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EARLY CHILDHOOD EDUCATION FOR SUSTAINABILITY IN PRESCHOOLS WITH ECO-PROGRAMS: IMPLEMENTATION AND LEARNING OUTCOMES

Jurka Lepičnik Vodopivec,
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Abstract. *Early Childhood Environmental Education (EECE) and Early Childhood Education for Sustainability (ECEfS) are becoming increasingly integrated into preschool curricula, highlighting their key role in shaping environmentally conscious and sustainably oriented generations from an early age. The mentioned concepts represent the theoretical starting points of this empirical quantitative study, the aim of which is to examine the differences in the implementation of ESD, as well as the differences in the achieved outcomes of Education for Sustainable Development (ESD) in kindergartens with and without eco-programs, based on the preschool teacher's assessment, and to identify the specifics of the implementation of ESD in kindergartens with an eco-program in Slovenia. The research was conducted in 2024, on a sample of 114 preschool teachers employed in Slovenian kindergartens. The results confirm that in kindergartens with an eco-program, ESD's ecological, social and economic dimensions are successfully connected, and an integrated approach is applied. In kindergartens with an eco-program, ECEfS is implemented more prominently in the regular curriculum, and the outcomes of ECEfS are achieved to a higher degree than in kindergartens without an eco-program, which indicates the success of the program from the point of view of sustainability.*

Keywords: *early childhood education for sustainability, early childhood environmental education, eco-school/eco-kindergarten program, ECEfS outcomes*

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Introduction

In the last few decades, the concept of sustainable development has become a central topic in global political and academic discussions because today the need to change the world is greater and more urgent than ever before. Kioupi and Voulvoulis (2019) have regarded sustainable development as an effort to address increasing concerns about various environmental challenges in conjunction with socio-cultural and economic goals. In other words, sustainability seeks to balance the economic, social and ecological needs (UNESCO, 2014; UN, 2015) of current generations, without compromising the ability of future generations to meet their own needs (WCED, 1987).

Education for Sustainable Development (ESD) and Early Childhood Education for Sustainability (ECEfS)

A key role in achieving sustainable development is played by education, which provides the foundation for understanding and solving complex problems related to sustainability UNESCO (2017), offering a wider range of educational activities that promote a holistic approach to learning, integrating the ecological, economic, social, and cultural dimensions starting from the earliest years of life (UNESCO, 2017). Kioupi and Voulvoulis (2019, 2022) have pointed out that the complexities of the concept of sustainability, the interdependence and interactivity of its dimensions, which have not necessarily been aligned, and often resulted in circumstances perceived as complex and confusing, with a lack of clarity about the issues and conflicting interests that have caused tensions, have made it difficult to link the SDGs with educational outcomes and their implementation. They have seen overcoming these challenges in the systemic, holistic, and integrative approach of Education for Sustainable Development (hereinafter: ESD), including participatory and transformative processes. Namely, the authors have drawn attention to the need to overcome challenges in ESD because the three dimensions of economic, social, and environmental sustainability have not always been in alignment. Similarly, Davis and Elliott (2014) and Ärlemalm-Hagser, and Sandberg (2017) have recognized the need for a transformative and par-

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ticipatory approach in Early Childhood Environmental Education (hereafter: ECEfS), which has focused on taking action and children as agents of change, while Samuelsson and Kaga (2008) have observed the complexity and multidimensionality of ECEfS by pointing to the practices of crossing the three pillars of sustainability (economic, environmental and social) in the process of implementing ESD in the ECE environment. Wals (2017) has pointed to the connection between these three aspects, emphasizing that it is important to motivate children to care for one another, flora, fauna and the inanimate world, alone, with other children, or with adults, emphasizing the importance of an environment that has enabled experiences that they strengthen children's connection with the human, the non-human and the material. The importance of taking a child-centered perspective has been emphasized (Engdahl, 2015), children's greater compliance with sustainability than adults has been indicated (Wals, 2017), and children's rights to ECEfS have been rightly considered (Engdahl & Furu, 2022).

Early Childhood Environmental Education (EECE)

Early Childhood Environmental Education (hereafter EECE) has been increasingly represented in research and practice due to constant environmental challenges and growing interest in the established benefits of experiences for babies and children acquired in the natural environment (Ardoin & Bowers, 2020). The researchers have confirmed that the early preschool age has been extremely important for the development of environmental awareness because they believe that environmental education in early childhood has a lifelong impact since this period is crucial for the development of ecological literacy in future adults. That is why early age, as claimed by Cutter-Mackenzie and Edwards (2013), has played a crucial role in forming eco attitudes and behavior, and the emphasis is on acquiring knowledge through environmental experiences in early childhood settings. Authors Dolenc Orbanić and Kovač (2021), based on an empirical study conducted on a sample of future preschool teachers in Slovenia, have concluded that they have been aware of the importance of environmental education and its contribution to environmental awareness, behavior, and attitude towards the environment of future adults. In this regard, they have been advocating for the strengthening of faculties and other educational institutions in this area and the establishment of permanent professional support for preschool teachers of preschool children in practice by encouraging the development of their environmental literacy and training for better ecological teaching. They have suggested further research in this area because, as Bailie (2012) has estimated, the synergistic relationship between preschool and environmental education ensures the improvement of the quality of human experience in the world with beneficial impacts on spaces and species for future generations. The results of research on children's affective relationship to nature Cheng and Monroe (2012) have revealed that children's connection with nature positively correlates with enjoyment of nature, empathy towards creatures, a sense of unity, and a sense of responsibility. Nazaruk and Klim-Klimaszewska (2017) have pointed to the advantages of direct learning about nature for preschoolers in four ecosystems: meadow, park, forest, and zoo. Kuo et al. (2019) have emphasized that nature plays a key role in the development of pro-environmental behavior, especially by nurturing an emotional bond with nature. Children's connection with nature, as Ardoin and Bowers (2020) have concluded in their systematic comprehensive research, is important not only for the healthy social-emotional development of children but through ECEE their affective and cognitive development is also supported. Comparing the restorative effects on cognitive functioning in children's interaction with natural and urban environments, Berman et al. (2008) have demonstrated enhanced abilities of directed attention in a natural environment. Nature is a resource for learning and development, and experiences in nature promote learning, which Kuo et al. (2019) have summarized through an overview of numerous achievements and studies. Evidence from these studies, provided by independent observers and participants themselves, has pointed to changes in perseverance, problem-solving, critical thinking, leadership, teamwork, and resilience. They have confirmed that nature improves students' attention, reduces stress levels, strengthens self-discipline, increases interest and enjoyment in learning, and increases physical activity and fitness. In the context of ECEE, the importance of learning through play and the development and connection of environmental knowledge through children's play have been emphasized (Cutter-Mackenzie & Edwards, 2013).

