



Predictors of Sustainable Development Outcomes in Learning Spaces of Early Childhood: Slovenian Teachers' Perspectives

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This research examined factors associated with sustainable development outcomes (O-SD) in early childhood learning settings, as perceived by preschool teachers, considering environmental, social, and economic aspects along with contextual elements (child age, eco-program affiliation, teacher experience). Data were gathered through an online survey targeting 114 Slovenian preschool teachers in 2024. The reliability of the instrument was high ($\alpha = .942$), and principal component analysis confirmed its validity. Correlation and stepwise regression analyses identified the key predictors of O-SD. Education focused on economic sustainability and child age emerged as the primary predictors, accounting for approximately 55% of the variance. While social sustainability was frequently observed in practice, it did not prove to be a significant predictor. The findings highlight the importance of developmentally appropriate and age-sensitive strategies, alongside the intentional inclusion of economic considerations. Limitations include a convenience sample and reliance on self-reported data. Future research should aim to replicate these results in diverse settings and consider mixed-method approaches that incorporate children's perspectives.

Keywords: quality education, early childhood education for sustainability, sustainable development outcomes, early childhood learning settings

INTRODUCTION

The 21st century presents escalating socio-ecological challenges, underscoring the urgency of transitioning to sustainable development models that meet present needs without compromising those of future generations (WCED, 1987). Although the 2030 Agenda and its Sustainable Development Goals, particularly those related to education, often appear ambitious and difficult to achieve (UNESCO, 2024), they remain essential

Citation: Vodopivec, J. L., Jevtić, A. V., & Šindić, A. (2026). Predictors of sustainable development outcomes in learning spaces of early childhood: Slovenian teachers' perspectives. *International Journal of Instruction*, 19(2), 491-506. <https://doi.org/10.29333/iji.2026.19227a>

to the wellbeing of current and future generations. Progress on Goal 4.7, which targets education for sustainable development and global citizenship, is still insufficient, indicating the need for sustained efforts in educational policies and practices (Global Education Monitoring Report Team, 2024).

Education, including early childhood education, is recognized as a central pillar of sustainable development, equipping young learners with the skills, values, and behaviors needed to advance environmental integrity, economic viability, and social justice (UNESCO, 2017). Despite growing support for Early Childhood Education for Sustainability (ECEfS) (Davis et al., 2024), researchers continue to identify gaps between policy rhetoric and implementation (Ärlemalm-Hagsér & Elliott, 2020; Engdahl & Furu, 2022). While numerous promising practices exist, activities that empower children to act as activists and agents of change for sustainability remain underrepresented (Šindić et al., 2025a; Engdahl & Furu, 2022), and the full range of ECEfS dimensions is inconsistently addressed (Kahriman-Pamuk & Borg, 2024; Višnjić Jevtić et al., 2022), which stands in contrast to the goals of ECEfS.

Integrating ECEfS dimensions and their influence on sustainability outcomes

ECEfS integrates three core dimensions—environmental, social, and economic—into pedagogical practices (Engdahl et al., 2022; Šindić et al., 2025b).

Environmental sustainability

Environmental sustainability refers to the conservation of natural resources and the protection of the environment through practices that minimize negative impacts on ecosystems. Activities promoting care for plants and animals, already present in Fröbel's kindergarten methods, remain relevant in Early Childhood Education (ECE) (Engdahl et al., 2021; Šindić, 2018). Education for ecological sustainability (EES) is realized through activities that foster love, responsibility, and connection with nature, such as outdoor play, exploring plants and animals, and similar experiences that encourage environmentally responsible behaviors (Davis et al., 2024). Research across Europe indicates that the environmental dimension is often the starting point and main focus of ECEfS implementation (Engdahl et al., 2021; Višnjić Jevtić et al., 2022).

Social sustainability

Social sustainability implies building a society that promotes social justice, equality, and the well-being of all community members (UN, 2019). In preschool education, this includes fostering cooperation, empathy, respect for diversity, and social responsibility, most effectively realized within the peer group (Davis et al., 2024; Šindić, 2021). If sustainability is seen as a matter of justice for children, the ideal lies in their active participation, addressing challenges such as inequality and gender issues (Engdahl et al., 2022).

