

Article

A Modeling Study on Science Teachers' Sustainable Development Knowledge, Attitudes and Practices

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Abstract: This study investigates possible predictors of science teachers' education for sustainable development (ESD) practices by controlling their significant life experiences (SLE), knowledge and attitudes about sustainable development (SD), and schools' environment. Fifty schools and 376 teachers participated in the study. A survey was conducted investigating teachers' demographic information and their knowledge and attitude about SD and ESD practices. Their schools were examined as ESD facilitators. Teachers' SLE was a significant predictor of their knowledge and attitude about SD and their ESD practices. Besides, teachers' knowledge about SD predicted their attitude towards SD. Their attitude towards SD and SLE predicted their ESD practices. Also, schools' physical environment was not a significant predictor of any teacher-related variables.

Keywords: sustainable development; education for sustainable development; significant life experiences; science teachers; teachers' practices



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1. Introduction

In Paris, 1968, it was argued and suggested in the declaration of the UNESCO Biosphere Conference [1] that environmental issues should be considered as part of education to increase social awareness [2]. According to Tilbury [3], while environmental education aims to develop a better perception and a positive attitude, it helps humans create necessary behaviors to understand the relationship between their environment and the earth. It also supports increasing global awareness in the struggle against non-renewable resources [4,5]. In the Brundtland Report [6], it was emphasized that there should be a balance between the development-oriented needs of human beings and the environment, and a new concept, Sustainable Development (SD), was put forward. It was defined as "... meets the needs of the present without compromising the ability of future generations to meet their own needs" [5] (p. 8). Tilbury [3] stated that SD primarily means (1) the necessity of a compromise between economic development and environmental protection; (2) addressing concerns about environmental problems within a socio-economic and political context; and (3) the need to combine concerns for development that focuses on the environment and development together. As understood from the definition, it was environment-oriented. Then, at the Johannesburg Summit [7], two additional dimensions, economic and socio-cultural, were added to the definition [8]. According to UNESCO [9], these three dimensions, namely socio-cultural, economic, and environmental, act together, and it is necessary to balance these three in interrelated areas of development [9].

1.1. The Importance of Education for Sustainable Development

Since the beginning of the 21st century, rapid industrialization and advancement of technology have led to global economic growth and have brought many environmental problems [10]. At this point, Education for Sustainable Development (ESD) is a powerful

solution to reach individuals who respect the ecological limits, who count the social balance and enable a sustainable life [11,12]. Considering the definition of SD, ESD promises a response to the solution to environmental, socio-cultural, and economic problems [13]. In this context, ESD aims to encourage individuals to develop awareness, attitudes, and reflections on their daily lives to support decisions about how to contribute to the quality of life in the future without degrading resources on earth. In addition, because education is critical to achieving all of the SDGs, it is vital to offer high-quality education that is inclusive, accessible, and accessible to everyone [14]. Thereby, it can be said that ESD should be considered a significant part of education. It was already reported at the Rio Summit to support the integration of ESD into the formal schooling system [9].

Educational systems play a vital role in developing an understanding, attitude, and necessary skills that form the basis of critical thinking and decision-making. Therefore, it is undeniable that societies use active educational systems. From this point of view, education systems have a serious potential to present students with the ability to develop a sustainable life and essential skills [15,16]. In other words, considering the principles of ESD for having awareness, attitudes, and practices for environmental protection, strengthening interdependence, and sustainable consumption, the education of young students, has an important place [10]. Young students seem innocent, vulnerable, immature, and are seen as inadequate in dealing with the global community's challenges. According to Elliot and Davis [17], even young students are not considered part of their world. They seem as apart from the environmental problems. Kahriman-Ozturk et al. [18] emphasized that such an approach may cause emerging anthropocentric attitudes toward the environment in students and the challenges they had to live in. Students are aware of the problems in the world in this decade. They can think critically about these environmental, social, and economic problems and join a sustainable society's decision-making process [19]. It is also a fact that contemporary approaches that emphasize a socio-cognitive context can expose young students' existing problem-solving potentials for sustainability [11]. Therefore, it is seen that it is imperative to address ESD in elementary education.

