



# European Journal of Educational Research

Volume 13, Issue 1, 341 - 352.

ISSN: 2165-8714

<http://www.eu-jer.com/>

## How Participation in a Teachers' Eco-Pedagogy Workshop Affects the Promotion of Teachers' Environmental Education and Organizational Concepts

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Received: April 10, 2023, ▪ Revised: June 9, 2023 ▪ Accepted: August 16, 2023

**Abstract:** Eco-pedagogy is a pedagogy utilized in the framework of teaching environmental education in schools. The adoption of various eco-pedagogy programs within schools has proven to be helpful in improving students' environmental attitudes, and it was concluded that schools are the best place for critical learning of environmental concerns. Thus, the primary purpose of this study was to investigate how a teachers' eco-pedagogy workshop promotes teachers' educational, environmental, and organizational concepts. An integrated study (quantitative and qualitative) was carried out that included a sample of 44 teachers in elementary schools. The sample was divided into two groups: an experimental group that participated in the workshop, and a control group that did not participate in it. Improvement was found in the environmental education and the organizational concepts of eco-pedagogy for teachers who participated in the program, compared with those who did not. The study's key findings indicated that attending an eco-pedagogy workshop helped teachers perceive the subject more favorably, developed their higher-order thinking skills, and they learned more about it. Another finding was that a workshop is crucial for teachers to advance their professional development.

**Keywords:** *ECO-pedagogy, environmental education, professional development, teachers' workshop.*

**To cite this article:** Asli, S., Abu-Alhiga, R., Teti, T., Algmal, S., Hofstein, A., Shehadeh-Nasser, A., & Hugerat, M. (2024). How participation in a teachers' eco-pedagogy workshop affects the promotion of teachers' environmental education and organizational concepts. *European Journal of Educational Research*, 13(1), 341-352. <https://doi.org/10.12973/eu-jer.13.1.341>

### Introduction

#### *Environmental Education*

Environmental education deals with the relationship between people and their environment; it is based on a holistic view that assumes interdependence between human and natural systems (Aydos & Yağcı, 2015; Burton, 2019). Environmental education aims to develop skills that benefit the physical, human, and social environment (Hart, 2007). Environmental education and schools have been viewed side by side for many years; gradually a central insight that underpins this relationship became clearer: both sides need each other. This means that environmental education cannot realize its goals without schools, and without the research and methods of action developed within it (Jeronen et al., 2017).

Environmental education requires the use of current alternative pedagogies that are now recognized as essential for human existence. These pedagogies should provide students with the ability to achieve life-long and transformative learning, i.e., the ability to change according to changing needs (Jeronen et al., 2017). The implementation of various

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projects in eco-pedagogy within schools has been shown to be effective in changing the students' environmental attitudes. The goals of a sustainable lifestyle refer to preventing the collapse of the ecological systems, and establishing a society based on the principles of equality and social justice for a more worthwhile life of the individuals and the groups therein (Jeronen et al., 2017; McGuire, 2015).

#### *Environmental Education Based on Eco-Pedagogy*

According to Kahn (2009), eco-pedagogy is a key process in which humans may face the worst aspects of today's globalization. Eco-pedagogy therefore promotes respect for nature, people, culture, and diversity. However, it is also stressful because adherence to this convention should start in schools and social groups (Burton, 2019; Gadotti, 2008; Kahn, 2009, 2010; Misiaszek, 2016; Palmer, 1998; Stevenson, 2006).

Environmental education based on eco-pedagogy aims to organize the schools and the curriculum to meet the needs of a sustainable environment and the future (Gadotti, 2010; Kahn, 2010). Curricula based on eco-pedagogy help to a greater extent to overcome the anthropocentricity of traditional pedagogy (Barry, 2006; Gadotti, 2010), and help in better understanding the nature-human relationship (Gadotti, 2010; Kahn, 2010).

Jeronen et al. (2017) and several researchers concluded that schools are the best place for the critical learning of environmental problems (Monte & Reis, 2021; Schröder et al., 2020; Zocher & Hougham, 2020). Central questions that arise in this context concern eco-pedagogy among teachers, who are known to play a very important and central role in the implementation and assimilation of educational projects in the school; in their educational capacity, teachers can act as agents of change in the education system (Hugerat et al., 2013).