Early Childhood Environmental Education (EECE) and Early Childhood Education for Sustainability (ECEfS)

Ecological education, as claimed by Lamanauskas (2023), at an early age supports not only the formation of values and knowledge of nature but also a sustainable and responsible style and way of life essential for a sustainable future. Carr et al. (2021) have linked outdoor play and ECEfS, while Ernst et al. (2021) through a systematic review of 36 scientific studies have identified outcomes related to nature play in young children, which are consistent

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with ECEfS outcomes. They have concluded that play in nature supports education for sustainability through the application of knowledge, and the development of dispositions and skills, thus connecting children's play, ECEE, and ECEfS, recognizing the link between them.

Other outdoor activities, as stated by Hughes (2023), can have positive outcomes for children, highlighting the transformative impact of school gardens on sustainable development. The researcher has suggested the conception of a kindergarten as a children's garden because it enables the acquisition of an invaluable learning experience for children and the community, as well as the potential for the development of ecological responsibility and sustainable management. The inextricable link between ECEfS and ECEE has been recognized by Ärlemalm-Hagsér and Sandberg (2017) observing ECEfS through the participation of young children and through the relationship that the child builds with nature through play and learning outdoors, pointing to the need for further research into this phenomenon. Through a systematic review of 66 empirical studies of ECEE programs, Ardoin and Bowers (2020) have observed that EECE includes two distinct but related approaches: nature-based early childhood education and early childhood education for sustainability. The approaches are similar because their emphasis is on the development of environmental awareness and responsible behavior in young children. Considering the above, it can rightly be claimed that Early Childhood Environmental Education (EECE) is an integral part of Early Childhood Education for Sustainability (ECEfS).

Program Eco-School/Eco-Kindergarten

As an attempt to respond from the immediate practice to the challenges of today, an international program of integrated ecological education and training called Eco-School/Eco-Kindergarten is established as part of a wider network led by the organization Foundation for Environmental Education (FEE). The program seeks to encourage sustainable development through environmental education, and one of the goals is to connect environmental issues with economic and social[1].The goals of the eco-kindergarten program include raising awareness of environmental issues among children, parents and staff, implementing sustainable practices in the day-to-day work of the kindergarten, involving the community in environmental projects and activities, and education through games, projects and interactive activities that promote environmental protection.

Research Problem

The increasing importance of sustainability and environmental education in early childhood has led to the implementation of various programs, such as the eco-school/eco-kindergarten program, aimed at fostering ecological values and behaviors in children from an early age. One of the key objectives of these programs is the integration of the ecological dimension into the daily educational process as an essential part of the broader framework of ECEfS, while simultaneously connecting the ecological, social, and economic dimensions of sustainability.

However, despite the growing adoption of these initiatives in preschool institutions worldwide, there is still limited empirical evidence regarding their effectiveness in achieving the desired outcomes of ECEfS. It remains particularly unclear whether kindergartens participating in the eco-school/eco-kindergarten program integrate all dimensions of sustainability into their educational processes more effectively than kindergartens without such programs.

Although eco-programs are suggested to offer a more systematic approach to sustainability through teacher training, specialized activities, and specific resources focused on environmental education, there is still insufficient data on how these programs truly impact children's knowledge, behaviors, and sustainable practices.

By exploring the implementation of ECEfS in preschools with and without eco-programs in Slovenia, this research provides insight into the effectiveness of these programs and contributes to the improvement of sustainability practices in early childhood education.

Research Aim and Research Hypotheses

This empirical quantitative research aimed to examine the differences in the implementation of ECEfS, as well as the differences in the achieved outcomes of ECEfS in kindergartens with and without an eco-program, based on the preschool teachers' assessment, and to identify the specifics of the implementation of ECEfS in kindergartens with an eco-program (in Slovenia).

1 https://ekosola.si/predstavitev-ekosole/

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In line with the study's focus, the following research hypotheses were set:

H1: An integrative approach to education for sustainable development (ESD) is represented in kindergartens with an eco-program as well as in kindergartens without an eco-program.

H2: There are significant differences in the degree of promotion of ECEfS and certain dimensions of ECEfS (ecological, social and economic dimensions) between kindergartens with an eco-program and kindergartens without an eco-program.