Speaking of the importance of students, the critical role that the teacher will play in understanding the issues related to the world they live in is remarkable. Although it is known that sustainability is essential for both humans and the earth, childhood is a critical period in establishing this awareness. It will be seen that there are not many studies on how teachers will play a successful role in ESD [9,10,20]. At the same time, teachers can offer opportunities that human beings can experience at an early age and similar opportunities to recognize SD [21,22]. According to McKown and Hopkins [23], teachers should be responsible for conveying sustainability to students, creating learning opportunities, and encouraging them in school and classroom settings. Thus, to achieve EfS goals, qualified teachers are essential [24].

Educators and researchers have long discussed teachers' practices since they aim to comprehend the value of early experiences for young students. In this regard, it is vital to determine the factors influencing teachers' ESD practices. However, the literature is incomplete concerning how teachers contribute to ESD practices and their dynamics [11]. On the other hand, when environmental education research is analyzed, some models determine the factors affecting educators' contributions [25–27]. One of these models, the Theory of Commitment to Environmental Education Teaching proposed by Shuman and Ham [28], can be adapted to ESD.

1.2. Theoretical Framework

The Theory of Commitment to Environmental Education Teaching [28] proposed the influence of facilities on educators' environmental education practices concerning Lewin's Field Theory [29]. Two constructs shaped field theory in terms of an individual and their environment. The underlying premise of field theory proposes that the individual and their environment work together integrally. Field theory claims that behavior (B) occurs at any given time as a function of the person (P) and their environment (E). Lewin defined behavior

(B) as “the environmental and psychological factors of the current situation developing” (p. 218). Hence, behavior is any change in psychological and environmental factors resulting from one’s action. All psychological situations associated with the person, such as thinking, acting, dreaming, etc. classified as personal factors (P). In addition, Lewin also included the hereditary traits of the person in this class as part of the person’s P-construct.

Furthermore, Lewin proposed that the specific time, place, and instant contact with other people can be called the environmental factors and divided the E-factor into two contexts: the physical environment and the social environment. According to Lewin [30], the physical environment includes time and place. Social environment, on the other hand, refers to the presence or participation implied by others. In conclusion, Lewin proposed that any behavior is linked to an individual’s characteristics and the current situation surrounding the behavior. Therefore, it would not be significant to consider the sources of behavior without referring to the individual and their environment together.

Teachers’ ESD practices are behavior, and this behavior is a function that occurs between the teacher and the environment. For example, behavior includes going on a nature trip with students, using a classroom notice board to raise awareness of socio-cultural issues, and running a project about consumption or recycling. On the other hand, P-factors include teachers’ beliefs, personalities, philosophies, moods, attitudes towards students, and other similar internal factors. E-factors have the demographic structure of the students in the classroom, the physical structure of the classroom, the psychological state of the classroom, school orientation, and other physical factors such as the philosophy and thoughts of other teachers, the school’s curriculum, and related resources, social factors such as SD related possibilities and social factors, etc. Therefore, as Lewin proposed, ESD practices can only occur when many internal (personal) and external (environmental) factors surrounding the behavior support the above.

When integrating field theory into the current study, the school environment regarding SD indicators was considered one of the E-factors. The productive environment of schools relating to SD indicators can be an excellent example of environmental facilities and provide learning opportunities for teachers. The research highlighted that the facilities concerning environmental issues in the school have an essential bearing on positive changes in teachers’ practices and students’ perceptions, attitudes, and behavior [31] and encourage students to be active in the SD process [32]. On the other hand, inadequate incorporation of these issues into classroom settings is one of the difficulties facing the practice of environmental education [23,33,34]. Many countries, such as the United Kingdom, Sweden, and Australia, have developed school settings to enhance SD. However, the Turkish Education System has features that are not consistent with the facilities of SD in schools. These facilities for SD could be educational materials like books, posters, etc. They could be references to SD issues (in terms of global warming, equity, recycling, etc.); recycling, reuse, and compost areas; graphic prints about encouraging energy and water-saving; natural opportunities and materials for taking an interest, including animals and plants [35].