Economic sustainability

Economic sustainability refers to practices that enable economic growth and development without harming the environment or society (UN, 2019). Within ECEfS, it can be fostered through everyday learning about responsible use of resources, saving,

and basic economic concepts in everyday activities (Davis et al., 2024). Economic ideas are increasingly embedded in sustainable practices, behaviors, and routines (Hosany et al., 2022; Šindić & Lepičnik Vodopivec, 2025).

Educators often recognize the environmental dimension as dominant in early childhood education practice (Višnjić Jevtić et al., 2022), while the social and economic dimensions receive less consistent attention (Hosany et al., 2022). The integration of these dimensions largely depends on national curricula, institutional priorities, and educator competences (Višnjić Jevtić et al., 2022). Globally, ECEfS is promoted across multiple levels, yet educational policies vary among countries (Güler Yıldız et al., 2021). For instance, the Swedish curriculum explicitly integrates sustainability, whereas in Turkey, the focus remains largely ecological, with limited social and economic integration (Kahriman-Pamuk & Borg, 2024).

In Slovenia, the principle of sustainable development in education is explicitly articulated and embedded in the updated national curriculum (Kurikulum za vrtece, 2025). Although institutional frameworks are in place, research indicates uneven implementation of ECEfS. In Croatia, Bosnia and Herzegovina, and Slovenia, educators do not always recognize the full interconnection among the three ECEfS dimensions (Višnjić Jevtić et al., 2022), although a holistic approach is often applied in practice (Šindić et al., 2025a, 2025b; Šindić & Lepičnik Vodopivec, 2025). In Slovenian kindergartens, the social dimension is present but only partially integrated (Šindić et al., 2025c), while economic understanding appears more developed than in neighboring countries (Višnjić Jevtić et al., 2022). Šindić and Lepičnik Vodopivec (2025) observed that ECEfS is implemented through both planned and spontaneous approaches in Slovenian preschools, while similar patterns—ranging from intentional to incidental—were reported in Sweden and Croatia (Osselson et al., 2024; Anđić, 2024).

Through play, interactive learning, and daily routines, children explore environmental care, social responsibility, and economic aspects of sustainability (Engdahl & Furu, 2022). Such experiential learning fosters sustainable behaviors (Lepičnik Vodopivec & Šindić, 2025), while activities like gardening, energy saving, or waste sorting nurture pro-environmental and prosocial attitudes (Ernst et al., 2021; Ginsburg & Audley, 2020; Hughes, 2023; Poje et al., 2024). These actions build children's empathy and awareness of human–environment interdependence (Dreamson & Kim, 2022; Watt & Frydenberg, 2024). Quantitative findings by Lepičnik Vodopivec and Šindić (2025) confirm direct links between sustainable development outcomes and education in environmental, social, and economic sustainability—key predictors analyzed in this study.

Outcomes of ECEfS (O-SD): Cross-national perspectives

Empirical research in Eastern Europe (Lepičnik Vodopivec & Šindić, 2025; Šindić et al., 2025c) and Sweden (Kahriman-Pamuk & Pramling Samuelsson, 2024; Ohlsson et al., 2024) shows that early childhood education can foster sustainability-related outcomes—awareness, understanding, and behavior—when supported by appropriate pedagogy. In Canada, gardening in the Ontario Kindergarten Program promoted sustainable behavior (Hughes, 2023), while an ECEfS and nature-based program in Australia enhanced empathy and pro-environmental attitudes (Watt & Frydenberg,

2024). Outdoor play and direct contact with nature further develop sustainability awareness (Ernst et al., 2021; Davis et al., 2024), and daily routines—saving energy, sorting waste, and conserving food—support sustainable habits (Ginsburg & Audley, 2020; Poje et al., 2024; Šindić & Lepičnik Vodopivec, 2025). Yet, curriculum constraints, limited parental support, and underestimation of children’s agency can limit ECEfS’s full potential (Ginsburg & Audley, 2020).

A safe and inclusive environment forms the foundation of learning (Machmud et al., 2023), with approaches varying by age (Šindić, 2021). Integrative ECEfS practices are more common with preschool-aged children, but less evident among younger children, particularly in planned activities and community engagement (Šindić et al., 2025b). There is a research gap between studies on toddlers and children aged 3–6, with the latter more frequently represented (Kahriman-Pamuk & Pramling Samuelsson, 2024). Findings suggest that suitable learning environments and integration of sustainability into daily routines enhance children’s sustainable behaviors and understanding. Experiential learning and simple practices—saving water, recycling, caring for living beings—support early sustainability awareness, motivating the present study to include child age as a predictor of observable sustainable development outcomes (O-SD).

