The Effects of Short Synchronous Online Training on the Environmental Attitude of Thai Undergraduate Students

*Jaime Paster**

Received: June 6, 2024 Revised: March 14, 2025 Accepted: April 10, 2025

Abstract

This study involved 39 voluntary participants who took part in a short online training program on environmental awareness, incorporating photograph sharing and online discussions. The primary objective was to examine the impact of the synchronous online training on participants' environmental attitudes. To assess this effect, the 24-item Environmental Attitude Inventory (EAI) by Milfont & Duckitt (2010) was adapted, with an additional 12 items based on the original 12 scale-inventory included in the post-intervention survey to measure the effect of the short synchronous online training on the students' environmental attitude. Given the non-normal distribution, the data were analyzed using the Wilcoxon signed-rank test and simple mediation analysis with Partial Least Squares Structural Equation Modeling (PLS-SEM). The Wilcoxon signed-rank test revealed a statistically significant increase in environmental attitude scores from pre-intervention to post-intervention. Moreover, PLS-SEM simple mediation analysis indicated that the short synchronous online training fully mediated the relationship between pre-intervention and post-intervention EAI scores. These findings suggest that synchronous online training, integrating photograph sharing and online discussions, can have a significant positive effect on undergraduate students' environmental attitudes.

Keywords: Environmental Attitude, Undergraduate Students, Synchronous Online Training, Simple Mediation Analysis

* Language Institute, Nakhon Pathom Rajabhat University
25/5 Moo 7, Nong Pak Long, Amphur Muang, Nakorn Pathom 73000, THAILAND
E-mail: jaimeli@webmail.npru.ac.th

ผลของการอบรมออนไลน์ระยะสั้นแบบประสานเวลา เรื่อง ทัศนคติด้านสิ่งแวดล้อมของนักศึกษาระดับปริญญาตรี

*ไฮเม พาสเตอร์**

รับวันที่: 6 มิถุนายน 2567 ส่งแก้ไขวันที่: 14 มีนาคม 2568 ตอบรับตีพิมพ์วันที่: 10 เมษายน 2568

บทคัดย่อ

งานวิจัยนี้มีกลุ่มตัวอย่าง 39 คน ที่เข้าร่วมการอบรมออนไลน์ระยะสั้น เรื่องการตระหนักรู้ด้านสิ่งแวดล้อม ด้วยการแบ่งปันรูปภาพและการอภิปรายออนไลน์ร่วมกัน ทั้งนี้มีวัตถุประสงค์หลักเพื่อศึกษาผลกระทบของการอบรมออนไลน์แบบประสานเวลาที่มีต่อทัศนคติด้านสิ่งแวดล้อมของกลุ่มตัวอย่าง โดยใช้มาตรวัดทัศนคติด้านสิ่งแวดล้อมจำนวน 24 ข้อ ที่ดัดแปลงจากมาตรวัดของ Milfont & Duckitt *(2010)* ทั้งนี้เป็นการเพิ่มคำถาม 12 ข้อ ซึ่งเติมจากต้นฉบับที่มี 12 ข้อ ไว้ในแบบสำรวจหลังการแทรกแซง เพื่อวัดผลของการอบรมออนไลน์ระยะสั้นแบบประสานเวลา เรื่องทัศนคติด้านสิ่งแวดล้อมของนักศึกษา ทั้งนี้เนื่องจากมีผลการแจกแจงที่ไม่เป็นปกติ จึงวิเคราะห์ข้อมูลโดยการทดสอบอันดับ ที่มีเครื่องหมายกำกับของวิลคอกซอน *(*Wilcoxon signed-rank test*)* และการวิเคราะห์ตัวแบบความสัมพันธ์แทรงกลางอย่างง่าย ร่วมกับสมการ โครงสร้างกำลังสองน้อยที่สุดบางส่วน *(*Partial Least Square Structural Equation Modeling - PLS-SEM*)* ทั้งนี้การทดสอบอันดับที่มีเครื่องหมายกำกับของวิลคอกซอนแสดงให้เห็นว่า คะแนนทัศนคติ ด้านสิ่งแวดล้อมก่อนและหลังการแทรกแซงสูงขึ้นอย่างมีนัยสำคัญ นอกจากนี้ ผลจากสมการโครงสร้างกำลังสอง น้อยที่สุดบางส่วนและการวิเคราะห์ตัวแบบความสัมพันธ์แทรกกลางอย่างง่าย แสดงให้เห็นว่าการอบรมออนไลน์ระยะสั้นแบบประสานเวลา มีอิทธิพลส่งผ่านโดยสิ้นเชิงต่อความสัมพันธ์ระหว่างคะแนนทัศนคติด้านสิ่งแวดล้อม ก่อนและหลังการแทรกแซง ผลการวิจัยนี้แสดงให้ทราบว่าการอบรมออนไลน์แบบประสานเวลา การแลกเปลี่ยน ผ่านการอภิปรายออนไลน์ ส่งผลกระทบเชิงบวกอย่างมีนัยสำคัญต่อทัศนคติ ด้านสิ่งแวดล้อมของนักศึกษา ระดับปริญญาตรี

คำสำคัญ : ทัศนคติด้านสิ่งแวดล้อม, นักศึกษาระดับปริญญาตรี, การอบรมออนไลน์แบบประสานเวลา, การวิเคราะห์ตัวแบบความสัมพันธ์แทรกกลางอย่างง่าย

* สถาบันภาษา มหาวิทยาลัยราชภัฏนครปฐม
เลขที่ 25/5 หมู่ 7 ตำบลหนองปากโลง อำเภอเมือง จังหวัดนครปฐม 73000
อีเมล : jaimeli@webmail.npru.ac.th

Introduction

UNESCO (2021) highlights the need to make environmental education practical and engaging by including social and emotional learning (SEL) instead of only using traditional teaching methods. Adding SEL helps students connect emotionally with environmental issues, making them more interested and motivated to take action. A holistic approach also supports this by combining thinking, feeling, and social interaction, helping students build both knowledge and a strong sense of responsibility toward the environment.