In addition to E-factors, P-factors are linked to teachers’ behavior, including philosophy, personality, beliefs, the mood of the day, attitudes, etc. [28]. For example, Hines et al. [25] put forward environmental attitudes as a clear indicator of sensitive behavior in the environment. Their meta-analysis study revealed the relationship between pro-environmental attitudes and pro-environmental behavior. Emotional components generally limit attitude as positive or negative feelings towards an object or a class of objects; however, definitions of attitudes include affective, cognitive, and behavioral components, and attitudes also have the idea of responding favorably or unfavorably [36,37]. Environmental attitude is an essential element that encourages educators to participate in environmental education and apply new knowledge, skills, and attitudes in their classes [38]. It is reasonably well accepted that behavioral change is in a motivating relationship with changes in attitude, which is reflected in behavior [26].

An important question needs to be answered concerning the predictors of attitudes. According to psychologists, knowledge is a primary determinant of attitudes. For instance, Kaiser et al. [39] reported that “because attitude includes not just the evaluation of a certain outcome but also the estimation of the likelihood of this outcome, salient information or factual knowledge is a necessary precondition for any attitude” (p. 3). Early attempts at examining environmentally responsible behavior proposed that a linear progression of environmental knowledge leads to environmental attitudes. Similarly, it is assumed that when people are provided with information about environmental issues (knowledge) and what they can do to decrease their impact on the environment, they will have some attitude, whether environmental or not [40]. Educators’ knowledge of SD is fundamental because educators play an essential role in introducing SD to students [5].

When discussing the predictors of SD knowledge and attitudes, it is seen that the significant life experiences (SLE) concept has been used frequently in environmental education. We can see if past life experiences explain the teacher’s current behavior. The Significant Life Experiences concept has been frequently used in environmental education, referring to the events, impacts, and experiences that occurred throughout life contributing to a person’s values toward environmental issues. Several studies reported identifying correlations between individuals’ SLEs and their environmental values [41–47]. From this perspective, researchers seeking to investigate why some educators are interested in environmental issues have worked on life experiences taken from early childhood and created a broad discussion in environmental education research proposing Significant Life Experiences (SLE) [44,47,48]. Hsu categorized these as education levels, parents’ education level, experience with the natural environment vis-a-vis childhood residence, and the kind of house that was lived in during childhood, participation voluntarily in events or social networks provided by environmental organizations, membership of an NGO, having a close friend, relative or others who are members of an NGO, fear of pollution and environmental disaster and reading or following social media, press or books and being offered different sights on nature and the environment and therefore possessing diverse motivation and attitudes towards the environment [49].

1.3. The Significance of the Study

The framework of this study proposes a new model to explain why some teachers are more committed to implementing ESD than others because, at this point, understanding the scope of SD, the value of ESD, and what influences teachers’ concept of sustainability is critical [24]. Although the current literature discusses sustainable development goals, there is not enough research on teachers’ knowledge, attitudes, and practices regarding SD and ESD and their predictors [50]. On the other hand, the environmental pillar of SD is still the focus of current research in ESD [51]. Some other studies have been done on teachers’ conceptions of sustainability and SD [52–54]. This study was designed to add to the growing body of knowledge regarding teachers practicing ESD and its relationship to knowledge on SD and attitude towards SD by controlling their significant life experiences. A new model was proposed and tested by conducting hierarchical linear modeling (HLM) analysis to achieve this (presented in Figure 1).