Participation in structured programs, such as the international Eco-School/Eco-Kindergarten initiative (FEE), further supports these outcomes. Active in more than 70 countries, the program promotes sustainability through daily routines and community engagement. Research in Southeast Europe shows children in these programs display pronounced sustainable behavioral outcomes (Šindić et al., 2025c). Many Slovenian kindergartens participate, with eco-kindergartens consistently fostering environmental sustainability, sustainable behaviors, and broader outcomes through routines and continuous educator training (Lepičnik Vodopivec & Šindić, 2025). Building on this evidence, the present study examines which variables—environmental, social, and economic dimensions of ECEfS, child age, participation in eco-programs, and teacher experience—predict O-SD in preschoolers.

Research Focus and Problem Statement

Recent studies show that early childhood programs often implement the environmental, social, and economic dimensions of ECEfS inconsistently (Kahriman-Pamuk & Borg, 2024; Šindić & Lepičnik Vodopivec, 2025), providing limited opportunities for children to act as agents of change (Engdahl & Furu, 2022; Šindić et al., 2025a). Despite growing interest in ECEfS, few empirical studies have examined which variables actually predict observable sustainable development outcomes (O-SD). Most research remains qualitative, focusing on educators’ attitudes and practices rather than measurable child outcomes. Moreover, a research gap exists between studies focusing on toddlers and those involving children aged 3–6, with the latter being far more frequently represented (Kahriman-Pamuk & Pramling Samuelsson, 2024).

The focus of this study is to address this gap by investigating the predictors of O-SD from the perspectives of Slovenian preschool teachers, linking global ESD principles to concrete early childhood practices and highlighting context-specific insights. By empirically identifying which factors—environmental, social, and economic

sustainability, child age, participation in eco-programs, and teacher experience—predict O-SD, this research contributes to a clearer understanding of how sustainability principles are implemented in early childhood education.

In this comprehensive quantitative study with a sample of 114 Slovenian preschool teachers, the aim was to examine which variables—specifically the environmental, social, and economic dimensions of ECEfS, child age, participation in eco-programs, and teacher experience—significantly predict observable sustainable development outcomes (O-SD) in early childhood. By empirically investigating these predictors, the study contributes new insights into how ESD principles are translated into concrete practices in early childhood education and highlights context-specific factors that influence children’s sustainability-related knowledge, attitudes, and behaviors.

METHOD

The research was conducted using a quantitative methodology, complemented by theoretical analysis and synthesis of relevant literature to interpret and contextualize the findings. Data collection was carried out via an online survey distributed to preschool teachers across Slovenia over a two-month period (May–July 2024). Participants were invited via email and through professional networks, with a survey link provided for online completion. Participation was voluntary and anonymous, in line with ethical standards. Standardized instructions were given to ensure consistency, and participants were asked to respond independently to minimize external influence or bias. Participation was voluntary and anonymous, in line with ethical standards approved by the Ethics Committee of the Faculty of Teacher Education, University of Zagreb. Participants were informed about confidentiality, withdrawal rights, and independent completion of the survey to minimize bias. The study employed a descriptive–predictive design, chosen to identify potential predictors of sustainable development outcomes within naturally occurring educational practices and teacher-reported data. Rigorous validation procedures ensured internal validity.

Participants

The study included 114 preschool teachers from all Slovenian regions. Using convenience sampling, participants were required to be actively working as preschool teachers in Slovenia and to complete all survey items; incomplete responses were excluded to maintain data quality. Although the sample was not representative, its demographic and professional provide insights into Slovenia’s early childhood education context, particularly regarding teacher experience, age of children taught, and involvement in eco-programs, which are relevant for interpreting sustainability practices. Participant characteristics are shown in Table 1.