H3: There are significant differences in the degree of achievement of the outcomes of education for sustainable development, including the environmental, social and economic dimensions of ECEfS, as well as the outcomes of sustainable behavior and knowledge, among children in kindergartens with an eco-program and kindergartens without an eco-program.

Research Methodology

General Background

This empirical work is part of a broader international quantitative research project on ECEfS, conducted in Slovenia, Croatia, and Bosnia and Herzegovina. The research was approved by the Ethics Committee of the Faculty of Teacher Education, University of Zagreb. Data were collected in 2024 and analyzed separately for each country. A comparison across the countries and further statistical analysis are planned for 2025. The focus of the work is on reviewing the eco-kindergarten program from the point of view of sustainable practices and outcomes.

A descriptive and causal non-experimental empirical pedagogical research design was employed, utilizing quantitative methods for data collection and analysis. For the theoretical foundation and pedagogical interpretation of the results, the method of theoretical analysis and synthesis was used, focusing on existing literature and conceptual frameworks.

Sample

The research sample is a convenient sample, including 114 preschool teachers from different cities in Slovenia who voluntarily agreed to participate by completing the questionnaire, ensuring diverse representation. Of the total number of participants, 112 (98.2%) are women, while 2 (1.8%) are men. This significant overrepresentation of women in the sample is not accidental, given the dominant presence of women in the preschool teacher profession. The following table (Table 1) presents the sample characteristics, including preschool teachers' work experience, participation in the eco-program, and the age group of children they work with, as well as their familiarity with the OMEP scale and the sustainability course from the outset.

Table 1
Sample Characteristics

Sample structure		*f*	%
Sex	Female	112	98.2
	Male	2	1.8
Years of service	Up to 10 YOA	35	30.7
	From 10 to 20 YOA	37	32.5
	From 20 to 30 YOA	24	21.1
	Over 30 YOA	18	15.8
The age group of children in which he works	From 1 to 2 YOA	19	16.7
	From 2 to 3 YOA	17	14.9
	From 1 to 3 YOA	4	3.5
	From 3 to 4 YOA	19	16.7
	From 4 to 5 YOA	19	16.7
	From 5 to 6 YOA	22	19.3
	From 3 to 6 YOA	14	12.3

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Sample structure		*f*	%
The age of the children he works with	From 1 to 3 YOA	41	36
	From 3 to 6 YOA	73	64
Participation in the Eco-program	Yes	86	75.4
	No	28	24.6
Familiarity with the OMEP ESD scale	Yes	15	13.2
	No	99	86.8
Familiarity with the 'Sustainability from the Start' course by the ECE Academy	Yes	5	4.4
	No	109	95.6

Regarding the implementation of the eco-program, the majority of preschool teachers, 86 (75.4%), work in institutions that have an eco-program, while 28 (24.6%) come from institutions that do not implement the eco-program. This distribution enables the analysis of the differences between eco and non-eco kindergartens in the implementation of education for sustainable development.

In terms of professional information, a smaller number of preschool teachers are familiar with OMEP's ESD scale, 15 preschool teachers (13.2%), as well as with the ECE Academy's "Sustainability from the Beginning" course, only 5 preschool teachers (4.4%). Therefore, most respondents are not familiar with this scale (99 preschool teachers; 86.8%) and the course (109 preschool teachers; 95.6%).

These characteristics provide insight into the demographic and professional aspects of the sample, which are crucial for the interpretation of the research results.

Variables

Following the subject and aim of the research, the variables significant for this research were defined: Representation of Education for Environmental Sustainability (EES); Representation of Education for Social Sustainability (ESS); Representation of Education for Economic Sustainability (EECS); Education for Sustainable Development (ESD) representation; Quantitative Measure of Educational and Developmental Outcomes for Environmental Sustainability (O-ES); Quantitative Measure of Educational and Developmental Outcomes for Social Sustainability (O-SS); Quantitative Measure of Educational and Developmental Outcomes for Economic Sustainability (O-ECS), Adopted Sustainable Behavior (SB), Quantitative Measure of Familiarity with Sustainability Elements (FSE), Quantitative Measure of Educational and Developmental Outcomes for Sustainable Development (O-SD).

Instrument with Metric Characteristics and Procedure

The research instrument was independently created in compliance with recent recommendations and settings of education for sustainable development (ESD) in early childhood education (ECE), following UNESCO guidelines (2017) and the OMEP scale for the qualitative assessment of promoting sustainable development in early childhood (OMEP ESD Environmental Rating Scale for Sustainable Development in Early Childhood, 2019). The instrument's content validity was additionally confirmed by preliminary qualitative research, the results of research by Višnjić Jevtić et al. (2022), and compliance with the course activities "Sustainability from the very beginning" (ECE Academy, 2023). In this way, the instrument ensures that it covers the key aspects of ESD that are the subject of research, both theoretically and substantively.

The method of principal components was implemented to verify the validity of the instrument from an empirical point of view. It was determined that the first factor explains 35.52% of the variance, which is significantly above the lower limit of 20%, which is considered acceptable for proving validity (Čagran, 2004). The high value of Cronbach's alpha ($\alpha = .942$) additionally confirms the high internal consistency and reliability of the instrument.

These findings show that the instrument has a solid theoretical and empirical basis, thus meeting the criteria of content and empirical validity and ensuring good practical validity of the instrument, making it a relevant and reliable tool for researching the specifics of ECEfS.

The objectivity of the instrument is ensured by using closed-type questions and a five-point Likert scale. In the implementation phase, objectivity is ensured by unique, unequivocal and precise instructions for filling in and uncontrolled data collection.