#### *Professional Development of Teachers*

To effectively implement changes in schools, teachers must undergo a learning process through in-service training. In this process, they learn how to become an active partner in creating change (Millard, 2000; Mitchell, 2013; Sabar & Shafiri, 1981). In the context of the teaching profession, the traditional view that the end of formal training marks the end of teachers' professional development has given way to the contemporary view in which higher education is seen as the beginning of life-long learning (Avalos, 2011; Bransford et al., 2005; Darling-Hammond et al., 2020).

The content of the professional development programs should be relevant and important to the teachers' classroom and practices. These programs include strategies for active learning; they involve the cooperation of teachers, the use of models and modeling, and offer personal training or expert support, including opportunities for feedback and reflection, as well as have persistence and continuity (Darling-Hammond et al., 2017; Hubers et al., 2022; Kennedy, 2016). The condition for succeeding with the program is having a certain combination between emphasis on the field of knowledge and the practice of pedagogy (Darling-Hammond et al., 2020; König et al., 2011). Environmental education cannot realize its goals without schools, and without the research and methods of action developed within them. However, to the same extent, today's schools need environmental education (Jeronen et al., 2017). From the students, it was concluded that schools are the best place for the critical learning of environmental problems (Kahn, 2009). Central questions that arise in this context concern eco-pedagogy among teachers, who have been known to play a very important and central role in the implementation and assimilation of educational projects in schools, and who can act as agents of change in the education system (Hugerat et al., 2013).

The present study examined the effect of participation in a teacher training program based on eco-pedagogy and on promoting the educational, environmental, and organizational concepts of teachers in the Arab sector. In addition, the suitability of an eco-pedagogy-based model developed by teachers who participated in the program for their educational, environmental, and organizational perceptions of the subject was tested. Specifically, achieving environmental behavioral changes focuses on certain steps, such as environmental knowledge, environmental awareness, and environmental attitudes. The purpose of research into environmental behavioral changes is to increase environmental awareness in order to solve ecological problems through education for sustainable living while emphasizing the importance of adult education (Burton, 2019). Therefore, to create environmental behavioral changes in the teachers, as mentioned above, the current study utilized in-service training, which is one of the main ways of professional development in teaching (Avalos, 2011).

Considering the above, the main goal of the current study is to implement a workshop based on eco-pedagogy for teachers, and to examine its effects on various aspects.

#### *The Purpose of the Study*

1. To examine how participation in the workshop affects teachers' environmental education and their organizational concepts of eco-pedagogy.
2. To examine the suitability of an eco-pedagogy-based model developed by teachers to study environmental education and the organizational concepts of eco-pedagogy.

### Research Questions

1. To what extent does participation in the workshop affect teachers' environmental education and their organizational perceptions of eco-pedagogy?
2. In what way does the model based on eco-pedagogy, developed by teachers, correspond to environmental education and the organizational concepts of eco-pedagogy?

### Hypotheses

1. Participating in the workshop will improve teachers' environmental education and their organizational concepts of eco-pedagogy.
2. The model based on eco-pedagogy, which will be developed by the teachers in the experimental group, will correspond to their environmental education and the organizational concepts of eco-pedagogy.

The second hypothesis focuses on the effect of the model built by the teachers at the end of the training and its effect on their environmental attitude; therefore, it differs completely from the first model, which focuses on the effect of their participation in the training in general.

## Methodology

### Study Participants

The study was conducted on a sample of 44 science teachers in elementary schools from the Arab sector in northern Israel. The sample consisted of 22 teachers who participated in the workshop (the experimental group) and 22 teachers who did not participate in it (the control group). Of these teachers, 77.2% (34) were women and 22.7% (10) were men.

### Research Tools

This study combined the quantitative method with the qualitative method; the quantitative method was in the form of a statistical analysis of data obtained through a questionnaire. The qualitative method was in the form of a semi-structured interview with a representative sample of teachers from the experimental group.

The data collection in the quantitative study was carried out using a closed questionnaire developed by Okur-Berberoglu (2020) and Okur-Berberoglu et al. (2015). The questionnaire contains 40 items; it was designed to examine teachers' environmental education and their organizational concepts of eco-pedagogy and refers to two dimensions, each of which has 20 items:

*Dimension 1:* Perceiving an environmental education concept.