Table 1
Demographic and Professional Characteristics of the Respondents

Sample structure	F	%
Sex	Female	112
	Male	2
Years of service	Up to 10 YOA	35
	From 10 to 20 YOA	37
	From 20 to 30 YOA	24
	Over 30 YOA	18
The age of the children the teacher works with	From 1 to 3 YOA	41
	From 3 to 6 YOA	73
Eco kindergarten / eco-school program	Yes	86
	No	28
Familiarity with OMEP's ESD scale	Yes	15
	No	99
Familiarity with the course at ECE Academy.	Yes	5
	No	109

Research instrument

The instrument was developed for preschool educators based on the key principles of ECEfS (UNESCO, 2017), the OMEP Environmental Rating Scale (OMEP, 2019), prior research (Višnjić Jevtić et al., 2022), and the *Sustainability from the Very Beginning* course (ECE Academy, 2023), ensuring both theoretical and content validity. Content validity was further supported by expert review and pilot testing with a small group of preschool teachers. Principal Component Analysis confirmed the separation of predictor and criterion variables, offering initial empirical support (Lepičnik Vodopivec & Šindić, 2025). Regression analysis and reliability testing indicated strong psychometric properties (Cronbach's $\alpha = .942$). Further validation in varied contexts is encouraged.

The instrument consisted of 34 Likert-scale items with 5 response options, covering strategies of implementation and outcomes of ECEfS. Specifically, 7 items addressed EES, 8 ESS, 7 EECS, and 12 items assessed O-SD concerning ECEfS dimensions, including children's behavior and understanding. The two-part structure included (1) six demographic/professional items and (2) 34 Likert-scale items focused on strategies of implementation and outcomes of ECEfS, ensuring alignment with study objectives.

Data analysis

In the research, a correlation analysis was performed to determine potential predictors of the Outcomes for Sustainable Development criterion variable (O-SD). The selection of these predictors was informed by both theoretical assumptions and prior empirical findings indicating their relevance in shaping sustainability practices in ECE (Davis, et al., 2024; Višnjić Jevtić et al., 2022), as well as the recognized importance of the role and professional competence of preschool teachers in implementing ECEfS (Višnjić Jevtić et al., 2022). Additionally, institutional support such as Eco-program involvement has been linked to enhanced sustainability outcomes (Lepičnik Vodopivec & Šindić, 2025), while educator experience and the age of children can influence the depth of implementation and pedagogical focus (Šindić et al., 2025). The variables included were: Age of children (AGE), Years of Teaching Experience (YTE), Involvement of the institution in the Eco Kindergarten/Eco-School Program (Eco Program), Education for

Environmental Sustainability (EES), Education for Social Sustainability (ESS), Education for Economic Sustainability (EEcS), and Integrative Early Childhood Education for Sustainability (ECEfS). These abbreviations will be used throughout the paper for consistency and clarity.

To identify regression models and significant predictors, multiple regression analysis was performed using the stepwise method. This method was chosen to systematically determine which variables significantly predict O-SD, while controlling for potential multicollinearity. To determine the prerequisites for the regression analysis and to explain the regression results in more detail, the calculation of the arithmetic means of the representation of the ECEfS dimensions, correlation analysis of potential predictors (Pearson's coefficient), and Multivariate Tests (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root) and Test of Within-Subjects Effects to determine the difference between the obtained predictors by determining the significance of the obtained Fisher coefficients (F Multivariate and F within subjects) were used. The Kolmogorov-Smirnov test was used to check the distributions of the variables. SPSS 28 software was used for all analyses. The theoretical analysis and synthesis of contemporary theoretical assumptions and research provided the theoretical foundation for the work, interpretation, and discussion of the obtained results.

FINDINGS

This section presents descriptive and inferential statistics aimed at identifying the key predictors of sustainable development outcomes in ECE.

Although the Kolmogorov-Smirnov test showed that some variables deviated from normality ($p > .05$), parametric tests were used, as variance analysis is robust to such deviations and the sample size per group was sufficient ($N = 114$; > 15) (Green & Salkind, 2016). Before conducting the regression analysis, Pearson's correlation analysis was used to identify suitable predictors (Bryman & Cramer, 2011). Only variables with statistically significant correlations ($p < .05$) and at least a moderate effect size ($|r| > .30$) were retained. AGE, EES, ESS, and EEcS were included, while YTE and the eco-program variable were excluded due to weak correlations ($|r| < .30$) (Table 2).

Table 2
Correlation Between Criterion Variable and Predictors (Pearson's Test)

	AGE	YTE	Eco.Pro.	EES	ESS	EEcS	ECEfS	O-SD
AGE	1							
YTE	.070	1						
Eco Program	.045	-.022	1					
EES	.168	.113	-.231*	1				
ESS	.100	.050	-.124	.680**	1			
EEcS	.074	.216*	-.235*	.727**	.693**	1		
ECEfS	.127	.144	-.221*	.897**	.880**	.906**	1	
O-SD	.444**	.162	-.215*	.580**	.508**	.612**	.635**	1

Notes. **. Correlation coefficient is significant at the .001 level. *. Correlation is significant at the .05 level. Variable names and abbreviations are defined in the *Data Analysis* section.