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Quantitative data were collected by online surveying with the use of scaling during the year 2024. The survey was conducted following the principles of voluntariness, anonymity and ethics.

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Quantitative data were collected through an online survey using scaling during the year 2024. The survey was carried out following the principles of voluntariness, anonymity and ethics.

Data Analysis

The collected data on the researched phenomenon were processed with the help of IBM SPSS Statistics 26 software, using a statistical approach, including descriptive, correlative and inferential procedures. Statistical measures such as frequencies, arithmetic means, standard deviations, Pearson's correlation coefficient, and *t*-ratio were analyzed. Principal Component Analysis and Reliability Analysis were performed to check the metric characteristics of the instrument. The normality of the distribution of the examined variables was checked by the Kolmogorov-Smirnov and Shapiro-Wilk tests.

Research Results

At the beginning of the quantitative analysis of the collected data entered into the SPSS program, the normality of the research variables was checked using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Although the spread of some of the tested variables did not deviate, while for other variables it deviated statistically significantly from the Gaussian curve (Table 2 and Table 3), in further statistical procedures, parametric analyses were used, because the sample size per group was greater than 30 (Pallant, 2009), i.e. 15 (Green & Salkind, 2016). This indicates that despite deviations from normality, the distributions are robust and adequate for parametric checks (calculation of Pearson's coefficient and t-ratio). The large sample size in each group contributes to the reliability of the results, making the use of parametric tests valid even when the data slightly deviates from normality.

Table 2
Test of Normality of Variables: Kindergartens with an Eco-program

Research Variables	Kolmogorov-Smirnov		
	K-S statistic	*df*	*p*
EES	.102	86	.027
ESS	.094	86	.057
EECS	.103	86	.024
ESD	.100	86	.032
O-ES	.088	86	.097
O-SS	.107	86	.016
O-ECS	.124	86	.002
SB	.084	86	.198
FSE	.097	86	.046
O-SD	.076	86	.200*

Note. *. This is a lower bound of the true significance; a. Lilliefors Significance Correction; Variable labels as in Table 4

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Table 3
Test of Normality of Variables: Kindergartens without an Eco-program

Variables	Shapiro-Wilk		
	S-W Statistic	*df*	*p*
EES	.988	28	.979
ESS	.987	28	.971
EECS	.872	28	.003
ESD	.963	28	.418
O-ES	.942	28	.125
O-SS	.964	28	.435
O-ECS	.928	28	.055
SB	.965	28	.464
FSE	.933	28	.074
O-SD	.947	28	.167

Note. Variable labels as in Table 4

Testing the First Hypothesis (H1)

To prove the first hypothesis (H1), and check the integrability, interdependence and connection of all dimensions within the ECEfS, a correlation analysis was performed, and the obtained results were presented in Table 4 and Table 6. The calculated statistical Pearson's coefficients were positive and statistically significant ($p < .01$) for all examined variables, and statistically significant correlations were proven between all variables related to ECEfS and achieved ECEfS outcomes in kindergartens with an eco-program (Table 4), as well as in kindergartens without an eco-program (Table 6). Thus, hypothesis H1 is proven.

Table 4
Correlations of Education with Different Dimensions of Sustainability and Outcomes: Kindergarten with Eco-program (Pearson Correlation)

	EES	ESS	EECS	ESD	O-ES	O-SS	O-ECS	SB	FSE	O-SD
EES	1	.628**	.722**	.877**	.494**	.394**	.422**	.458**	.480**	.497**
ESS		1	.687**	.867**	.442**	.439**	.348**	.450**	.425**	.460**
EECS			1	.915**	.524**	.471**	.492**	.543**	.529**	.566**
ESD				1	.550**	.492**	.477**	.548**	.541**	.575**
O-ES					1	.722**	.654**	.851**	.838**	.891**
O-SS						1	.588**	.801**	.816**	.856**
O-ECS							1	.781**	.870**	.881**
SB								1	.783**	.922**
FSE									1	.963**
O-SD										1

Note. **. Correlation is significant at the .01 level (2-tailed); Education for Environmental Sustainability (EES); Education for Social Sustainability (ESS); Education for Economic Sustainability (EECS); Education for Sustainable Development (ESD); Outcomes for Environmental Sustainability (O-ES); Outcomes for Social Sustainability (O-SS); Outcomes for Economic Sustainability (O-ECS); Adopted Sustainable Behavior (SB); Familiarity with Sustainability Elements (FSE); Outcomes for Sustainable Development (O-SD)

Given that the results (Table 4) obtained based on preschool teachers' insights in kindergartens with an eco-program indicated that the dimensions of ECEfS strongly correlated with each other, as well as the outcomes of ECEfS, it was useful for the research to find out the degree of their representation, whether there were significant

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differences in the representation of dimensions and whether there were significant differences in the amount of realized outcomes. The results shown in Table 5 indicated that there was a statistically significant difference in the representation of the ECEfS dimensions in the kindergarten with the eco program because the tested *t*-ratios (for the pairs: EES – ESS; ESS – EECS and EES – EECS) were significant ($p < .001$). It can be seen that the most represented is ESS ($M = 3.91$), then EES ($M = 3.70$), and then EECS ($M = 3.53$). Regarding the outcomes, it is observed that differences existed only between the outcomes of ecological and economic sustainability ($t = 2.59$; $p < .01$), and between the outcomes of sustainable behavior and knowledge ($t = 5.86$; $p < .001$). The most dominant outcomes were sustainable behavior ($M = 3.85$), followed by environmental sustainability outcomes ($M = 3.81$), and social sustainability outcomes ($M = 3.73$), while outcomes related to knowledge acquisition were the least achieved ($M = 3.58$).