*Dimension 2:* Perceiving an organizational concept.

A semi-structured interview was designed to assess the suitability of the teachers' developed model to the environmental education (e.g., In what ways does the model you developed correspond to the environmental education concept of eco-pedagogy that you studied in the workshop? Explain the model), and the organizational concept (e.g., To what extent did your participation in the workshop contribute to changing your organizational perception of eco-pedagogy?) The interview questions were developed by the researchers, and two experts in the field commented on and clarified them; their comments were considered within the questionnaire (see the appendix).

### Research Process

The training program was prepared by four experts in the teaching of science and the environment after a long discussion. The program was administered by a lecturer specializing in ecological issues and who had a PhD in teaching science and the environment, and a lecturer in environmental education at a college for teaching science and the environment as well as in schools and teacher training courses.

The content of the training included topics related to the environmental education concept and the organizational concept regarding eco-pedagogy. The issues related to the environmental education concept emphasize issues from nature in various fields of knowledge, and the preservation of biological diversity. The issues related to the organizational concept enable learning from models in nature and copying them for use in educational organization. Specifically, the main topics that were conveyed in the training program were the flight of the pelicans when they lead their group, relegation to a rocky coastal environment, division of roles in ant nests, and communication in a beehive. The training program included ten sessions and lasted ten weeks; each week included a session lasting three academic hours.

The quantitative research questionnaire was developed and compiled in Arabic to fit the research sample. The questionnaire was handed over to two lecturers-researchers of the Arabic language who had a PhD. They were asked to refer to the interpretation of the sentence's meaning, wording, and clarity. The comparison at the end of the process showed that there is an "almost" complete match between the evaluations of the two lecturers. The comments made to the research editor focused on grammatical and clarity issues. The questionnaire was redrafted according to their

comments. The questionnaire was sent to a limited number of teachers. Cross-checking the information that came from different sources made it possible to increase the reliability and validity of the research tools.

Two experts with PhDs in science teaching and with in-depth knowledge of the subject referred to the characteristics of the sections of the questionnaire in terms of the clarity of the sections, adapting the questionnaire to the level of the research sample, adapting the sections within the questionnaire to the stated research goals, and the length of the questionnaire. Following the judges' comments, the questionnaire was modified accordingly.

The data collection in the qualitative research was carried out through a semi-structured interview. The semi-structured interview was designed to (1) assess the suitability of the eco-pedagogy-based model developed by the teachers (following the training program) to the educational, environmental, and organizational concept of eco-pedagogy, and to (2) examine the effect of the training program on changing the educational, environmental, and organizational concepts on eco-pedagogy among the teachers. The six interview questions were developed by the researchers and two experts in the field, and their comments were considered in the questionnaire.

In conclusion, the workshop was conducted according to the following steps:

1. The pre-intervention phase - the research questionnaire was administered to the experimental group as well as to the control group.
2. The intervention phase - the workshop included ten meetings. In the first seven meetings, the theoretical material was administered; the training was carried out using the workshop and discussion method. In the first seven meetings, the lecturer of the training prepared presentations on topics related to eco-pedagogy from a theoretical and practical point of view and the participants discussed and practiced what they had learned. In the last three meetings, the teachers prepared and presented their models based on eco-pedagogy. In presenting their models, they explained how their models were suitable for environmental education and the organizational concepts of eco-pedagogy; this included how they applied the knowledge, conclusions, and insights they had acquired in the workshop in their daily lives, and how they will share this information with others.
3. The post-intervention stage - the research questionnaire was administered to the teachers in both the experimental and control groups.
4. Making assessments regarding the suitability of the teachers' eco-pedagogy-based model for environmental education and the organizational concepts as well as the effect of the workshop on the environmental education and the organizational concepts of eco-pedagogy among teachers in the experimental group through a semi-structured interview.

#### Data Analysis

The data analysis was carried out using both quantitative and qualitative methods. An ANOVA test was conducted to determine whether a significant difference exists regarding changes in the teachers' environmental education and their organizational perceptions (each dimension separately) of eco-pedagogy before and after they had participated in the workshop. To determine whether a significant difference exists between the experimental group and the control group regarding these aspects, another ANOVA test was conducted. In addition, appropriate findings from the content analysis of the interviews with the teachers were presented.