The second prerequisite for regression analysis concerns sample size. Stepwise regression analysis requires 20 times more cases than predictors (Coakes, 2013), which

was met. To ensure the reliability of the regression coefficients, VIFs were checked as a key indicator of multicollinearity (Tabachnick & Fidell, 2013) (Table 3). All VIFs were below 10, confirming the stability of the regression coefficients.

Table 3
VIF Value of Regression Models

Model		Collinearity Statistics	
		Tolerance	VIF
1	EEcS	1.000	1.000
2	EEcS	.471	2.124
	EES	.471	2.124
3	EEcS	.398	2.515
	EES	.411	2.431
	ESS	.454	2.203
4	EEcS	.396	2.527
	EES	.402	2.490
	ESS	.454	2.203
	AGE	.967	1.034

Note. Dependent variable: (O-SD);
Predictor variables: EE; ESS; EEcS; AGE.

In the next step, the predictor variables were entered into a stepwise regression analysis, starting with the variable most strongly correlated with the criterion variable. Since all selected predictors—Education for Environmental Sustainability (EES), Education for Social Sustainability (ESS), Education for Economic Sustainability (EEcS), and children's age (AGE)—showed statistically significant correlations at the .001 level, the variables were entered in order of the highest Pearson coefficient. First, EEcS was entered ($r = .612$; $p < .001$), followed by EES ($r = .580$; $p < .001$) in the second model, ESS ($r = .508$; $p < .001$) in the third model, and AGE ($r = .444$; $p < .001$) last (Table 4).

Table 4
Regression Models for the Criterion Variable (O-SD)

Step	model predictor	B	t	p	Regression model						
					R	R ²	R ² _{cor.}	SE	RSS	F	p
1.	EEcS	.612	8.198	<.001	.612	.375	.369	.5845	38.266	67.20	<.001
2.	EEcS	.404	3.816	<.001	.643	.414	.403	.5687	35.904	39.14	<.001
	EES	.286	2.702	.008							
3.	EEcS	.373	3.228	.002	.745	.554	.538	.5701	35.752	26.124	<.001
	EES	.259	2.276	.025							
	ESS	.074	.068	.496							
4.	EEcS	.414	4.075	<.001	.745	.554	.538	.5003	27.287	26.124	<.001
	EES	.169	1.671	.098							
	ESS	.069	.724	.470							
	AGE	.378	5.815	<.001							

Notes. Standardized beta coefficient (β); t -ratio (t); Statistical significance (p -value) (p), Correlation coefficient (R); Coefficient of determination / R square (R^2); Adjusted R square ($R^2_{cor.}$); Standard error of the estimate (SE); Residual sum of squares (RSS); Variation not explained by the model (error); F -statistic or F -ratio in regression analysis (F); All other variable names and abbreviations are defined in the *Data Analysis* section.

The correlation coefficients (R values) for all four models showed a strong positive linear relationship between the actual and predicted values of the criterion variable,

ranging from .612 to .745 (Bryman & Cramer, 2011). The coefficient of determination, which indicates the proportion of variance in the criterion variable explained by the predictors, increased from the first to the third model and reached its highest value in both the third and fourth models ($R^2 = .554$), explaining 55.4% of the variance. When selecting the best model, it is important to consider that adding predictors can reduce the significance of existing ones. The adjusted R^2 , which accounts for the number of predictors and penalizes for overfitting, also indicated that models three and four explained most of the variance ($R^2_{\text{cor}} = .538$), suggesting no improvement by adding the fourth predictor.

The Standard Error of the Estimate, reflecting variability of the predicted values, decreased with each model, reaching its lowest value in the fourth model ($SE = .50$), indicating improved prediction accuracy. Residual analysis confirmed that the Residual Sum of Squares (RSS), representing unexplained variance, decreased across models, with the smallest error in model four ($RSS = 27.287$). The F-ratio from regression analysis, testing whether all coefficients were significant together, was statistically significant in all models ($p < .001$), indicating that all stepwise regression models were valid and worthy of consideration.

A more detailed examination of the regression models clarified the independent predictive value of each variable for the criterion variable.