Table 5
Differences in Representation, Especially among ECEfS Dimensions and especially among ECEfS Outcomes in the Kindergarten with the Eco-program

Pair	*N*	*M*	*SD*	*t*	*df*	*p*
EES – ESS	86	3.70	.58	-5.49	85	< .001
	86	3.91	.52			
ESS – EECS	86	3.91	.52	9.34	85	< .001
	86	3.53	.67			
EES – EECS	86	3.70	.58	4	85	.001
	86	3.53	.67			
O-ES – O-SS	86	3.81	.68	.84	85	.130
	86	3.73	.64			
O-SS – O-ESC	86	3.73	.64	1.88	85	.157
	86	3.62	.87			
O-ES – O-ESC	86	3.81	.68	2.59	85	.009
	86	3.62	.87			
SB – FSE	86	3.85	.56	5.86	85	< .001
	86	3.58	.89			

Note. Variable labels as in Table 4

Given that the results (Table 6), obtained based on the assessment of preschool teachers from kindergarten who were not included in the eco-program, indicated that the dimensions and outcomes of ECEfS strongly correlated with each other, it was useful for the research to find out the degree of their representation, whether there were significant differences in the representation of the dimension and whether there were significant differences in the amount of realized outcomes.

Table 6
Correlations of Education with Different Dimensions of Sustainability and Outcomes: Kindergarten without Eco-program (Pearson Correlation)

	EES	ESS	EECS	ESD	O-ES	O-SS	O-ECS	SB	FSE	O-SD
EES	1	.775**	.719**	.926**	.681**	.615**	.611**	.666**	.638**	.663**
ESS		1	.709**	.916**	.544**	.612**	.498**	.608**	.528**	.573**
EECS			1	.879**	.702**	.669**	.654**	.721**	.670**	.705**
ESD				1	.705**	.693**	.644**	.729**	.671**	.709**
O-ES					1	.826**	.865**	.945**	.896**	.935**
O-SS						1	.897**	.913**	.948**	.951**
O-ECS							1	.932**	.969**	.972**

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	EES	ESS	EECS	ESD	O-ES	O-SS	O-ECS	SB	FSE	O-SD
SB								1	.922**	.974**
FSE									1	.986**
O-SD										1

Note. Variable labels as in Table 4

The results shown in Table 7 indicated that there was a statistically significant difference in the representation of ECEfS dimensions in the kindergarten without the eco-program because the tested *t*-ratios (for the pairs: EES – ESS; ESS – EECS and EES – EECS) were significant ($p < .001$, that is, $p < .05$). It is observed that the most represented was ESS ($M = 3.75$), then EES ($M = 3.36$), and then EECS ($M = 3.16$). Regarding the outcomes, it is observed that differences existed only between the outcomes of sustainable behavior and knowledge ($t = 5.86$; $p < .01$). The most dominant outcomes were sustainable behavior ($M = 3.48$), followed by social sustainability outcomes ($M = 3.43$), and environmental sustainability outcomes ($M = 3.34$), while outcomes related to sustainability knowledge were the least achieved ($M = 3.23$).

Table 7
Differences in Representation Especially among ECEfS Dimensions and Especially among ECEfS Outcomes in Kindergarten without Eco-program

Pair	*N*	*M*	*SD*	*t*	*df*	*p*
EES – ESS	28	3.36	.75	-5.49	27	< .001
	28	3.75	.61			
ESS – EECS	28	3.75	.61	9.34	27	< .001
	28	3.16	.60			
EES – EECS	28	3.36	.75	4	27	.05
	28	3.16	.60			
O-ES – O-SS	28	3.34	.86	.84	27	.379
	28	3.43	.92			
O-SS – O-ESC	28	3.43	.92	1.88	27	.161
	28	3.29	1.15			
O-ES – O-ESC	28	3.34	.86	2.59	27	.637
	28	3.29	1.15			
SB – FSE	28	3.48	.81	5.86	27	.009
	28	3.23	1.09			

Note. Variable labels as in Table 4

Testing the Second Hypothesis (H2)

To verify the second hypothesis (H2), descriptive indicators were calculated and the Independent-Samples *t*-test was applied, through which the differences of the arithmetic means of variables related to ECEfS in kindergartens with and without eco-programs were tested.

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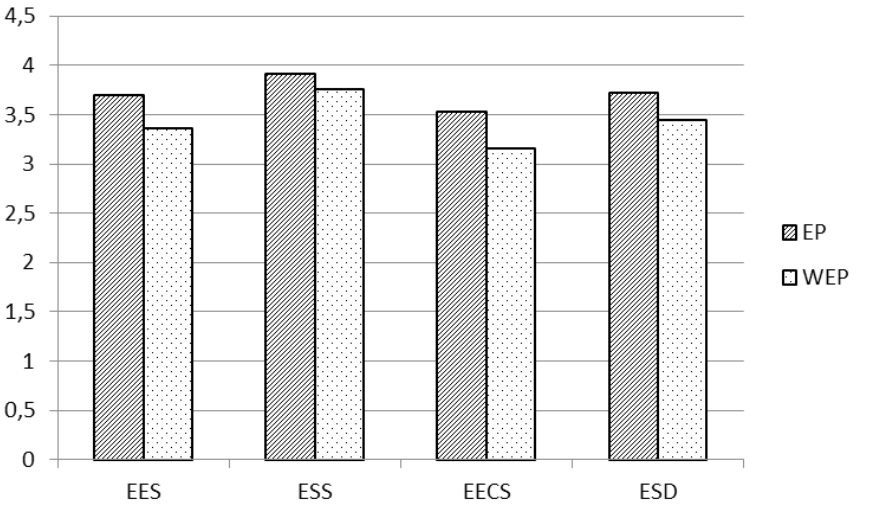
Figure 1
Representation of ECEfS Aspects in the Kindergarten Environment with and without an Eco-Program (Arithmetic Mean)



