

LEARNING BEYOND WALLS: HOW NATURE-BASED FIELDWORK SHAPES STUDENT WELL-BEING, ENGAGEMENT AND LEARNING

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Abstract

Nature-based education is increasingly promoted as a means of enhancing student learning, well-being, and engagement; however, empirical evidence on dosage effects remains limited. This study examines pre–post changes associated with participation in urban park and forest fieldwork programs delivered by NGO Biospektrum (Slovakia) across two academic years (2024–2025). The dataset comprised 57 students from upper primary and lower secondary students (urban park $n = 28$; forest $n = 29$) completed between three and six sessions ($M = 4.54$). Standardised measures of science learning, well-being, and engagement were administered before and after participation. Gain scores were analysed using linear regression to examine associations between session frequency (dosage) and outcome changes. Mean pre–post gains were positive across domains (science: $M = 5.99$, $SD = 2.97$; well-being: $M = 6.64$, $SD = 3.20$; engagement: $M = 7.13$, $SD = 3.25$). Session frequency was significantly associated with gains in science ($\beta = 0.80$, $p = .040$, $R^2 = .075$), well-being ($\beta = 1.04$, $p = .012$, $R^2 = .110$), and engagement ($\beta = 1.88$, $p < .001$, $R^2 = .345$), indicating that each additional session corresponded to incremental improvements, particularly in engagement. Although gains generally increased with session number, variability across dosage levels suggests that participation intensity alone does not fully account for outcomes. Given the pre–post design without a comparison group and the modest sample size, findings should be interpreted as indicative associations rather than causal effects. Nevertheless, the study provides quantitative evidence linking sustained nature-based fieldwork participation with improvements in engagement, learning, and well-being, and offers practical guidance for integrating structured outdoor education into mainstream curricula.

Keywords: *Nature-based education, outdoor learning, student well-being, engagement, fieldwork pedagogy.*

1. Introduction

Nature-based and outdoor learning has gained increasing scholarly attention as a pedagogical approach that can support academic, cognitive, and psychosocial development in children and adolescents. A recent systematic review found evidence linking outdoor, nature-specific learning with improvements in children's academic performance, motivation, and well-being across multiple subject areas, including science and mathematics (Goldenberg, 2025; Mann et al., 2021; Mann et al., 2022). Empirical research suggests that regular engagement with natural environments is associated with enhanced cognitive focus, reduced stress, and improved emotional health, even after relatively short exposure periods (Kiviranta et al., 2024), reinforcing the idea that nature contact supports holistic learning outcomes. Beyond cognitive and emotional domains, studies also reveal that interactions with green spaces are associated with broader developmental benefits, such as increased physical activity and greater environmental awareness (Vasilaki et al., 2025; Patchen et al., 2024; Johnstone et al., 2022).

Despite this growing body of evidence, research examining how **dosage** — the frequency of participation in nature-based fieldwork — relates to student outcomes remains limited, particularly in urban contexts where access to nature can be inequitable. The present study investigates pre–post changes in science learning, well-being, and engagement associated with participation in structured urban park and forest fieldwork programmes delivered over two academic years. By linking session dosage to outcome gains, this research contributes new empirical evidence to the nature-based education literature and informs the design of effective curricula that extend learning beyond traditional classrooms.

2. Methodology

The study included 57 students participating in structured nature-based education fieldwork programs delivered by NGO Biospektrum (Slovakia). Participants were enrolled in one of two program formats: forest fieldwork ($n = 29$) or urban park fieldwork ($n = 28$). Program implementation spanned two academic years, with 31 students participating in 2024 and 26 students in 2025.

A quantitative pre–post design was employed to examine changes in science learning, well-being, and engagement associated with program participation. Descriptive statistics (means, standard deviations, and ranges) were calculated to summarise participant characteristics, program dosage, and outcome measures at both time points.

Program dosage was operationalised as the number of fieldwork sessions completed by each participant, ranging from three to six sessions ($M = 4.54$). Pre–post change was assessed using gain scores, calculated as the difference between post-program and pre-program scores for each outcome variable.

To examine associations between program dosage and student outcomes, simple linear regression analyses were conducted. The number of completed sessions served as the independent variable, and gain scores for science learning, well-being, and engagement were entered as dependent variables. Unstandardised regression coefficients (B) were interpreted as the average change in outcome gain associated with each additional session. Statistical significance was evaluated at the $\alpha = .05$ level, and model fit was assessed using the coefficient of determination (R^2).