Model 1: Education for Economic Sustainability (*EEcS*) was entered as the sole predictor and showed the strongest relationship with the criterion variable. The coefficient of determination ($R^2 = .375$) indicated that *EEcS* accounted for 37.5% of the variance in Outcomes for Sustainable Development (*O-SD*). The beta coefficient ($\beta = .612, p < .001$) confirmed its statistical significance, highlighting *EEcS* as a key driver of sustainability outcomes.

Model 2: Education for Environmental Sustainability (*EES*) was added to *EEcS*. Together, the two predictors explained 41.4% of the variance in *O-SD* ($R^2 = .414$). Both *EEcS* ($\beta = .612, p < .001$) and *EES* ($\beta = .404, p < .01$) were statistically significant, with *EEcS* remaining the stronger predictor. *EEcS* remained the stronger predictor, while *EES* contributed meaningfully, indicating that environmental education supports but does not outweigh economic sustainability education in predicting *O-SD*.

Model 3: Education for Social Sustainability (*ESS*) was included in the model, increasing the explained variance to 55.4% ($R^2 = .554$). *EEcS* ($\beta = .373, p < .01$) and *EES* ($\beta = .259, p < .05$) remained significant predictors, while *ESS* ($\beta = .373, p > .05$) did not reach statistical significance. The inclusion of *ESS* slightly reduced the significance of *EEcS* and *EES*, suggesting potential overlap or shared variance.

Model 4: The Age of children (*AGE*) was added as a fourth predictor. While the coefficient of determination remained the same ($R^2 = .554$), the Standard Error of the Estimate ($SE = .50$) and the Residual Sum of Squares ($RSS = 27.287$) decreased, indicating greater precision and reduced residual error. *EEcS* ($\beta = .414, p < .001$) and *AGE* ($\beta = .378, p < .001$) emerged as significant predictors, whereas *EES* ($\beta = .169, p > .05$) and *ESS* ($\beta = .069, p > .05$) were not. This demonstrates that older children are associated with higher observable sustainability outcomes, reinforcing *EEcS* as the

strongest predictor. Confidence intervals for β values were calculated and support the reliability of these estimates. Effect sizes (R^2 and β) are reported alongside p -values, highlighting the practical importance of EECs and AGE as predictors.

The strong correlation coefficients ($R = .612$ to $.745$) further indicate the reliability of the predictive models. It is noteworthy that both Model 3 and Model 4 had identical R^2 (.554) and R^2_{cor} (.538), indicating that adding AGE did not increase the total explained variance, although it reduced prediction error (SE and RSS).

The arithmetic means for *EES*, *ESS*, and *EEcS* were calculated and presented (Figure 1). It was evident that *ESS* was the most prominent dimension, followed by *EES* and *EEcS*. The significance of these differences was confirmed by Fisher's multivariate and within-subjects F -values (see Table 5 and Table 6).

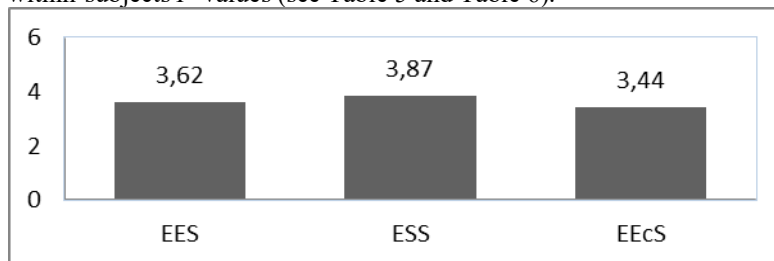


Figure 1
Representation of ECEfS Dimensions

Notes. Variable names and abbreviations are defined in the *Data Analysis* section.

Results from Tables 5 and 6 showed statistically significant differences in the representation of *EES*, *ESS*, and *EEcS*. Multivariate tests (Pillai's Trace, Wilks' Lambda, Hotelling's Trace, Roy's Largest Root) confirmed these differences ($F = 43664$, $p < .001$), and the within-subject effects test (Sphericity Assumed) showed significant differences across all sustainability dimensions ($F = 44868$, $p < .001$). This indicates that aspects of *ECEfS* are unequally integrated into educational programs.