#### Findings

The teachers strongly agreed with the questionnaire items. Thus, answers 4 (to a large extent) and 5 (to a very large extent) were the ones chosen the most by 37 out of 44 teachers. In addition, only 7 teachers chose answer 1 (to a very small extent).

In the second stage, the descriptive indices of the dimensions of the environmental education and organizational concepts were examined in the pre- and the post-test. The indices tested are the minimum and maximum values, averages, and standard deviations.

In the first step, the relationships between the variables were examined. Pearson's correlation was used to examine the relationships. The results are shown in Table 1.

Table 1. Pearson Correlations between the Study Variables: The Whole Sample

Variable	1	2	3	4
Environmental Educational perception - Pre-test	--			
Organizational Perception - Pre-test	.75***	--		
Environmental Education Perception - Post-test	.59***	.72***	--	
Organizational Perception - Post-test	.60***	.85***	.94***	--

\*\*\* $p < .001$

As shown in Table 1, all the correlations between the study variables were significant, positive, and very high. Particularly striking is the almost perfect correlation ( $r(40)=.94, p<.001$ ) between perceiving the environmental education concept in the post-test and perceiving the organizational concept in the post-test. The correlations were then tested again, this time for each study group separately. The results are presented in Table 2 (the upper part of the table shows the results for the experimental group. The lower part of the table shows the results for the control group).

Table 2. Pearson Correlations between the Study Variables: The Division According to the Study Groups

Variable		1	2	3	4
Environmental Education Perception - Pre-test		--	.37	.60**	.29
Organizational Perception - Pre-test		.90***	--	.50*	.77***
Environmental Education Perception - Post-test		.97***	.91***	--	.58**
Organizational Perception - Post-test		.88***	.99***	.91***	--

\* $p<.05$ ; \*\* $p<.01$ ; \*\*\* $p<.001$

As shown in Table 2, most of the correlations were significant and positive, although less high, compared with the general population. Exceptional items were the correlation between the environmental education perception in the post-test and the organizational perception in the pre-test as well as the correlation between the environmental education perception in the pre-test and the organizational perception in the post-test, which were not significant ( $r(19)=.37, p=.097$  and  $r(19)=.29, p=.200$ , respectively). On the other hand, in the control group, all the correlations were significant, positive, and very high. Particularly striking is the almost perfect correlation ( $r(19)=.99, p<.001$ ) between perceiving the organizational concept in the pre-test and perceiving it in the post-test.

### Testing the Research Hypotheses

#### Quantitative Analysis

To test the research hypothesis, a two-way mixed design ANOVA was used. The between-subjects independent variable was the study group, and the within-subjects independent variable was the measurement time. The dependent variable was the measured values. Two such analyses were performed: for the dimensions of perceiving the environmental education concept and perceiving the organizational concept. First, the dimension of perceiving the environmental education concept was examined. The results are presented in Tables 3-5.

Table 3. Means and Standard Deviations of the Dimension Perceiving the Environmental Education Concept, Divided by the Measurement Time

	The Experimental Group		The Control Group	
	M	SD	M	SD
Pre-test	3.92	.24	3.80	.39
Post-test	4.70	.19	3.79	.33

Table 4. The Results of the Analysis of Variance for the Dimension Perceiving the Environmental Education Concept - Changes Within Subjects

Source of Variation	SS	df	MS	F	p
The Measurement Time	3.21	1	3.21	259.56	<.001
Interaction - Measurement Time X Research Group	3.25	1	3.25	263.29	<.001
The Error Factor (Time of Measurement)	.49	40	.01		

Table 5. Results of the Analysis of Variance for the Dimension Perceiving the Environmental Education Concept - The Variable between Subjects

Source of Variation	SS	df	MS	F	p
The Research Group	5.55	1	5.55	33.68	<.001
The Factor of Error (the Study Group)	6.59	40	.17		