They also recommend including environmental education across different subjects, using activities that involve students emotionally and socially through hands-on learning and teamwork. Learning through action helps students develop problem-solving and critical thinking skills while also making them feel more involved in environmental issues. Similarly, Ruiz-Mallen et al. (2009) explain that participatory teaching methods in Environmental Education Programs (EEP) improve students' understanding of nature and their awareness of local environmental problems. When students take part in discussions, hands-on projects, and community activities, they feel more responsible and connected to the solutions. Dunlap et al. (2022) also emphasize that emotional teaching methods can have a big impact on environmental and climate education. These approaches help students handle feelings like worry or fear about climate change while encouraging them to stay hopeful and take positive action for sustainability.

However, the COVID-19 pandemic presented significant challenges to the implementation of participatory learning. While educators turned to social networking sites, learning management systems, and video conferencing platforms to continue teaching. These tools often fell short in replicating the innovative pedagogies characteristic of effective environmental education. As Squire (2021) noted, platforms like Canvas and Khan Academy, while useful for maintaining learning goals, rarely incorporated crucial participatory methods such as place-based learning or constructionist approaches. Furthermore, universities often prioritized traditional assessments like advanced placement courses, standardized test scores,

and GPAs over student portfolios. This emphasis on traditional metrics frequently sidelined participatory learning methods, which are essential for fostering engagement with real-world environmental issues. Project-based learning, fieldwork, and collaborative problem-solving, all vital components of participatory learning, were often deprioritized during remote learning (Morgan, 2022). This shift made it more difficult for students to actively engage with environmental problems.

To enhance participation in online learning, this training incorporated photograph sharing and online discussions. Research consistently supports the use of photography and media in environmental education, demonstrating their efficacy in raising awareness and fostering engagement (Ardoin et al., 2013; Farnsworth, 2011). Notably, Jones and Baldwin (2009), in their case study of the Save the Mary River campaign, found that photographs, particularly those featuring environmental themes and embedded text, effectively evoked emotional responses and influenced attitudes. This study underscores the power of visual media to communicate complex environmental messages succinctly. Consequently, by encouraging participants to share and discuss photographs of environmental issues and local sustainable initiatives, this online training aimed to facilitate active exploration and deeper connection with the subject matter.

This training provided English as a Foreign Language (EFL) learners with an opportunity to engage with environmental issues from both global and local perspectives in an online setting. Conducted as part of a summer program by the Language Institute, the training primarily used English as the medium of instruction while incorporating a translanguaging approach to encourage participation. As part of the institute's effort to equip students with practical language skills, the program explored current and relevant topics to broaden their exposure to English in real-world contexts. By engaging with meaningful discussions, students not only developed their linguistic competence but also enhanced their critical thinking skills. Recognizing that limited vocabulary and fear of grammatical errors can hinder EFL students' engagement (Husna & Astria, 2021), participants were allowed to use their native language (Thai) when necessary. This approach prioritized idea exchange over linguistic

accuracy, fostering an inclusive and participatory learning environment. For instance, if a participant struggled to articulate their thoughts in English on the Padlet platform, they could write in Thai and provide an approximate English translation.

The training sessions utilized Padlet for sharing content, Zoom Meetings for synchronous discussions, Line for information dissemination, and a Google Site dedicated to housing training materials. Figure 1 outlines the training flow and components, while Table 1 presents the alignment between training topics and Environmental Attitude (EA) scales.