Table 5
Differences in Representation of Aspects of ECEfS (Multivariate Tests)

The effect	Test	Value	F	Hypothesis df	Error df	p
Within-subject factors (EES, ESS, EEcS)	Pillai's Trace	.438	43664	2000	112000	<.001
	Wilks' Lambda	.562	43664	2000	112000	<.001
	Hotelling's Trace	.780	43664	2000	112000	<.001
	Roy's Largest Root	.780	43664	2000	112000	<.001

Notes. Fisher's coefficient (F); statistical significance (p); All other variable names and abbreviations are defined in the *Data Analysis* section.

Table 6
Differences in the Representation of ECEfS Aspects (Within-Subjects Effects Test)

	Type III SS	Df	MS	F	p
F (Sphericity Assumed)	10615	2	5307	44868	<.001
Error(F)	26733	226	118	-	-

Notes. Fisher's coefficient (F); statistical significance (p); Sum of squares (SS); Degrees of freedom (df); Mean square (MS); Statistical significance (p).

DISCUSSION

Interpretation of Findings

(Model 1) In the first model, education for economic sustainability (EEcS) significantly contributed to the achievement of sustainable development outcomes (O-SD), explaining one-third of the total variance.

(Model 2) The addition of education for environmental sustainability (EES) in the second model increased the explained variance to over 41%, with both EEcS and EES remaining statistically significant predictors.

(Model 3) Although education for social sustainability (ESS) showed a strong correlation with the outcomes (Table 2), it did not emerge as a significant predictor in the third model. The continued significance of EEcS and EES suggests their more direct role in shaping these O-SD. These findings raise questions, especially considering that ECEfS is conceptualized as an integration of three interdependent pillars—environmental, social, and economic (Englahl et al., 2022; Lepičnik Vodopivec & Šindić, 2025). While ESS is frequently emphasized in early childhood contexts (Anđić, 2024; Lepičnik Vodopivec & Šindić, 2025; Šindić et al., 2025b, 2025c), its implementation often occurs spontaneously, within the microsystem of the group and everyday interactions—through routines and socialization activities—rather than through formally structured ECEfS programs (Šindić & Lepičnik Vodopivec, 2025). Additionally, outcomes associated with ESS may be embedded in broader educational programs, rather than explicitly tied to ECEfS (Kurikulum za vrtce, 2025). Although ESS was the most prevalent in practice according to the results (Figure 1), its developmental focus on basic tasks of socialization and emotional security—long embedded in early childhood curricula—may explain its lower statistical significance in predicting O-SD, which are of more recent origin. Research (Lepičnik Vodopivec & Šindić, 2025) confirms that ESS is more often oriented toward the group microsystem, while it is less present in transformative practices that encourage children's social action on a macro level (Engdahl et al., 2021; Šindić et al., 2025b).

In contrast, EEcS—though less frequently present—emerged as the strongest individual predictor. Activities involving saving, resource management, and economic responsibility contribute to a deeper understanding of sustainability principles. Despite being conceptually recognized, EEcS is the least implemented dimension among all three, not only among regional respondents but also Slovenian educators (Šindić et al., 2025c), even though Slovene teachers demonstrate more pronounced understanding of economic sustainability compared to other countries in the region (Višnjić Jevtić et al., 2022). A balanced, synergistic approach remains key, but understanding individual contributions supports targeted pedagogical strategies.

The Role of Child Age in Shaping Sustainability Outcomes (Model 4)

(Model 4) When age was added as a predictor in Model 4, it absorbed part of the variance previously explained by environmental sustainability (EES), causing EES to lose statistical significance.

AGE appears to have greater predictive power than program-related variables, reflecting children's developmental characteristics. This suggests the developmental

stage may play a more critical role in predicting O-SD than some educational inputs. *Economic*

Sustainability in Early Childhood Education: An Emerging Focus (Model 3, Model 4)

Why did EEcS remain a strong predictor while EES and ESS, more commonly implemented, did not?? One explanation lies in the historical embedding of environmental and social content in preschool programs. Values such as cooperation, care for nature, and equality were already present before formal ESD introduction (Engdahl et al., 2021). EEcS is more recent, gaining relevance due to overconsumption, resource management, and economic awareness. Recent studies (Hosany et al., 2022; Šindić & Lepičnik Vodopivec, 2025) document the rise of practices such as resource saving, recycling, and upcycling in kindergartens. These may explain EEcS's strong predictive value, offering fresh, concrete learning opportunities that fill previous gaps in ECE.