As shown in Table 4, in accordance with the research hypothesis, a significant interaction was found between the experimental group and the measurement time ( $F(1,40)=263.29, p<.001$ ). In addition, significant major effects were found for the measurement time ( $F(1,40)=259.26, p<.001$ ) and the study group ( $F(1,40)=33.68, p<.001$ ). To locate the source of the interaction, a Bonferroni post-hoc test was used. In accordance with the research hypothesis, it was found that in the experimental group, the level of perceiving the environmental education concept in the post-test ( $M=4.70, SD=.19$ ) was significantly ( $p<.001$ ) higher than that of the pre-test ( $M=3.92, SD=.24$ ). It was also found that in the control group the level of perceiving the environmental education concept in the post-test ( $M=3.79, SD=.33$ ) did not

significantly ( $p=.935$ ) differ from that of the pre-test ( $M=3.80$ ,  $SD=.39$ ). Thereafter, the dimension of perceiving the organizational concept was tested. The results are presented in Tables 6-8.

Table 6. Means and Standard Deviations of the Dimension Perceiving the Organizational Concept, Divided by the Measurement Time

	The Experimental Group		The Control Group	
	M	SD	M	SD
Pre-test	3.89	.29	3.55	.47
Post-test	4.45	.23	3.55	.46

Table 7. The Results of the Analysis of Variance for the Dimension Perceiving the Organizational Concept - Variables within Subjects

Source of Variation	SS	df	MS	F	p
The Measurement Time	1.59	1	1.59	171.41	<.001
Interaction - Measurement Time X Research Group	1.70	1	1.70	183.49	<.001
The Error Factor (Time of Measurement)	.37	40	.01		

Table 8. Results of the Analysis of Variance for the Dimension Perceiving the Organizational Concept – The Variable between Subjects

Source of Variation	SS	df	MS	F	p
The Research Group	8.14	1	8.14	29.23	<.001
The Factor of Error (Study Group)	11.14	40	.28		

As shown in Table 7, in accordance with the research hypothesis, a significant interaction was found between the study group and the measurement time ( $F(1,40)=183.19$ ,  $p<.001$ ). In addition, significant major effects were found for the measurement time ( $F(1,40)=171.41$ ,  $p<.001$ ) and the study group ( $F(1,40)=29.23$ ,  $p<.001$ ).

To locate the source of the interaction, a Bonferroni post-hoc test was used. In accordance with the research hypothesis, it was found that in the experimental group, the level of perceiving the organizational concept in the post-test ( $M=4.45$ ,  $SD=.23$ ) was significantly ( $p<.001$ ) higher than that of the pre-test ( $M=3.89$ ,  $SD=.29$ ). It was also found that in the control group, the level of perceiving the organizational concept in the post-test ( $M=3.55$ ,  $SD=.46$ ) did not differ significantly ( $p=.750$ ) from that of the pre-test ( $M=3.55$ ,  $SD=.47$ ).

### Qualitative Analysis

The quantitative research findings indicate that participation in the workshop improved the teachers' environmental education and organizational concepts. To determine how this occurred, interviews were also conducted with 10 teachers from the experimental group. The analysis revealed that all teachers claimed that their participation had a positive effect on their environmental education concept.

### Examples of Quotes from Teachers

*Samia (pseudonym)*: "The environmental education concept that I learned in the workshop indicates that there is a group of people who share a common cultural base, cooperate, and that their relationship is based on giving and receiving, and this fits my model of the ants, which are an example of cooperation". *Salwa (pseudonym)*: "The model I developed fits the environmental education concept I learned because it emphasizes the need for a critical look at the state of the world". Two questions were posed: "In what ways does the model you developed correspond to the environmental education concept regarding eco-pedagogy, which you studied in the program? Can you provide an explanation and describe the model?" One of the teachers replied: "The environmental education concept that I learned in the program indicates that there is a group of people who share a common cultural base, cooperate, and that their relationship is based on giving and receiving... and this fits my model of the ants, which are an example of cooperation. One of the reasons for the great success of ants lies in the cooperation between individual ants". Another teacher's answer to this question was: "The model I developed fits the environmental education concept I learned because both emphasize a critical look at the state of the world, centered on a natural environment. Because of the ecological understanding that one thing is connected to another, those involved in eco-pedagogy understand that environmental action is connected with social, economic, and cultural action". Therefore, the teachers' answers unequivocally show an improvement in their environmental education perceptions. In other words, apparently this improvement is reflected in the notion that there is compatibility (as opposed to contradiction) between humans and nature, and therefore humans must strive to achieve harmony between themselves and the natural environment in which they live. This harmony is necessary for the continuation of human existence, and it produces many and varied advantages and benefits for humans. Therefore, humans should strive to