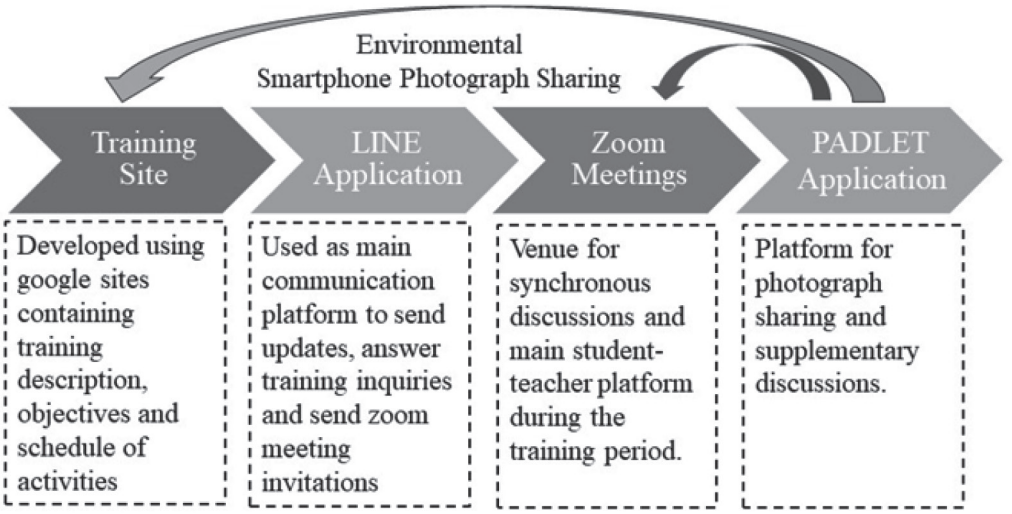

Figure 1: Training Flow and Components

Table 1: Training Framework

Topic	Duration	Main Activity Description	EA Scale (Milfont & Duckitt, 2010)
Enjoying Nature	5 hrs.	Share a photo of you enjoying nature. Discussion revolves around the main questions: How do you enjoy nature? Do you observe nature-friendly practices?	(1) Enjoyment of nature, (7) Altering nature, & (8) Personal conservation behavior.
Benefits from Nature	5 hrs.	Share a photo of a farm near you or you have visited before. The discussion revolves around the main questions: Do you know where your food and other products came from? What is over farming?	(10) Human utilization of nature, (9) Human dominance over nature, & (6) Environmental threat.
Protecting Nature	5 hrs.	Share a photo of you or a group of people in your local community showing an act of conserving nature. Discussion revolves around the main questions: Have you participated in activities to protect or conserve nature? Are you aware of laws that protect nature?	(3) Environmental movement activism, (2) Support for interventionist conservation policies, & (4) Conservation motivated by anthropocentric concern.
Sustainable Practices	5 hrs.	Share a photo of your home or community observing sustainable practices. Discussion revolves around the main questions: What is sustainability? Do you believe in the impact of sustainability	(11) Eco-centric concern, (12) Support for population growth policies, & (5) Confidence in science and technology

Literature Review

The transformative potential of visual media, particularly photography, in environmental education has been consistently demonstrated. Ardoin et al. (2013), through a summer camp study, illustrated that participant-generated photography, coupled with reflective journaling, effectively sparked situational interest. This approach fostered a tangible connection with nature and social interactions, allowing participants to capture and document their experiences, thereby transforming abstract environmental concepts into personal, meaningful narratives. Farnsworth (2011) extended this concept by highlighting the pedagogical value of professional conservation photography, especially in the context of digital media and environmental crises. By examining the work of photojournalists, Farnsworth emphasized the development of visual literacy and the discursive use of images to deepen ecological understanding. Building upon this, Jones and Baldwin (2009) explored the persuasive power of photography in environmental advocacy. Their case study of the Save the Mary River campaign demonstrated that photographs, especially those with emotional themes and embedded text, effectively evoked strong emotional responses and influenced viewer attitudes. These studies collectively underscore the multifaceted role of photography in environmental education, ranging from fostering individual interest to driving social change. In the post-COVID era, this study leverages these insights by integrating photograph sharing and online discussion within a synchronous learning framework, adapting to the increased reliance on digital education (De Koff, 2020).

The COVID-19 pandemic necessitated a rapid shift to online learning (Ali, 2020; Dhawan, 2020), highlighting both the opportunities and challenges of digital education. Synchronous online training emerged as a critical modality, offering real-time interaction and collaboration that mitigated students sense of connection to their peers and instructors (Yamagata-Lynch, 2014). As noted by Squire (2021) and Morgan (2022), traditional online platforms often failed to replicate the participatory and experiential pedagogies essential for effective environmental education. Synchronous training, however, facilitates live discussions,

immediate feedback, and collaborative activities, fostering a sense of community and active engagement. This approach aligns with the principles advocated by UNESCO (2021) and Ruiz-Mallen et al. (2009), who emphasize the importance of practical, engaging, and participatory methods. In the post-COVID context, where online learning has become increasingly prevalent, synchronous sessions enhance accessibility and provide a platform for dynamic engagement with complex environmental issues. The integration of visual media, particularly photography, is crucial in this format. Building upon the established efficacy of photography (Ardoin et al., 2013; Farnsworth, 2011; Jones and Baldwin, 2009), real-time sharing and analysis of visuals brings environmental issues to life, fostering deeper understanding and emotional connections. As Dunlap et al. (2022) emphasizes, fostering emotional connections is vital for impactful climate education, and synchronous training, with its ability to facilitate immediate discussion and feedback, provides a powerful platform for realizing this goal within the new norm of online education.

To effectively assess the impact of synchronous online training on environmental attitudes in the post-COVID context, this study employed a robust instrument designed to address the multidimensional nature of environmental attitudes. The theoretical landscape surrounding attitude measurement is diverse, with several perspectives informing our approach. Kaiser et al. (1999) highlighted the complexity of measuring environmental attitudes, influenced by various psychological and situational factors. While Cottrell (2003) proposed a three-component model (cognitive, affective, behavioral), Fabrigar et al. (2005) argued that these components serve as bases for an overall evaluative summary. Milfont (2007) further refined this understanding by proposing an integrative framework with horizontal and vertical structures. The EAI, validated by Ajdukovic et al. (2019), directly evaluates these structures, providing a comprehensive measure. Specifically, this study employs the 24 balanced items (Milfont & Duckitt, 2010) selected for the brief version of the EAI, which are distributed across 12 scales: (1) Enjoyment of nature, (2) Support for interventionist conservation policies, (3) Environmental movement activism, (4) Conservation motivated by anthropocentric concern,

(5) Confidence in science and technology, (6) Environmental threat, (7) Altering nature, (8) Personal conservation behavior, (9) Human dominance over nature, (10) Human utilization of nature, (11) Ecocentric concern, and (12) Support for population growth policies. Each scale includes both favorable and unfavorable attitudes towards the environment, allowing for a nuanced overall measure of environmental attitude. In the context of post-COVID online education, this study aims to investigate the effects of synchronous online training, incorporating photography and discussion, on environmental attitudes, using the EAI to quantify changes and provide empirical evidence of the training's effectiveness in this new educational landscape.

In conjunction with having a validated inventory that measures environmental attitude, this study investigated the effects of online training on Environmental Attitude. To make it possible 12 items were added in the post-intervention survey to introduce latent variables associated with each Environmental Attitude Scales (Milfont & Duckitt, 2010) ranging from 1 strongly disagree and 7 strongly disagree which coincides with the scale used in Environmental Attitude Inventory.