Note. Education for Environmental Sustainability (EES); Education for Social Sustainability (ESS); Education for Economic Sustainability (EECS); Education for Sustainable Development (ESD); Environmental Program (EP); Without Environmental Program (WEP)

The results obtained based on the preschool teachers' assessment in both kindergartens were presented graphically (Figure 1) and tabularly (Table 8). From the presented results, it can be seen that the differences in the arithmetic means were statistically significant for the variables *Representation of Education for Environmental Sustainability* (*M*eco = 3.70*; M*neco = 3.36*; t* = 2.51*; p* < .05); *Representation of Education for Economic Sustainability* (*M*eco = 3.53*; M*neco = 3.16*; t* = 2.56*; p* < .05)*; Representation of Education for Sustainable Development* (*M*eco = 3.72*; M*neco = 3.44*; t* = 2.4*; p* < .05)*;* while for *Education for Social Sustainability*, a statistically significant difference was not proven (*M*eco = 3.91; *M*neco = 3.75; *t* = 1.32; *p* > .05) (Table 8). Based on the calculated arithmetic means (Graph 1 and Table 8) and the *t*-ratio presented tabularly (Table 8), it can be concluded that there were differences between kindergartens with and without eco-programs in the degree of implementation of ECEfS and two of its dimensions, in favor of kindergartens with eco-programs. Thus, hypothesis H2 was mostly proven.

Table 8
Differences in the Representation of ECEfS Implementation in Kindergartens with and without Eco-programs

Aspects of ECEfS	Kindergarten	*N*	*M*	*SD*	*t*	*df*	*p*
EES	EP	86	3.70	.58	2.51	112	.013
	WEP	28	3.36	.75			
ESS	EP	86	3.91	.52	1.32	112	.188
	WEP	28	3.75	.61			
EECS	EP	86	3.53	.67	2.56	112	.012
	WEP	28	3.16	.60			
ESD	EP	86	3.72	.52	2.4	112	.018
	WEP	28	3.44	.59			

Note. Environmental Program (EP); Without Environmental Program (WEP); Other labels as in Table 4

Testing the Third Hypothesis (H3)

To verify the third hypothesis (H3), descriptive indicators were calculated and the Independent-Samples *t*-test was applied, through which the differences of the arithmetic means of the variables related to the achieved out-

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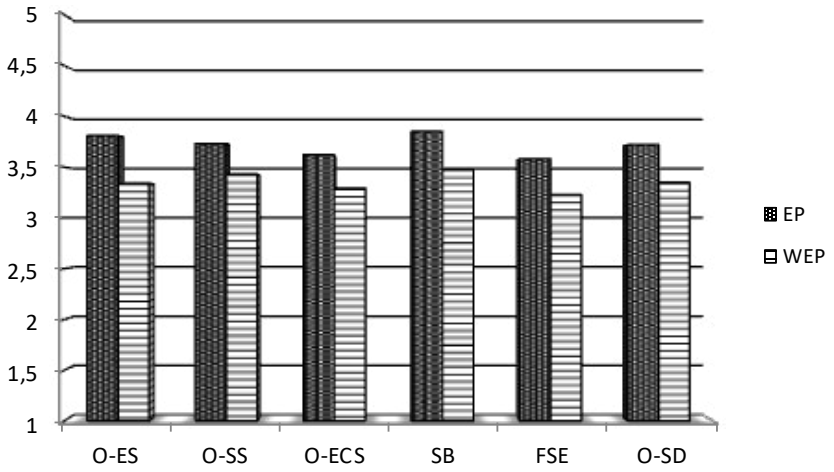
comes of ECEfS kindergartens with and without the eco-program were tested. Based on the calculated arithmetic means (Graph 2, Table 9) and *t*-ratio (Table 9), it was concluded that there were differences between kindergartens with and without eco-programs regarding the achieved outcomes, in favor of kindergartens with eco-programs.

Figure 2
Representation of ECEfS Outcomes in the Kindergarten Environment with and without an Eco-Program (Arithmetic Mean)



Note. Outcomes for Environmental Sustainability (O-ES); Outcomes for Social Sustainability (O-SS); Outcomes for Economic Sustainability (O-ECS); Adopted Sustainable Behaviour (SB); Familiarity with Sustainability Elements (FSE); Outcomes for Sustainable Development (O-SD)

Namely, the differences in the arithmetic means were statistically significant for the variables *Adopted Sustainable Behavior* (*M*eko = 3.85*; M*neko = 3.48*; t* = 2.77*; p* < .01)*; Quantitative Measure of Educational and Developmental Outcomes for Environmental Sustainability* (*M*eco = 3.81*; M*neco = 3.34*; t* = 2.63*; p* < .05)*; Quantitative Measure of Educational and Developmental Outcomes for Sustainable Development* (*M*eco = 3.72*; M*neco = 3.35*; t* = 2.33*; p* < .05)**.** For variables *Quantitative Measure of Educational and Developmental Outcomes for Social Sustainability* (*M*eco = 3.73; *M*neco = 3.43; *t* = 1.91*; p* > .05)*; Quantitative Measure of Educational and Developmental Outcomes for Economic Sustainability* (*M*eco = 3.62*; M*neco = 3.29*; t* = 1.60*; p* > .05)*, Quantitative Measure of Familiarity with Sustainability Elements* (*M*eco = 3.58*; M*neco = 3.23*; t* = 1.85*; p* > .05) although there was, the difference was not statistically significant (Table 9). Thus, the hypothesis (H3) was partially proven.