achieve harmony between themselves and the surrounding nature, through their personal behaviors and actions, which do not require a great effort and investment. However, at first there may be difficulties in implementing these behaviors, but eventually they can be made routine and performed daily. The teachers also emphasized the immediate need to implement behaviors and actions for the environment, since we are currently in a severe environmental crisis. Next, we examined how participation in the workshop affected the teachers' organizational perceptions by conducting a content analysis of their answers. The analysis also indicated that the teachers' organizational perceptions improved. *Examples of Teachers' Quotes: Haya (pseudonym) stated: "The model I developed is very compatible with the organizational concept I learned in the workshop: it emphasizes the importance of communication between individuals". Samah (pseudonym) stated: "The model I developed contributes to organizing the class schedule like in the model of the ants that always work together and with great cooperation". To the question, "In what ways does the model you developed correspond to the organizational concept of eco-pedagogy that you learned in the program?" Haya replied: "The model I developed is very compatible with the organizational concept I learned in the program: it emphasizes the importance of communication between individuals and the importance of mutual cooperation between individuals...; it refers to learning experiences, to the learning process and to the importance of the learning environment. Additional answers were as follows: "The model I developed corresponds to the organizational concept of eco-pedagogy that I learned in the program in that both teach the importance of learning that arises from everyday situations and takes on meaning from the context of each student and in the way in which the students make connections and understand things in a way that fits into their lives".*

Therefore, the teachers' answers unequivocally show an improvement in their organizational perceptions. In their words, it appears that this improvement is reflected in the perception that they can learn from topics, models, and phenomena related to nature as well as in the context of their work as school teachers. Thus, for example, the teachers claimed that the workshop empowered them and strengthened their ability to make changes, lead, and think about non-routine educational activities, such as extracurricular learning. Another example is that the workshop made them understand that they depend on each other. The teachers even emphasized the importance of integrating environmental education, in its various aspects, into the school curriculum. In conclusion, the quantitative and qualitative findings confirmed the first research hypothesis.

## Discussion

The education system must work to promote, lead, and assimilate environmental education, which includes a variety of aspects of life as an individual and as a human society to develop a generation, as part of its daily routine, adopting a 'sustainable lifestyle', through its integration within educational institutions (Mensah, 2019; Zocher & Hougham, 2020). The success of environmental education in an education system largely depends on the teachers and the quality of their teaching in this field (Elshof, 2005). In general, promoting the quality of teachers is carried out in practice through processes of professional development that occur, among others, through professional workshops.

### *Discussion of the First Research Hypothesis*

The quantitative research data obtained regarding the teachers' environmental education perceptions showed that in the experimental group there was a significant improvement in their environmental education perception of eco-pedagogy. The teachers' perception of environmental education after the workshop was higher than the average before it. In contrast, in the control group, no significant difference was found in teachers' average environmental education perceptions between the pre- and post-tests. These data (shown in Tables 3.1-3.3) support the research hypothesis. This was reflected in practice because the teachers expressed more sympathetic and positive views on various environmental issues, such as the principles of the Earth Charter, the quality of the environment, and concern for animals, a concept that links the destruction of rainforests to global warming, paper recycling to protect forests, and so on.

Support for the positive effect of teachers' participation in the workshop on their environmental education perceptions, as indicated above, was also obtained by analyzing the findings of the qualitative research. The teachers indicated that their participation in the workshop strengthened, for example, their perception of human-nature/environment compatibility, which in humans, creates the desire to establish harmony with the environment/nature, and in turn, contributes to humans in many ways. The teachers also pointed out that the concepts of human-nature compatibility, human-nature harmony, and their contributions to humans can result in a practical realization in practice through positive behaviors regarding the environment daily and immediately. According to the teachers, the urgent need for these behaviors stems from the existence of a severe environmental crisis around the world.