Table 2: Environmental Attitude Scales and Items Constructs on Online Training as Intervention

12 Environmental Attitude Scales	Item Constructs on Online Training as Intervention
1. Enjoyment of nature.	1. This training helped improve my interest in enjoying nature.
2. Support for interventionist conservation policies.	2. This training increased my awareness on the importance of conservation policies.
3. Environmental movement activism.	3. This training increased my willingness to participate in environmental protection movements.
4. Conservation motivated by anthropocentric concern.	4. This training helped me realize the role of people in preserving or destroying nature.
5. Confidence in science and technology.	5. This training helped me realize the role of people in preserving or destroying nature.

Table 2: Environmental Attitude Scales and Items Constructs on Online Training as Intervention (continued)

12 Environmental Attitude Scales	Item Constructs on Online Training as Intervention
6. Environmental threat.	6. This training helped me understand the role of science in environmental protection.
7. Altering nature.	7. This training helped increase my knowledge on how extensively human activities affect nature.
8. Personal conservation behavior.	8. This training helped develop my positive behavior towards environmental protection.
9. Human dominance over nature.	9. This training helped me realize that human is a part of nature and not its owner.
10. Human utilization of nature.	10. This training allowed me to realize that humans should adopt a more responsible use of natural resources.
11. Ecocentric concern.	11. This training helped me understand the importance of prioritizing preservation over the use of natural resources.
12. Support for population growth policies.	12. This training allowed me to reflect on the relationship of overpopulation and the exhaustion of natural resources.

Research Objective and Hypotheses

The primary aim of this study is to examine the impact of online training on environmental attitudes. This investigation is motivated by the goal of creating an online platform where EFL (English as a Foreign Language) students can engage in discussions and activities related to environmental issues. Consequently, this study seeks to address the following hypotheses:

H1: Participation in the short synchronous online training program will result in a statistically significant increase in environmental attitude (EA) scores among Thai undergraduate students.

H2: The relationship between pre-intervention and post-intervention environmental attitude (EA) among Thai undergraduate students will be fully mediated by participation in the short synchronous online training program.

Methodology

At the start of the training, participants were informed about the research purpose and assured that their participation was voluntary. Before distributing the pre-intervention Environmental Attitude Inventory (EAI) survey electronically, the researcher emphasized that participation was non-coerced. Out of 56 training attendees, 39 undergraduate students from Nakhon Pathom Rajabhat University volunteered to take part in the study (see Table 3). These students were enrolled in a summer training program offered by the Language Institute during the 2021 academic year.

Participants explicitly confirmed their willingness to participate and were reminded that they could withdraw from the study at any time. As all respondents were of legal age, they provided informed consent before proceeding with the EAI survey. The questionnaire was administered twice—once before the training (pre-intervention phase) and again after the training (post-intervention phase).

Table 3: Shows the Participants' Profile

Participants' Profile by		**Count**	**Total**
Sex assigned at birth	Male	12	39
	Female	27	
Age	19 years old	17	
	20 years old	8	
	21 years old	8	39
	22 years old	4	
	23 years old	2	
Year Levels	1st year	18	
	2nd year	7	39
	3rd year	9	
	4th year	5	
Major or Field of Study	Jurisprudence	3	
	Public health & Nursing	4	
	Education	7	
	Accounting	5	39
	Human Resource Management	6	
	Food Management	5	
	Digital Art Design	4	
	Software Engineering	5	

Materials

The Environmental Attitude Inventory (EAI) developed by Milfont and Duckitt (2010) was used to measure participants' environmental attitudes. The EAI is a 24-item scale that assesses various dimensions of environmental attitude. Participants completed the EAI at two time points: before the online training (pre-intervention) and after the online training (post-intervention). In the post-intervention survey, an additional 12 items were included to measure the effectiveness of the online training as an intervention. These 12 items were developed based on the 12 scales of the original EAI, as shown in Table 2, allowing for a more specific evaluation of the training's impact on each dimension of environmental attitude.

The Thai translations of the EAI items underwent careful proofreading by two native Thai speakers, both of whom are highly experienced English instructors at the university level. Their expertise in both English language instruction and Thai linguistic nuances ensured that the translated items were not only accurate in terms of meaning but also clear and culturally appropriate for the study's participants. This process aimed to maintain the integrity of the original items while ensuring that the translated versions conveyed the intended concepts effectively to the Thai-speaking respondents.

Online Training Intervention

The online training intervention consisted of a short synchronous program designed to enhance environmental awareness. The training incorporated participatory learning methods through photograph sharing and online discussions. Participants used the Padlet application for discussions and sharing, the Line application for information dissemination, and a Google Site for access to training content. The training program spanned four sessions, with each session focusing on a specific theme related to environmental attitude. For an overview of the training topics and structure, refer to Table 1.

Data Analysis

Non-Parametric Significance Analysis

To assess whether there was a statistically significant change in environmental attitude scores from pre-intervention to post-intervention, the Wilcoxon signed-rank test was conducted. The Shapiro-Wilk test for normality revealed that both the pre-intervention ($W = 0.87$, $p = 0.000$) and post-intervention ($W = 0.912$, $p = 0.005$) environmental attitude inventory (EAI) scores deviated significantly from normality. As the normality assumption was violated, the Wilcoxon signed-rank test was selected as an appropriate non-parametric method for comparing the paired data and detecting a significant difference between the two conditions.

Simple Mediation Analysis

To examine the mediating effect of the online training on the relationship between pre-intervention and post-intervention environmental attitude, Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed using SmartPLS 4 software (Ringle et al., 2022). PLS-SEM is a suitable method for analyzing mediation effects, particularly with smaller sample sizes and non-normal data. Furthermore, voluntary participation is classified as non-probabilistic sampling (Muraiwa, 2015).

