developed a 17-item, three-factor environmental attitude scale with 948 students and reported KMO=0.837 and internal consistency coefficients that rose from 0.76 in the exploratory analysis to 0.91 in the confirmatory analysis. These figures show the importance of testing validity and reliability when scores are used for stronger inference. In this study, the 12-item instrument covers three practical domains—concern, responsibility during play, and ecological action—but this coverage does not yet establish the factor structure, construct validity, or internal consistency of the instrument. The psychometric coefficients reported by Tan and Demirci Güler (2024) also cannot be applied directly to the instrument in this study because of differences in items, sample, and measurement context. Interpretation of score changes must therefore take into account the possibility of measurement error that cannot yet be quantified from the available information. Future studies need to examine factor structure, reliability, sensitivity to change, and equivalence of item comprehension in a wider group of students.

The relationship among nature experience, well-being, and learning also needs to be placed in proportion. The review by Mann et al. (2022) shows that nature-based learning can benefit various domains of child development, but research design and quality vary widely. Arola et al. (2023) also found a positive relationship between nature connectedness and children's well-being, while emphasizing variation in definitions, measures, and designs and the need for longitudinal and comparative research. This literature provides theoretical context for using the school environment, but the present study did not measure nature connectedness,

psychological well-being, or children's developmental outcomes directly. Benefits in those domains therefore cannot be inferred from the current findings. Research that follows students over a longer period is needed to assess whether attitude change persists and whether ecological behavior transfers to other contexts.

The main limitations of the study are the one-group design, the participation of only 32 students from a single class, the four-lesson duration, and the observation of behavior at the aggregate level. Without a comparison group, score changes cannot be convincingly separated from the possible influence of time, repeated measurement, classroom dynamics, or other concurrent experiences. Measurement limitations also need attention because evidence of the validity and reliability of the 12-item questionnaire has not been adequately reported. In addition, the traceability of individual change requires verification of the pretest–posttest matching procedure, while observer reliability and the equivalence of response opportunities across lessons cannot be confirmed from the available documentation. These limitations matter because the literature on school-based experiments still shows large variation in effects and an uneven evidence base (Bikomeye et al., 2021; van de Wetering et al., 2022). Future research should therefore use a comparison group or randomization where possible, involve multiple schools, extend the intervention, add follow-up measurement, and link behavioral observations with individual data in a secure manner. Testing the quality of the instrument and developing a standardized observation rubric are also needed before stronger conclusions about attitude and behavior change can be drawn.

Even so, this study makes a practical contribution by documenting an example of a format for integrating ecological experience and movement tasks that Physical Education, Sports, and Health teachers can consider in line with school conditions. The four lessons made use of school spaces, play routes, reuse of equipment, responsibility for plants and cleanliness, and the design of environmental improvements as part of the motor experience. This model is consistent with the view that sustainability education within physical education needs to turn sustainability from a conceptual theme into a practice that learners experience (Baena-Morales & González-Víllora, 2023; Bucht et al., 2022). The contribution of this study lies in documenting the design and implementation of instruction in the context of a single class, not in proving the effectiveness of the model or its superiority over other Physical Education, Sports, and Health approaches. The available descriptive findings can be used to refine task design and to prepare further testing with stronger measurement procedures and comparison designs.

From an ecopedagogical perspective, designing movement tasks is valuable when students are not only doing physical activity but are also given the opportunity to consider the reasons and ecological consequences of their actions. In approaches to sustainability education through physical education, motor activity need not be a neutral vessel to which an environmental message is merely attached. Bucht et al. (2022) showed that behavioral goals can be translated into activities that connect knowledge, norms, and action. Baena-Morales et al. (2024) add that identity, social norms, collective action, and behavior change are psychological mechanisms that need to be considered when sustainability is brought into physical education. In this study, several of these elements were present in simple form: students chose routes, took responsibility for equipment, looked after plants, worked in groups, and put forward ideas for improvement. Activities like these have the potential to bring environmental issues closer to the bodily and spatial experiences that students have every day. The pedagogical value lies in uniting "knowing" and "doing," although the present study cannot yet determine which mechanism contributed most to the score change. Even so, the documented activities mainly reflect everyday ecological reflection and responsibility. This study did not specifically measure the dimension of critical reflection on structural issues and socio-ecological justice that forms an important part of the ecopedagogy framework. The application of ecopedagogy in this study should therefore be understood as a limited operationalization within the fifth-grade learning context, not as a comprehensive test of ecopedagogy theory.