In addition, the quantitative research data, obtained in relation to the hypothesis regarding the teachers' organizational perceptions, indicated that in the experimental group, there was a significant improvement in their organizational perceptions: the teachers' average organizational perception after participating in the workshop was significantly higher than their average before the workshop. In contrast, in the control group no significant difference was found in their average organizational perceptions between the pre- and post-tests. These data (shown in Tables 6-8) support the research hypothesis.

The improvement in the teachers' organizational perceptions was attributed to their participation in the workshop. This was reflected in that after participating in the workshop, the teachers expressed more sympathetic and positive

perceptions regarding the possibility of learning from models in nature and translating them in practice to their educational setting. For example, they expressed higher support in their claims indicating that their "views on nature have changed for the better as a result of eco-pedagogy" and "an environmental approach can be used to predict environmental behavior and behavioral change".

Support for the positive effect of teachers' participation in the workshop on their organizational perceptions, as indicated above, was also obtained from the analysis of the findings of the qualitative research. Some teachers pointed out that their participation in the workshop made them realize that they could apply nature-related topics to their educational activities within the classroom teaching processes. That is, the teachers stated that after their participation in the workshop, they realized that they could draw conclusions and insights from environmental issues and apply them in the field of education and teaching (see the *qualitative analysis part*).

This included, for example, integrating the environmental and nature aspects outside of their teaching by implementing the extracurricular learning system and the classroom projects in nature. Furthermore, their participation in the workshop strengthened their abilities and skills that they perceived as relevant to their professional work, such as their sense of professional competence in the context of making changes in their teaching methods, as well as their sense of sharing and their feelings of interdependence with their colleagues.

The positive change in the environmental education concept and the organizational concept among teachers can be explained by the characteristics of the workshop. Specifically, the program was administered by a renowned professional who is an expert in ecological and environmental issues; it focused on content that included a wide variety of topics related to environmental education and the organizational concepts of eco-pedagogy; it included strategies for active learning, it is used in models, and it had sequence and continuity. Indeed, according to the literature, these workshop characteristics have been shown to promote the professional development of teachers in general and the characteristics of workshops for the professional development of teachers and have contributed to the effectiveness of the workshop (Darling-Hammond et al., 2017).

In addition, these research findings, which indicated an improvement in the workshop participants' environmental education and their organizational concepts, are consistent with previous studies that found positive effects of teachers' participation in similar projects because of the similar cognitive aspects related to environmental education. The integrated research (quantitative and qualitative) by Okur-Berberoglu (2015), which examined how an environmental education workshop based on eco-pedagogy affected the teachers' environmental attitudes, found that their participation in the workshop led to an improvement in their environmental attitudes in aspects such as their perception of its value through nature-based education, attitudes regarding environmental problems, access to nature, and an individual's ability to influence environmental issues. Okur-Berberoglu also found that the workshop contributed to improving teachers' environmental awareness in general, and that this is reflected in a wide variety of aspects, such as increasing their general knowledge regarding the environment, improving their ability to distinguish between practical knowledge acquired and the topics studied, and improving their ability to see the environment from a different angle. The workshop also exposed the teachers to the biological diversity in an environment.

#### *Discussion of the Second Research Hypothesis*

The findings of the qualitative research supported the hypothesis and revealed a match between the eco-pedagogy-based model developed by the teachers following their participation in the training program and their environmental education perceptions of eco-pedagogy. This was expressed in ways that refer to the strong human-nature/environment connection and its meaning for man, e.g., regarding concern for human existence and preservation of the earth.

. Thus, the model developed by the teachers reflected the environmental education and the organizational concepts of eco-pedagogy that they had acquired in the training program.

### **Conclusion**

Implementing changes in the school requires the teacher to undergo a learning process through in-service training. In this process, the teacher learns how to be an active partner in creating change. Achieving environmental behavioral change is not easy, and it requires focusing on certain steps, such as acquiring environmental knowledge, environmental awareness, and suitable environmental attitudes. The purpose of environmental behavioral change is to increase environmental awareness and solve ecological problems through education for sustainable living while emphasizing the importance of adult education. Considering the above, the main goal of the study was to implement a training program (in-service training) based on eco-pedagogy for teachers and to examine its effects on various aspects.