Other analytical models may struggle to effectively investigate the effects of an intervention with a sample size of 39 students. However, Rigdon et al. (2018) noted that PLS-SEM is suitable for small sample sizes because it does not estimate overall model parameters simultaneously. Chin et al. (2003) further highlighted that PLS is effective for analyzing non-normal data due to its bootstrapping procedure, which imposes minimal restrictions on sample distributions. Sarstedt et al. (2016) also found PLS-SEM to be robust even with limited data sets. Additionally, Nitzl et al. (2016) emphasized that PLS-SEM is particularly useful for analyzing mediation effects, especially with small sample sizes and non-normal data.

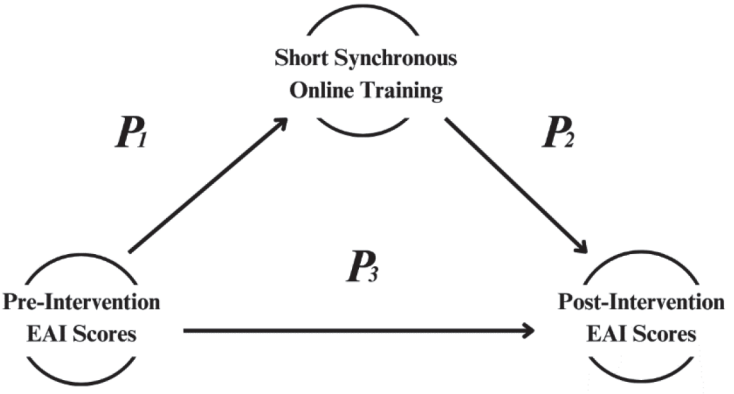

Figure 2: Simple Mediation Model

Figure 2 shows the example of a simple mediator model, whereby P_3P_3 is the direct effect, P_1P_1, P_2P_2 is the indirect effect, and the direct effect P_3P_3 + the indirect effect P_1P_1, P_2P_2 = the total effect. (Ringle et al., 2022)

This study followed the procedure by Nitzl et al. (2016) to test mediation effects on PLS-SEM. The procedure considers five important statements for testing mediating effects in PLS. (1) Testing the indirect effect P_1P_1, P_2P_2 provides all the information to assess the significance of a mediation. (2) The strength of the indirect effect P_1P_1, P_2P_2 should determine the size of the mediation. (3) A significant indirect effect P_1P_1, P_2P_2 is the only prerequisite for establishing a mediation effect. (4) A bootstrap test should be used to test the significance of the indirect effect P_1P_1, P_2P_2. (5) The significance of the direct effect P_3P_3 must be tested in order to determine the type of effect and/or mediation.

Multiple Findings

The results of the preliminary statistical analyses are presented in Tables 4 and 5. Table 4 shows the results of the normality tests for pre-intervention and post-intervention EAI scores.

Table 4: Normality Tests for Pre-Intervention and Post-Intervention EAI Scores

Phase	M (SD)	W Statistic	p-value	Normality Assumption
Pre-Intervention EAI Score	4.01 (1.69)	0.87	0.000	Not normally distributed
Post-Intervention EAI Score	4.61 (1.52)	0.912	0.005	Not normally distributed

Table 5 presents the results of the Wilcoxon signed-rank test, which was used to analyze the change in environmental attitude scores from pre-intervention to post-intervention.

Table 5: Wilcoxon Signed-Rank Test for Pre-Intervention and Post-Intervention EAI Scores

Test Statistic	W Statistic	p-value	Effect Size (r)	Interpretation
Wilcoxon Signed-Rank Test	226	0.036	-0.34	Significant difference ($p < 0.05$)

The data were then analyzed and modeled using SmartPLS 4 software (Ringle et al., 2022) after the inclusion of 12 supplementary items to assess the impact of online training as the intervention. The analysis also includes measures of construct reliability and validity. The following tables and figures present the results of bootstrapping, path coefficients, specific indirect effects, total effects, and the outer loadings of latent variables.

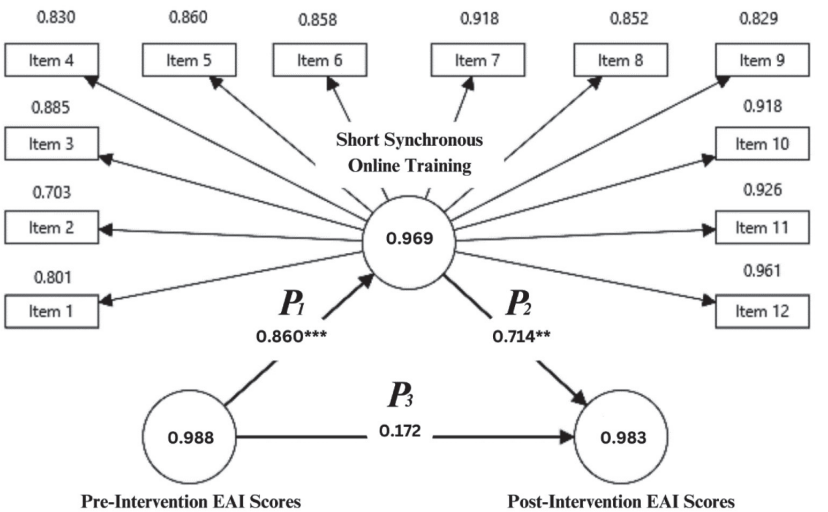

Figure 3: PLS-SEM Simple Mediation Modelling. Source: SmartPLS Report (Ringle et al., 2022).
**p < .05. ***p < .01.