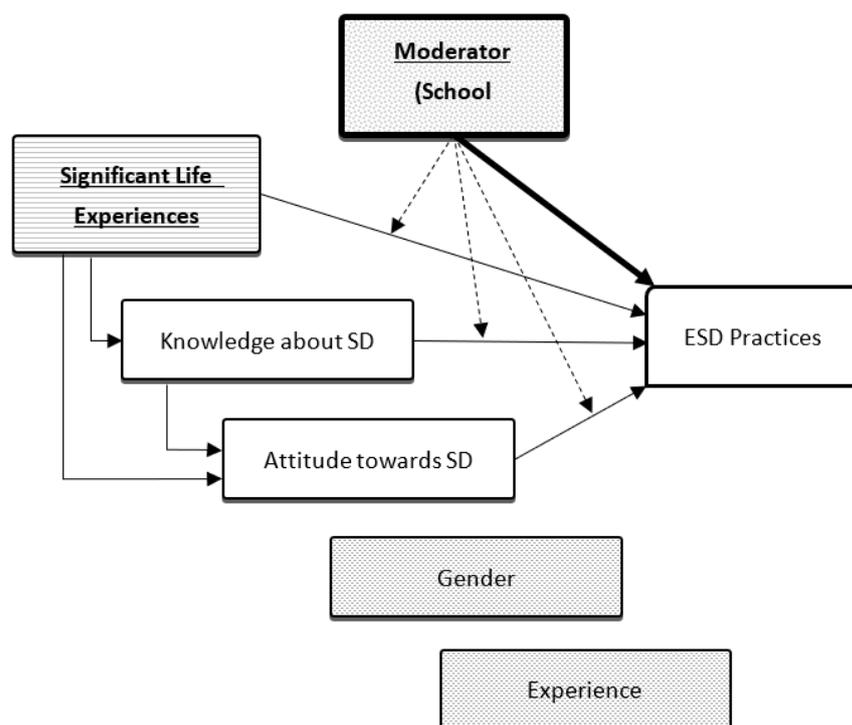


Figure 1. The proposed model is based on science and classroom teachers' significant life experiences, knowledge about SD, and attitudes towards SD as predictors of science and classroom teachers' ESD Practices.

2. Materials and Methods

In this study, the direct and indirect relationships among (1) teachers' Education for Sustainable Development Practices (hereafter ESDP), Knowledge about SD (hereafter KaSD), and Attitude towards SD (hereafter AtSD), and (2) their Significant Life Experiences (hereafter SLE) were investigated by controlling School Environments (hereafter SE) as a moderator variable. The data were gathered from teachers' self-reports and analyzed by conducting two-level Hierarchical Linear Modeling (HLM). Level-1 was formed with teacher-based variables, whereas Level-2 was formed with school-related variables.

2.1. Variables

2.1.1. Predictor (Latent) Variables

Teachers' ESD practices partially shaped by KaSD, AtSD and SLE were measured by an online questionnaire. The questionnaire was used to determine KaSD, AtSD, and SLE together. All the teachers in the sample filled it. In the online questionnaire, KaSD was represented by 9, AtSD was represented by 30, and SLE was represented by 16 items, respectively. All items are on a five-point Likert scale, "never" to "always". KaSD and AtSD scales were developed by Park et al. [55] and translated to the Turkish language by Kahriman [56]. The previously reported Cronbach Alfa values for these scales' scores were 0.75 and 0.94. In the current study, the calculated Cronbach Alfa values for these scales' scores were 0.91 and 0.94. The Significant Life Experience Form was developed by researchers based on Hsu's [43] categories. Hsu claimed that although experiences in nature in childhood are essential criteria in revealing environmental actions, 'environmental organizations', 'friends', and 'loss of loved natural places' offer much more important life experiences. Therefore, significant life experiences, including these categories, deserve more attention in curriculum development and teaching practices. In the present study, while developing the form, an item was written for each category determined by Hsu, and options were given to participants over a 2-point system with "Yes" or "No". Then, an SLE score was obtained for each participant by calculating the sum of the item scores. To

determine the reliability, KR-20 was conducted to data. The calculated KR-20 score was found as 0.84.