In this study, we examined how participating in a teachers' workshop improved the teachers' environmental education and organizational concepts. As mentioned, adapting an eco-pedagogy-based model developed by teachers contributed to their environmental education and organizational perceptions. The findings of the study generally indicate that the



teachers' participation in the workshop contributed to their professional development regarding eco-pedagogy. In addition, it contributed to the development of high-order thinking strategies and improved their knowledge of the subject. Therefore, it is possible to formulate practical recommendations for the professional development of teachers in the field of environmental education based on eco-pedagogy and based on the findings. The importance of the study stems from its innovations and its contributions to knowledge of this topic, as follows:

1. The concept of eco-pedagogy is new in the field of science; therefore, examining it in a scientific context will contribute to science teachers' knowledge of it.
2. The study strengthens the new concept of in-depth learning over time and contributes to meaningful learning.
3. It tests the eco-pedagogical concept among science teachers and the effectiveness of an eco-pedagogy-based training program for teachers in terms of their environmental literacy.

### **Recommendations**

1. This research topic should also be examined by focusing on teachers in the Jewish community in Israel. The proposed study will make it possible to compare how participating in a teacher training program based on eco-pedagogy affects the promotion of teachers' environmental education and organizational concepts, according to the community (Arab/Jewish). Therefore, we recommend conducting the same study in different countries around the world. This study will make it possible to make international comparisons regarding teachers' participation in such a teacher training program, based on eco-pedagogy and on promoting environmental education and teachers' organizational concepts.
2. A follow-up study should be conducted to examine which aspects of the eco-pedagogy-based teacher training program affect environmental education and the organizational perceptions of the teachers. The findings of this research will contribute to the professional development of teachers regarding eco-pedagogy by developing appropriate training programs.

### **Limitations**

The proposed study should deal with the limitations related to the research sample (the research field, sample size, characteristics, and the sampling method) by including a larger sample of teachers in diverse fields of study, mainly in the field of science, from schools in the Arab sector throughout the country, both women and men in a similar numerical proportion. The teachers who will participate in the proposed study should be sampled using a random probability sample. The external validity of the proposed study may be higher than that of the present study.

### **Ethics Statements**

This research proposal was approved by the Ethics Committee at the Arab Academic College and the Ethics Committee at the Galilee Association; the committees consist of senior researchers in the field and the proposal was then approved by the supervisors of the Arab sector at the Israeli Ministry of Education.

### **Acknowledgments**

This work was supported partially by the Ministry of Science, Technology and Space of Israel, the Academic Arab college for education in Israel and Al-Qasemi Research Foundation. The authors gratefully acknowledge this financial support.

### **Declaration of interest**

The authors declare no conflict of interest.

### **Availability of data and materials**

The data set and materials used in this manuscript are available and can be shared whenever necessary.

### **Consent for publication**

All authors have seen and approved their consent for publication.

### **Funding**

The authors received no direct funding for this research.

### **Authorship Contribution Statement**

Asli: Concept and design, drafting the manuscript, critical revision of the manuscript, statistical analysis, material support, and supervision. Riad Abu-Alhiga: Concept and design, data acquisition, data analysis / interpretation, drafting

the manuscript, securing funding, administration, and material support. Teti: Data acquisition, data analysis / interpretation, statistical analysis, securing funding, administration. Almal: Concept and design, drafting the manuscript, critical revision of manuscript, or material support. Hofstein: Concept and design, critical revision of the manuscript, supervision, and final approval. Shehadeh-Nasser: Design, critical revision of the manuscript, securing funding, administration, and technical support. Hugerat: Concept and design, data acquisition, data analysis / interpretation, drafting the manuscript, critical revision of the manuscript, statistical analysis, securing funding, administration, technical and material support, supervision, and final approval.

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## Appendix

### *Semi-Structured Interview*

1. Briefly describe how the environmental education and the organizational concepts affected the eco-pedagogy that you learned during the workshop.
2. Briefly describe the model based on eco-pedagogy that you developed following the workshop.
3. In what ways does the model you developed correspond to the environmental education concept of eco-pedagogy that you studied in the workshop? Explain the model.
4. In what ways does the model you developed correspond to the organizational concept of eco-pedagogy that you studied in the workshop? Explain the model.
5. To what extent did your participation in the workshop contribute to changing your environmental education concept of eco-pedagogy?

To what extent did your participation in the workshop contribute to changing your organizational perceptions of eco-pedagogy?