The significance of the estimated path coefficients in the PLS-SEM mediation model was evaluated using bootstrapping. The p-values obtained from the bootstrapping procedure for the path from pre-intervention EAI to online training, the path from online training to post-intervention EAI, and the direct path from pre-intervention EAI to post-intervention EAI are presented below.

Table 6: Bootstrapping

Path	P values	Interpretation
Pre-intervention EAI , Online Training*	0.000	significant
Online Training* , Post-intervention EAI	0.027	significant
Pre-intervention EAI , Post-intervention EAI	0.638	not significant

* *Short Synchronous Online Training*

To test the significance of the estimated path coefficients and the indirect effect in the PLS-SEM model, bootstrapping with 5000 resamples was performed. Bootstrapping is a non-parametric resampling procedure that estimates the sampling distribution of the model parameters. The resulting path coefficients indicate the strength and direction of the relationships between the constructs. Path coefficients close to +1 indicate a strong positive relationship, those close to -1 indicate a strong negative relationship, and coefficients near 0 suggest weaker relationships. The significance of the path coefficients and indirect effects was determined based on the p-values obtained from the bootstrapping results shown in Table 6, and the path coefficients themselves are shown in Table 7.

Table 7: Path Coefficients

Path	Path coefficients Interpretation
Pre-intervention EAI , Online Training*	0.860 significant
Online Training* , Post-intervention EAI	0.714 significant
Pre-intervention EAI , Post-intervention EAI	0.172 not significant

* *Short Synchronous Online Training*

To understand the role of mediation, it's essential to distinguish between direct and indirect effects in a path model. A direct effect represents the relationship between two constructs that are linked by a single path. An indirect effect is the effect of an independent variable on a dependent variable that is transmitted through one or more intervening variables, known as mediators. Thus, an indirect effect involves a sequence of relationships. The total effect is the combination of the direct and indirect effects, representing the overall relationship between the independent and dependent variables. A suppressor effect can occur when the direct and indirect effects operate in opposite directions, potentially leading to an underestimation of the true relationship between the independent and dependent variables (Cheung & Lau, 2008). Full mediation, as defined by Hair et al. (2016), is supported when a significant indirect effect is observed, and the direct effect is non-significant. Nitzl et al. (2016) emphasize the importance of interpreting total effects to gain a complete understanding of the structural model relationships. Table 8 presents the specific direct effects and total effects for the current study.

Table 8: The Specific Indirect Effects and Total Effects

Path	**Effects**	
	Specific indirect	P values
Pre-intervention EAI , Online Training* , Post-intervention EAI	0.615	0.037 ($p < .05$)
	Total effects	P values
Pre-intervention EAI, Online Training*	0.86	0.000 ($p < .01$)
Online Training* , Post-intervention EAI	0.714	0.038 ($p < .05$)
Pre-intervention EAI , Post-intervention EAI	0.786	0.000 ($p < .01$)

** Short Synchronous Online Training*

The results presented in Table 9 indicate satisfactory construct reliability and validity. Both Cronbach's alpha and composite reliability coefficients were above the recommended threshold of 0.70, and the average variance extracted (AVE) values were above the 0.50 threshold. In addition, discriminant validity was

supported, as all Heterotrait-Monotrait Ratio (HTMT) values were below the 0.90 criterion, as suggested by Ringle et al. (2022).

Table 9: Overall Construct Reliability and Validity

Variables	Cronbach's alpha	Composite reliability (rho_a)	Average variance extracted (AVE)
Pre-intervention EAI	0.988	0.990	0.790
Online Training*	0.969	0.974	0.747
Post-intervention EAI	0.983	0.987	0.721
			Heterotrait – Monotrait Ratio (HTMT)
Pre-intervention EAI , Online Training*			0.856
Post-intervention EAI , Online Training*			0.849
Pre-intervention EAI , Post-intervention EAI			0.767

** Short Synchronous Online Training*

The outer loadings for the reflective constructs were assessed and are presented in Table 10. This table includes the outer loadings for the online training indicators (the intervention) as well as the pre-intervention and post-intervention Environmental Attitude Inventory (EAI) items. As shown in Table 10, all outer loadings exceeded the 0.70 threshold, indicating adequate indicator reliability.

Table 10: Outer Loadings for Online Training* Indicators and EAI Items

Pre-intervention EAI Items	Outer Loadings	Online Training*	Outer Loadings	Post-intervention EAI Items	Outer Loadings
EAI 1	0.877	Item 1	0.801	EAI 1	0.879
EAI 2	0.705	Item 2	0.703	EAI 2	0.805
EAI 3	0.936	Item 3	0.885	EAI 3	0.858
EAI 4	0.83	Item 4	0.83	EAI 4	0.779
EAI 5	0.733	Item 5	0.86	EAI 5	0.71

Table 10: Outer Loadings for Online Training* Indicators and EAI Items (continued)

Pre-intervention EAI Items	Outer Loadings	Online Training*	Outer Loadings	Post-intervention EAI Items	Outer Loadings
EAI 6	0.925	Item 6	0.858	EAI 6	0.919
EAI 7	0.834	Item 7	0.918	EAI 7	0.831
EAI 8	0.94	Item 8	0.852	EAI 8	0.93
EAI 9	0.941	Item 9	0.829	EAI 9	0.95
EAI 10	0.954	Item 10	0.918	EAI 10	0.95
EAI 11	0.9	Item 11	0.926	EAI 11	0.915
EAI 12	0.883	Item 12	0.961	EAI 12	0.808
EAI 13	0.933			EAI 13	0.818
EAI 14	0.91			EAI 14	0.831
EAI 15	0.809			EAI 15	0.801
EAI 16	0.922			EAI 16	0.754
EAI 17	0.943			EAI 17	0.785
EAI 18	0.866			EAI 18	0.739
EAI 19	0.873			EAI 19	0.894
EAI 20	0.955			EAI 20	0.939
EAI 21	0.904			EAI 21	0.916
EAI 22	0.958			EAI 22	0.8
EAI 23	0.756			EAI 23	0.844
EAI 24	0.969			EAI 24	0.846

** Short Synchronous Online Training*

Discussion

This study investigated the effect of a short synchronous online training program on the environmental attitude of undergraduate students. The results supported both hypotheses. First, online training led to a significant increase in environmental attitude. Second, this increase was fully mediated by participation in the online training program.