Table 9
Differences in the Degree of Achievement of Sustainable Development Outcomes in Kindergartens with and without Eco-programs

Achieved outcomes	Kindergarten	*N*	*M*	*SD*	*t*	*df*	*p*
O-ES	EP	86	3.81	0.68	2.63	112	.012
	WEP	28	3.34	0.86			
O-SS	EP	86	3.73	0.64	1.91	112	.059
	WEP	28	3.43	0.92			
O-ECS	EP	86	3.62	0.87	1.60	112	.112
	WEP	28	3.29	1.15			
SB	EP	86	3.85	0.56	2.77	112	.007
	WEP	28	3.48	0.81			
FSE	EP	86	3.58	0.80	1.85	112	.067
	WEP	28	3.23	1.09			

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O-SD	EP	86	3.72	0.64	2.33	112	.022
	WEP	28	3.35	0.93			

Note: Outcomes for Environmental Sustainability (O-ES); Outcomes for Social Sustainability (O-SS); Outcomes for Economic Sustainability (O-ECS); Adopted Sustainable Behaviour (SB); Familiarity with Sustainability Elements (FSE); Outcomes for Sustainable Development (O-SD)

Discussion

The significant, positive Pearson coefficients for the ecological, social, and economic dimensions of ECEfS, calculated in both eco-kindergartens and non-eco-kindergartens, indicate the interdependence of all dimensions of ESD. If the preschool teacher emphatically performed one of the dimensions of ECEfS, there was a high chance that they would also realize other dimensions, which indicated their connection during the implementation of ECEfS. The results showed that preschool teachers in both types of kindergartens applied an integrative approach in ECEfS. A holistic and integrative approach to ECD and ECEfS is recommended by the UN (2015) and UNESCO (2017). Also, all tested ECEfS outcomes correlate with each other, which means that a developmental shift in one aspect of sustainability often follows progress in other dimensions of ECEfS. Statistically significant and positive Pearson's coefficients were calculated for the application of the complete ECEfS and all its dimensions on the one hand and the outcomes of all dimensions of sustainability (ecological, social, and economic), sustainable behavior, and knowledge, confirming the integrative approach in the implementation of ECEfS. Contemporary research on ECD implementation in the ECE environment proves that sustainable practices are predominantly implemented through an integrative approach (Samuelsson & Kaga, 2008; Šindić et al., 2022; 2024; Šindić & Lepičnik Vodopivec, 2024), which some authors have considered the only adequate approach to ECD (Kioupi & Voulvoulis, 2019; 2022; Gokool-Ramdoo & Rumjaun, 2017). Also, those findings pointed to the direct connection of ECEfS with children's developmental shifts, which confirms its successful implementation, although, as Kioupi and Voulvoulis (2019, 2022) have emphasized in their research, the complexity of the concept of sustainability may create challenges in linking the SDGs with learning outcomes in education. Given that the preschool teacher has been most responsible for the implementation of ECEfS (Bahtić & Višnjić Jevtić, 2020), the findings of this study confirmed his significant role in children's development towards sustainability. Emphasized mutual correlations for all aspects and outcomes of ECEfS obtained by this research confirmed that a holistic approach, as claimed by Kioupi and Voulvoulis (2022) and Gokool-Ramdoo and Rumjaun (2017), is the most adequate for achieving ECD goals. Although the activities of the eco-program were specifically focused on the ecological dimension, this research's results suggest that it is stably integrated into the complete and holistic approach of ECEfS. The fact that the social dimension is the most dominant in eco-kindergarten, as shown by the results of this study, suggests that the preschool teacher's strategy, support, organization, and implementation of activities to promote social sustainability in the kindergarten not only refer to the planned promotion of ESD but also to the more frequent unplanned promotion, which has been observed in previous research through everyday situations where preschool teachers encourage children's adaptation, socialization, and the development of social competencies essential for sustainability (Šindić & Lepičnik Vodopivec, 2024). In other words, the intensity of preschool teacher strategies and activities is the most emphasized in this domain, because the improvement of social sustainability intersects with the developmental tasks that a child of this age needs to achieve, namely adaptation to the peer group and socialization of the child. Similar data on the difference in the representation of individual dimensions of ECEfS were also obtained in part of this research, conducted in kindergartens without an eco-program.