All analyses were conducted using anonymised data. Given the exploratory design and the absence of a comparison group, findings are interpreted as indicative associations rather than causal effects.

3. Results

3.1. Pre-post outcome gains

Across the sample ($N = 57$), mean pre–post gains were positive for science learning, well-being, and engagement (Table 1). Average science learning gain was 5.99 ($SD = 2.97$), with scores ranging from -2.3 to 11.2 . Well-being gain averaged 6.64 ($SD = 3.20$; range = 0.3 – 12.6), and engagement gain averaged 7.13 ($SD = 3.25$; range = 0.1 – 13.4).

Although mean improvements were observed across all domains, the relatively wide ranges indicate variability in individual responses to the fieldwork programs.

Table 1. Mean pre-post outcome gains.

Outcome	Mean gain	SD	Min	Max
Science learning gain	5.99	2.97	-2.3	11.2
Well-being gain	6.64	3.20	0.3	12.6
Engagement gain	7.13	3.25	0.1	13.4

3.2. Association between program dosage and outcome gains

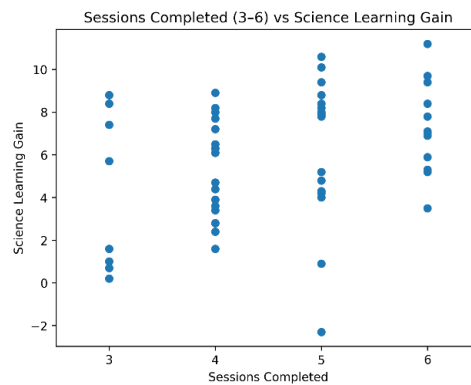
Simple linear regression analyses examined whether the number of completed sessions (3–6; $M = 4.54$) was associated with outcome gains (Table 2).

Table 2. Regression analysis: Effect of sessions completed on student outcomes.

Outcome variable	Session coefficient	Std. Error	p-value	R^2
Science gain	0.797	0.378	0.040	0.075
Well-being gain	1.043	0.401	0.012	0.110
Engagement gain	1.875	0.348	< .001	0.345

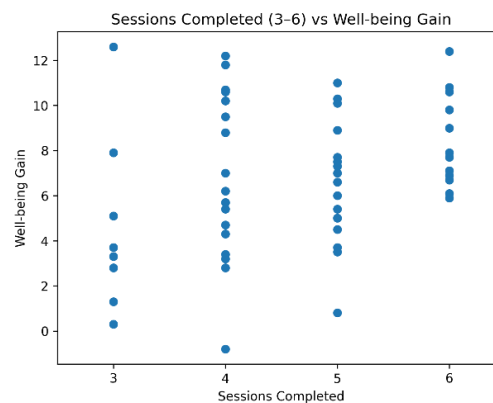
Science learning: The number of completed sessions was positively associated with science learning gain ($B = 0.80$, $SE = 0.38$, $p = .040$), explaining 7.5% of the variance ($R^2 = .075$). On average, each additional session corresponded to a 0.80-point increase in learning gain. While statistically significant, the proportion of explained variance suggests a modest association. Visual inspection of the scatterplot (Fig. 1) indicates a general upward trend, though gains were not restricted to the highest session group, reflecting heterogeneity in student outcomes.

Figure 1. Relationship between number of fieldwork sessions completed and science learning gain.



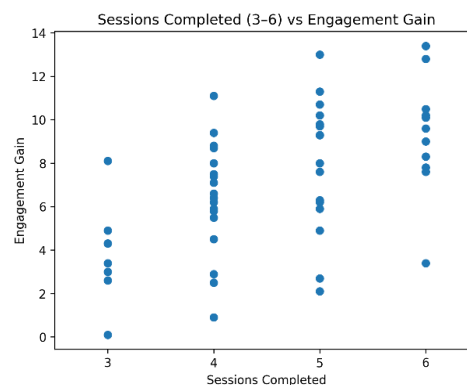
Well-being: Session frequency was also significantly associated with well-being gain ($B = 1.04$, $SE = 0.40$, $p = .012$), accounting for 11.0% of the variance ($R^2 = .110$). Each additional session corresponded to an average increase of **1.04-point increase in well-being gain** ($p < .05$). Although the association was statistically significant, considerable dispersion across session levels was observed (Fig. 2), indicating that dosage alone does not fully account for changes in well-being.