The significant increase in environmental attitude following the online training program ($W = 226$, $p = .036$, $r = -0.34$) suggests that this type of intervention can be effective in fostering positive environmental attitudes among undergraduate students. The medium effect size ($r = -0.34$) indicates that the intervention had a practically meaningful impact. This finding aligns with UNESCO's (2021) emphasis on engaging and participatory methods in environmental education. Our study demonstrates that synchronous online training, incorporating photograph sharing and discussion, can effectively replicate these participatory elements in a digital environment. The real-time interaction and collaborative activities inherent in synchronous learning likely contributed to a sense of community and active engagement, mitigating the challenges of traditional online platforms, as noted by Squire (2021) and Morgan (2022). Furthermore, the use of visual media, as highlighted by Ardoin et al. (2013) and Farnsworth (2011), proved to be a valuable component of the training, fostering engagement and connection with environmental issues. The photograph-sharing activities likely transformed abstract environmental concepts into personal, meaningful narratives, enhancing the students' situational interest and fostering a tangible connection with nature.

The finding of full mediation indicates that the online training program is not just an added factor but the primary mechanism through which changes in environmental attitude occur. The path analysis revealed that the effect of pre-intervention environmental attitude on post-intervention environmental attitude was fully explained by participation in the online training program. The path coefficient for Pre-intervention EAI to Online Training was 0.860 ($p < .001$), the path coefficient for Online Training to Post-intervention EAI was 0.714 ($p = .038$), and the path coefficient for Pre-intervention EAI to Post-intervention EAI was 0.172 ($p = .654$).

This highlights the importance of the online training experience itself in shaping students' environmental perspectives. The significant indirect effect (0.615, p = .037) underscores the crucial role of the intervention in facilitating a change in environmental attitude. This finding supports the notion that active learning methods, when effectively integrated into online environments, can address students' emotional challenges and promote positive action for sustainability, as emphasized by Morgan (2022) and Dunlap et al. (2022).

The construct reliability and validity of the measurement instruments were confirmed (Cronbach's alpha for Pre-intervention EAI = 0.988, Online Training = 0.969, Post-intervention EAI = 0.983; HTMT values < 0.90), providing confidence in the accuracy and consistency of the results. The high outer loadings of the intervention indicators (all above 0.70) further support the effectiveness of the online training in targeting the intended constructs. These results align with Ajdukovic et al. (2019) who supported the use of EAI to measure environmental attitude.

This study has several limitations. The sample size was relatively small (n=39), and the participants were drawn from a single university using a non-probability sampling method, which limits the generalizability of the findings to other populations. The participants were undergraduate students enrolled in a summer training program, which may have introduced self-selection bias. Additionally, the specific design of the online training program, including the use of Padlet, Line, and Google Sites, and the specific topics covered, may have influenced the results, and further research is needed to explore the effectiveness of other online platforms, pedagogical approaches, and a wider range of environmental issues. The study's reliance on self-report measures may also be subject to social desirability bias.

The findings of this study have important implications for environmental education in the post-COVID era. They suggest that synchronous online training, when designed to be participatory and engaging, can be a valuable tool for promoting positive environmental attitudes. Educators can leverage online platforms to create effective learning experiences that foster connection, discussion, and active engagement with environmental issues. The integration of visual media and

collaborative activities in online synchronous settings holds promise for enhancing environmental literacy and promoting pro-environmental behavior. Future research should explore the long-term effects of online training on environmental behavior, investigate the effectiveness of different online pedagogical approaches, examine the role of individual differences in response to online environmental education interventions, and investigate diverse populations and contexts.

Conclusion

In conclusion, this study demonstrated that a short synchronous online training program can effectively enhance environmental attitudes among undergraduate students, and this effect is fully mediated by participation in the training. The findings indicate that online interventions, when designed to be participatory and engaging through elements like photograph sharing and discussion, hold significant promise for fostering positive environmental perspectives in higher education. This study contributes to the growing body of literature on online environmental education by providing empirical evidence for the effectiveness of synchronous online training in promoting environmental attitude, and highlights the potential of online platforms to create impactful learning experiences that can promote environmental awareness and action. As online learning continues to play an increasingly important role in education, this study underscores the importance of designing online interventions that are participatory, engaging, and grounded in sound pedagogical principles to effectively address critical global challenges such as environmental sustainability.

References

Ajdukovic, I., Gilibert, D., & Fointiat. V. (2019). *Structural confirmation of the 24-item environmental attitude inventory / Confirmación estructural del Inventario de Actitudes Ambientales de 24 ítems, Psyecology.* https://doi.org/10.1080/21711976.2019.1586140

Ali, W. (2020). Online and remote learning in higher education institutes: A necessity in light of COVID-19 pandemic. *Higher Education Studies, 10*(3), 16. https://doi.org/10.5539/hes.v10n3p16

Ardoin, N. M., DiGiano, M., Bundy, J., Chang, S., Holthuis, N., & O'Connor, K. (2013). Using digital photography and journaling in evaluation of field-based environmental education programs. *Studies in Educational Evaluation, 41*, 68–76. https://doi.org/10.1016/j.stueduc.2013.09.009