Similar to the previous one, although the achieved ECEfS outcomes strongly correlated, they were not equally represented, and in the kindergarten with the eco-program, the outcomes of sustainable behavior led, followed by ecological dimensions, and the lowest achieved outcomes were related to knowledge about sustainability, while in the kindergarten without the eco-program, the outcomes of sustainable behavior lead, followed by social dimensions, and the lowest achieved outcomes related to knowledge about sustainability. The fact that there is a difference between behavior and knowledge about sustainability in all kindergartens has been understood by looking at the specifics of early age and children's inability to fully understand the complexity of the concept of sustainability in all its segments. Accordingly, the specifics of ECEfS and EECE, which emphasize sustainable behavior, have been noted (Ardoin, & Bowers, 2020), where the focus should be on taking action by children (Davis & Elliott, 2014; Samue Ärlemalm-Hagser & Sandberg, 2017), based on a transformative and participative approach (Kioupi & Voulvoulis, 2019). Activities in the school garden can have a transformative character for preschoolers and contribute to shaping sustainable behavior (Hughes, 2023). Play, as the leading activity of preschool children,

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especially play in nature, provides transformative experiences related to sustainability (Ernst et al., 2021) and the development of pro-environmental behavior (Kuo et al., 2019). Šindić et al. (2021) have indicated that the sustainable behavior of preschool teachers has had a significant role in shaping the sustainable behavior of children. Numerous studies of the implementation of ECEfS have proven that daily routines in kindergarten constantly provide development opportunities and can grow into sustainable routines and behaviors, such as rational use of energy sources, sorting waste, and not throwing away food (Mahat et al. 2016; Ginsburg & Audley, 2020; Poje et al., 2024; Šindić & Lepičnik Vodopivec, 2024).

This research's results also indicated the existence of a difference in the implementation of ECEfS and its ecological and economic dimensions in kindergartens with and without an eco-program, with the fact that ECEfS was implemented to a higher degree in kindergartens with an eco-program.

Differences in the scope and depth of ECEfS implementation have been confirmed by Furu and Heilala (2021) through their research on sustainability practices in Finnish kindergartens. Although the eco-kindergarten program emphasizes EECE, the environmental dimension of ECEfS is strongly linked to the economic and social dimensions (proven by correlational links). These results confirm the coherence of the ECEfS concept and show that when a preschool teacher educates children in an ecological direction, he simultaneously touches on the economic and social aspects of sustainability. In this regard, one of the goals of the eco-school/eco-kindergarten program is to "connect environmental issues with economic and social issues", which, according to the findings of this research, is achieved to a higher degree in kindergartens with an eco-program than in kindergartens that are not included in this program.

Kindergartens with and without an eco-program also differed in the realization, first of all, of sustainable behavior outcomes, then ecological outcomes, and overall ECEfS outcomes. Findings showing that differences in the realization of some outcomes were more pronounced in kindergartens with an eco-program suggested that these kindergartens may have specific approaches that more strongly promote certain aspects of ECD. Given that the main starting point of the eco-program is environmental preservation and sustainability, the more emphasized ecological and overall ECEfS outcomes in kindergartens with the eco-program confirm the effectiveness of this program. The results of research by Poje et al. (2024) have shown that preschool children included in the environmental program in Croatian kindergartens have better results on sustainability topics than children who are not included. These findings support the idea that kindergartens with an eco-program have a different focus and methods that can lead to a stronger realization of ECEfS outcomes.

The most prominent realization of the outcome referred to the sustainable behavior of preschool children in eco-kindergartens and could be interpreted by the fact that the eco-program was integrated not only in all segments of the educational-upbringing process but also in the daily life of children and eco-kindergarten employees. Research by Krnela and Naglič (2009) has shown that students who attended schools included in the eco-school project in Slovenia have had greater knowledge about the environment compared to students from schools not included in that project, but the differences in attitudes and behavior have not been confirmed. These contrasting findings from kindergartens and schools involved in the eco-school/eco-kindergarten project may indicate that education for sustainable development, to form sustainable behavior, should be started at an earlier age to be more effective (UNESCO, 2017; Pramling Samuelsson, 2011).

The shortcoming of the study was that it was based only on self-reporting by preschool teachers, and it would have been desirable, in future research, to include other ECEfS participants. Also, the sample did not include an equal number of respondents from kindergartens with and without eco programs.

Further research involving longitudinal studies is recommended to monitor the long-term benefits of eco-programs. Also, it is important to explore specific methods and approaches that prove to be the most effective in promoting sustainable practices among preschool children.

Conclusions and Implications

The findings of this research clearly indicate significant differences in the implementation of education for sustainable development (ESD) in kindergartens with and without eco-programs. Preschool teachers in eco-kindergartens report a higher level of integration of ecological, social, and economic dimensions of sustainability in their daily activities. The results confirm that kindergartens with an eco-program successfully achieve one of the main goals of the program, which is to connect environmental issues with economic and social issues, which further proves the effectiveness and importance of a holistic approach in the implementation of ECEfS. The ecological dimension of ECEfS is tightly connected with the economic and social dimension, which indicates the coherence

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and integrability of this approach. The implementation of the eco-program allows preschool teachers to naturally include the economic and social aspects of sustainability through environmental education.

Also, the findings point to the important role of preschool teachers in kindergartens included in the eco-school/eco-kindergarten program, who, using specific procedures and activities within the eco-program, contribute to the development of sustainable behavior in children. These kindergartens not only promote ecological awareness but also integrate sustainable practices into children's daily lives, thus laying the foundations for long-term sustainable behavior. Children in eco-kindergartens are more engaged in ecological and economic sustainability activities, they have adopted sustainable and ecological behavior to a higher degree, and in general, achieve higher levels of ECEfS outcomes.

These results contribute to a better understanding of how different types of kindergartens apply and integrate education for sustainable development and can help in future research and practical applications of ECEfS. Implications for educational policies and practice suggest that the expansion of eco-programs can significantly contribute to sustainable development in early education. With adequate support and resources, kindergartens with an eco-program could become significant actors in education for sustainable development, laying the foundations for more responsible and aware generations.

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Declaration of Interest

The authors declare no competing interest.

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