As a “missing link,” EEcS enhances the coherence and completeness of sustainability education in early learning spaces.

Implications for Theory, Research, and Practice

Unexpectedly, one of the main findings of this study is that observable O-SD are strongly predicted by EEcS, contrary to prevailing research and reflections on ECEfS implementation. In contrast to Güler Yıldız et al. (2021), who emphasized the predominance of ecological approaches, the results of this study suggest a more balanced integration in some contexts, supporting Višnjić Jevtić et al. (2022) assertion that institutional context and educator training are critical factors in shaping the depth of ECEfS implementation.

The key findings of this study not only highlight the theoretical significance of recognizing EEcS as a fully integrated pillar of ECEfS, but also underscore the critical role of age-related differences in shaping observable O-SD. Most research has overlooked toddlers (0–3 years), focusing instead on children aged 3–6 (Kahriman-Pamuk & Pramling Samuelsson, 2024), creating a gap in understanding age-appropriate ECEfS implementation.

Pedagogical implications suggest that educators should recognize developmental differences in ECEfS implementation (Šindić et al., 2025b) and align learning outcomes with children's capacities. For children under three, the focus is on emotional security, early empathy, and prosocial behavior, which can be supported through peer and nature interactions, group routines, and outdoor play—introducing “little-s sustainable” behaviors (Kahriman-Pamuk & Pramling Samuelsson, 2024). Children aged three to six develop critical thinking, responsibility, and understanding of sustainability, enabling educators to introduce structured activities and support their potential as active agents of change in both immediate and broader environments (Engdahl & Furu, 2022; Šindić et al., 2025a). The study also highlights that, although EEcS is less frequently implemented in practice, it consistently emerged as the strongest predictor of O-SD. This aligns with observations that Slovenian preschool teachers, despite demonstrating a stronger understanding of EEcS than regional peers (Višnjić Jevtić et al., 2022), still report EEcS as the least represented dimension of ECEfS, both regionally and within

Slovenia (Šindić et al., 2025c). Age-appropriate experiences such as playful saving, sharing, and reusing can therefore lay the foundations for later economic awareness, indicating the curricular potential of EEcS. Finally, while all three ECEfS dimensions hold individual value, their interdependence is crucial, as stronger implementation of one often fosters the others (Table 2), highlighting the need for developmentally aligned strategies that integrate environmental, social, and economic learning and consider child age in designing interventions, curricula, and research.

Limitations and Future Directions

One limitation of this study is its national scope and the non-representative nature of the sample, which may limit the generalizability of the findings. Additionally, the reliance on self-reported data from preschool teachers highlights the need for triangulation in future research. To further enrich the field, future studies should incorporate children's voices using participatory methodologies that position children as active contributors in understanding and shaping sustainable education from early childhood onward.

CONCLUSION

This study highlights the strong predictive role of education for economic sustainability (EEcS) in shaping observable sustainable development outcomes (O-SD) in early childhood. Although EEcS is the least represented dimension in practice—even among Slovenian preschool teachers (Šindić et al., 2025c; Višnjić Jevtić et al., 2022)—its strong predictive value emphasizes the need to fully integrate EEcS as a core pillar of ECEfS. Key findings also underscore the importance of age-related differences: children aged three to six can act as active agents of change (Engdahl & Furu, 2022; Šindić et al., 2025a), while younger children benefit from developmentally appropriate, everyday sustainability practices (Kahriman-Pamuk & Pramling Samuelsson, 2024; Šindić & Lepičnik Vodopivec, 2025).

Pedagogically, educators should align ECEfS practices with children's developmental capacities, embedding structured and playful learning opportunities that foster ecological, social, and economic awareness. Theoretically, the findings reinforce the necessity of age-sensitive approaches and highlight research gaps, particularly for toddlers, calling for targeted studies that examine effective implementation of ECEfS in early childhood (Kahriman-Pamuk & Pramling Samuelsson, 2024).

Future research should explore diverse contexts, incorporate participatory methodologies to capture children's perspectives, and examine underrepresented age groups to advance understanding of sustainable education in early childhood. Overall, this study contributes new insights into the balanced integration of ECEfS dimensions and offers practical guidance for curriculum design and pedagogical strategies that meaningfully promote sustainability from toddlerhood onward.

ACKNOWLEDGEMENTS

This work was supported by the Slovenian Research Agency [P5-0444].

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