Another important aspect is the continuity between the learning environment and classroom social norms. Liang et al. (2022) showed that teachers and peers can serve as models of pro-environmental behavior for children aged 7–13 years. In Physical Education, Sports, and Health instruction, modeling mechanisms can appear very concretely because students' behavior is directly visible to their peers: returning equipment, not stepping on plants, choosing safe routes, picking up litter, or politely reminding the group. When teachers consistently reinforce these behaviors, classroom norms can form through shared experience. However, this study did not specifically measure teacher reinforcement, peer influence, or the formation of classroom norms, so these mechanisms can only be proposed as theoretical possibilities, not as an empirical explanation for the score change. Conversely, if ecological messages appear only during the intervention period, the possibility of long-term internalization becomes more limited. This also helps explain why school-based environmental education studies such as Jaime et al. (2023) show change in children but not always spillover of behavior to the family environment. Transforming attitudes into habits requires reinforcement across time and across contexts.

The literature on school environments shows that the physical condition of the play space and the way that space is used are two aspects that need to be distinguished. The review by Bikomeye et al. (2021) indicates that schoolyard greening has potential for physical activity and socioemotional health, while van Dijk-Wesselius et al. (2022) documented more and more varied play after greening. However, this study did not alter the physical structure of the schoolyard; the intervention worked through the way students observed and used the existing space. This study thus documents the pedagogical use of the available environment and does not test the effects of greening or of changes in the physical quality of the schoolyard. The present results are better read as evidence of pedagogical implementation than as evidence of the effects of changing the physical environment. Its contextual contribution lies in using school environmental conditions as material for observation, decision-making, and ecological reflection during Physical Education, Sports, and Health movement activities.

For curriculum development, these descriptive findings suggest that indicators for monitoring the process and outcomes of ecopedagogy-based Physical Education, Sports, and Health should be arranged in several layers. The first layer is participation in movement tasks, which needs to be distinguished from mastery of motor competence, duration of movement, and intensity of physical activity. The second layer is responsible behavior toward space and equipment. The third layer is the ability to express ecological ideas or the reasons behind chosen actions. The fourth layer is attitude as reported through an instrument. This separation makes evaluation more informative because teachers can distinguish students' engagement in movement activities, responsible actions toward the environment, the ability to put forward ideas, and attitudes expressed through the questionnaire. Even so, each indicator requires an operational definition, a measurement procedure, and evidence of instrument quality before it is used to evaluate program success more broadly. A layered perspective is also consistent with the meta-analysis of van de Wetering et al. (2022), which distinguishes knowledge, attitudes, intentions, and behavior as non-identical environmental outcomes showing different effect sizes.

Generalization of the results must remain limited. One class of 32 students does not represent the diversity of elementary school conditions, availability of space, school culture, or Physical Education, Sports, and Health practices. In addition, the sample comprised 18 girls and 14 boys, but the study was not designed to analyze differences in response by gender. It is therefore not appropriate to draw conclusions about particular groups from these data. Cross-school research could help assess whether similar patterns of change emerge in schools with different schoolyard conditions, student density, and resources. Future research also needs to

consider differences in task characteristics, measurement quality, and consistency of implementation so that results across schools can be compared more meaningfully. Arola et al. (2023) emphasize the need for longitudinal and comparative designs in studies of children's connection with nature, while Mann et al. (2022) show the extent of design variation in outdoor learning. Multisite replication and follow-up measurement will be essential before this learning model is recommended as a general approach.

CONCLUSION

Ecopedagogy-based Physical Education, Sports, and Health instruction showed a descriptive pattern of change that tended to be positive in fifth-grade students' environmental-care attitudes and documented movement engagement and ecological indicators during the learning process. The mean score rose from 29.50 to 32.19, but this change cannot be directly attributed to the intervention because the study used a one-group design without a comparison. Aggregate observation showed that movement activity and ecological action can emerge within the same sequence of lessons, although differences in task characteristics limit the comparability of indicators across lessons. The proportion of movement participation also cannot be used to infer that the duration or intensity of physical activity was maintained. The contribution of this study lies in documenting a classroom implementation format that combines motor and environmental goals and uses the questionnaire and observation as complementary information. However, the limited psychometric evidence for the instrument, the need to verify the pairing of the paired data, and the inadequate information on observation reliability constrain the strength of interpretation of the findings. To strengthen the evidence, future research should use a comparison group or randomization where possible, involve multiple schools, extend the duration of the intervention, test the validity and reliability of the instrument, conduct individual observation with a consistent rubric, and add follow-up measurement.

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