Cheung, G. W. & Lau, R. S. (2008). Testing mediation and suppression effects of latent variables: Bootstrapping with structural equation models. *Organizational Research Methods. 11*(2), pp. 296-325. https://doi.org/10.1177/1094428107300343

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research, 14*(2), 189–217. https://pubsonline.informs.org/doi/10.1287/isre.14.2.189.16018

Cottrell, S. P. (2003). Influence of sociodemographics and environmental attitudes on general responsible environmental behavior among recreational boaters. *Environment and Behavior, 35,* 347–375. https://doi.org/10.1177/0013916503035003003

Dhawan, S. (2020). Online learning: a panacea in the time of COVID-19 crisis. Journal of *Educational Technology Systems, 49*(1), 5–22. https://doi.org/10.1177/0047239520934018

De Koff, J. P. (2020). Utilizing teaching technologies for higher education in a post COVID-19 environment. *Natural Sciences Education, 50*(1). https://doi.org/10.1002/nse2.20032

Dunlap, R. E., & Jones, R. E. (2002). *Environmental concern: conceptual and measurement issues.* In R. E. Dunlap, & W. Michelson (Eds.), Handbook of environmental sociology (pp. 482–524). Greenwood Press. http://www.kia.hu/konyvtar/tartalom/t108.htm

Fabrigar, L. R., MacDonald, T. K., & Wegener, D. T. (2005). *The structure of attitudes.* In D. Albarracín, B. T. Johnson, & M. P. Zanna (Eds.), The handbook of attitudes. Mahwah,NJ: Lawrence Erlbaum. https://www.routledgehandbooks.com/doi/10.4324/9781410612823.ch3

Farnsworth, B. E. (2011). Conservation photography as environmental education: focus on the pedagogues. *Environmental Education Research, 17*(6), 769–787. https://doi.org/10.1080/13504622.2011.618627

Hair, J. F., Hult, G. T. M., Ringle, C. M. & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM).* Sage.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM).* (2nd Ed.). Sage.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019). When to use and how to report the results of PLS-SEM, *European Business Review, 31*(1), pp. 2-24. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). A Primer on partial least *squares structural equation modeling (PLS-SEM) (3e).* Thousand Oaks, CA: Sage.

Husna, L. & Astria, W. J. (2021). *A case study of students' ability to speak in EFL classroom.* Edukatif: Jurnal ILmu Pendidikan. https://doi.org/10.31004/edukatif.v3i5.957

Jones, C. M., & Baldwin, C. (2009). *Using emotion eliciting photographs to inspire awareness and attitudinal change: A user-centered case study.* In Proceedings of the 21st Annual Conference of the Australian Computer-Human Interaction Special Interest Group: Design: Open 24/7 (pp. 201–207). ACM. https://doi.org/10.1145/1738826.1738859

Kaiser, F. G., Wo¨lfing, S., & Fuhler, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology, 19*, 1–19. https://doi.org/10.1006/jevp.1998.0107

Milfont, T. L. (2007). *Psychology of environmental attitudes: A cross-cultural study of their content and structure.* Unpublished doctoral dissertation, University of Auckland, http://www.milfont.com/publications/

Milfont, T. L., & Duckitt, J. (2010). The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology. 30*(1), 80-94. https://doi.org/10.1016/j.jenvp.2009.09.001

Morgan, H. (2022). Alleviating the challenges with remote learning during a pandemic. *Education Sciences. 2022; 12*(2):109. https://doi.org/10.3390/educsci12020109

Murairwa, S. (2015). Voluntary sampling design. *International Journal of Advanced Research in Management and Social Sciences, 4*(2), 185-200. http://www.garph.co.uk/IJARMSS/Feb2015/18.pdf

Nitzl, C., Roldán, J. L., & Cepeda-Carrión, G. (2016). Mediation analysis in partial least squares path modeling: Helping researchers discuss more sophisticated models. *Industrial Management & Data Systems, 116*(9), 1849–1864. https://doi.org/10.1108/IMDS-07-2015-0302

Ringle, Christian M., Wende, Sven, & Becker, Jan-Michael. (2022). SmartPLS 4. boenningstedt: SmartPLS. https://www.smartpls.com

Rigdon, E. E., Sarstedt, M., & Ringle, C. M. (2017). *On comparing results from CB-SEM and PLS-SEM: Five perspectives and five recommendations.* Marketing: ZFP – *Journal of Research and Management, 39*(3), 4–16. https://www.beck-elibrary.de/10.15358/0344-1369-2017-3-4

Ruiz-Mallen, I., Barraza, L., Bodenhorn, B., & Reyes-García, V. (2009) Evaluating the impact of an environmental education programme: An empirical study in Mexico. *Environmental Education Research, 15*(3), 371-387. https://doi.org/10.1080/13504620902906766

Sarstedt, M., Hair, J.F., Ringle, C.M., Thiele, K.O. & Gudergan, S.P. (2016b), Estimation issues with PLS and CBSEM: where the bias lies!, *Journal of Business Research, 69*(10), 3998-4010. https://doi.org/10.1016/j.jbusres.2016.06.007

Squire, K. D. (2021). *From virtual to participatory learning with technology during COVID-19.* Article information. E-learning & Digital Media. https://journals.sagepub.com/doi/10.1177/20427530211022926

UNESCO. (2021). *Learn for our planet: a global review of how environmental issues are integrated in education.* https://unesdoc.unesco.org/ark:/48223/pf0000377362

Yamagata-Lynch, L. (2014). Blending online asynchronous and synchronous learning. *International Review of Research in Open and Distributed Learning, 15*(2), 189–212. https://doi.org/10.19173/irrodl.v15i2.1778

Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research, 37*(2), 197–206. https://doi.org/10.1086/651257