Figure 2. Relationship between number of fieldwork sessions completed and student well-being gain.



Engagement: Engagement demonstrated **the strongest association with program dosage** ($B = 1.88$, $SE = 0.35$, $p < .001$), with session frequency explaining 34.5% of the variance in engagement gains ($R^2 = .345$). Each additional fieldwork session corresponded to an average **1.88-point increase in engagement gain** ($p < .01$), explaining **34.5% of the variance**. A clear upward trend is evident, with engagement gains increasing consistently as the number of sessions rises from three to six (Fig. 3). This pattern supports the regression results, indicating that sustained participation in nature-based education fieldwork is strongly associated with improved student engagement. This has a substantial effect on educational research.

Figure 3. Relationship between number of fieldwork sessions completed and student engagement gain.



3.3. Summary of dosage associations

Overall, the number of fieldwork sessions completed was positively associated with gains in all three outcome domains, with the strongest relationship observed for engagement, followed by well-being and science learning. However, variability within each dosage level indicates that participation intensity does not solely determine student outcomes. These findings should be interpreted as indicative associations rather than causal effects, given the pre–post design without a comparison group.

4. Discussion

This study examined associations between participation in structured nature-based fieldwork and pre–post changes in science learning, well-being, and engagement among upper primary and lower secondary students. Consistent with recent evidence on outdoor learning, our findings suggest positive associations between fieldwork participation and student outcomes. Systematic reviews have reported that nature-specific outdoor learning is linked with improvements in cognitive, social, and emotional domains in young people (Arola et al., 2023; Harper et al., 2025; Müller-Kuhn, 2025). In the present study, higher session frequency was associated with greater gains in engagement and science learning, echoing evidence that regular, hands-on experiences in natural settings can reinforce meaningful learning and intrinsic motivation (Haraldsson et al., 2025).

The association with well-being was positive but more modest, aligning with research indicating that short-term exposure to natural environments tends to support psychological restoration but may be influenced by individual and contextual factors (Mannion et al., 2025; Nguyen & Walters, 2024). Together, these patterns suggest that while increased dosage of fieldwork is generally associated with stronger outcomes, it is neither a necessary nor a sufficient condition for positive change. The observed variability across dosage levels highlights the complex interplay of pedagogical quality, learner background, and environmental context, consistent with calls to broaden research beyond simple exposure metrics (Johnstone et al., 2022).

Importantly, this study’s exploratory pre–post design without a control group limits causal inference. Similar limitations have been noted in the outdoor learning literature, where few studies have employed experimental designs, and effect estimates vary widely across settings and measures (Taylor et al., 2022). Future research would benefit from longitudinal, mixed-methods designs that can disentangle mechanisms of effect and explore how curriculum alignment, instructional quality, and individual student characteristics moderate outcomes.

Despite these limitations, this study contributes quantitative evidence to the emerging field of nature-based education by linking session dosage with multiple domains of student development. The results support the inclusion of regular, well-structured fieldwork experiences within mainstream curricula, while underscoring the need for nuanced implementation that accounts for variability in student responses and educational contexts.

5. Conclusions

This study examined pre–post changes associated with participation in urban park and forest fieldwork programmes across two academic years, with particular attention to programme dosage. Overall, participation in structured nature-based fieldwork was associated with positive gains in science learning, well-being, and engagement. Regression analyses indicated that the number of completed sessions was significantly associated with gains in engagement and science learning, while the association with well-being, although statistically significant, was comparatively more modest.

Notably, considerable variability in gains was observed across session levels. High improvements were evident even among students completing a moderate number of sessions, suggesting that while sustained participation may strengthen outcomes on average, dosage alone does not fully account for student gains. Contextual influences, programme quality, and individual learner characteristics likely play important roles in shaping outcomes.

As an exploratory study employing a pre–post design without a comparison group, the findings should be interpreted as indicative associations rather than causal effects. The relatively small sample size and reliance on short-term outcome measures further limit generalisability. Future research should adopt longitudinal and mixed-methods approaches to better understand the mechanisms through which nature-based education influences learning and well-being, and to examine how programme intensity interacts with pedagogical quality and learner diversity.

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