2.1.2. Moderator Variable

The second questionnaire related to SE is a separate form developed by the researchers, and it was only answered online by a science or a classroom teacher from each school in the sample. It aimed to get information about the school environment, including recycling bins, compost areas, alternative energy sources, posters, and books related to human rights, democracy, equality, etc. There are 26 items in the form and two response options: “available” and “not available”. To test the reliability of the questionnaire, KR-20 was conducted. The calculated KR-20 was 0.84.

2.1.3. Outcome Variable

ESD practices of science teachers can be related to teachers and their environment. They are primary factors depending on Lewin’s Field Theory (1942). ESDP can be shaped by teachers’ knowledge and attitudes as personnel (P) factors. Besides, significant life experiences can be the other essential (P) factor for supporting ESDP. The school environment is counted as an environmental (E) factor. Researchers proposed the theoretically predicted and empirically tested model that P and E factors are strong predictors and moderators of ESDP. In the questionnaire, ESDP was presented with 25 items, and the scale was developed by Kahriman [56]. The response format is a five-point Likert scale ranging from “never” to “always”. The previously reported Cronbach Alfa values for ESDP scale scores were 0.88. In the current study, the calculated Cronbach Alfa value for ESDP scale scores was 0.92.

2.2. Population and Sample

The target population of this study is all science teachers in Afyon province in Turkey. A random sampling method was used to reach the representative sample of the study: The city center of Afyon has 89 public elementary schools. Fifty schools from different parts of each district were randomly selected for the present study. In addition to science teachers, primary school teachers were also included in the sample because they also attend science classes in the 3rd and 4th grades of primary school. Researchers reached out to 50 schools and 290 primary school teachers, and 86 science teachers (Table 1).

Table 1. Some demographic information about the teachers.

		N	%
Gender	Female	178	47.3
	Male	198	52.7
Experience	1–10 years	117	31.1
	11–20 years	167	44.4
	21–30 years	69	18.4
	30–40 years	23	6.1

2.3. Data Collection and Analysis Procedure

The data were collected through two online questionnaires from 50 schools. The first questionnaire consisted of SLE (16), KaSD (9), AtSD (30), and ESDP (25) items, respectively, and a total of 80 items. The second questionnaire was about SE and consisted of 26 items. Researchers omitted the data that did not belong to the classroom or science teachers. All the respondents with missing values in their questionnaire were also excluded from the initial data set. In the end, there were 376 science teachers in the sample.

The data analysis procedure included three stages, preliminary analysis, descriptive statistical analysis, and inferential statistical analysis. In the preliminary analysis, data were examined concerning missing values, outliers, and univariate and multivariate normality.

Secondly, descriptive statistical analyses were conducted to examine the mean, standard deviation, skewness, and kurtosis values of the teacher- and student-related variables. Finally, Hierarchical Linear Modelling (HLM) was used as an inferential statistical procedure to investigate the relations between teacher- and student-related variables.

For the present study, Hierarchical Linear Modeling (HLM) was performed because of the nested structure of the data set gathered from the sample. Raudenbush and Bryk [57] proposed that their environment might influence teachers in the same schools. HLM analysis offers a technique to inspect the associations in these situations, including cross-level interactions among the constructs [57]. Therefore, this study's significance was to contribute to the body of literature by employing multilevel analysis to examine the role of teacher-level (Level-1) variables on teachers' ESDP by considering SE (Level-2) because of the nested structure of the data.

3. Results

3.1. Descriptives

First, the teachers' KaSD, AtSD, and ESDP levels were examined. Concerning the teachers' KaSD, the mean score was high ($M = 4.07$, $SD = 0.72$). Moreover, the results indicated high scores on their AtSD ($M = 4.50$, $SD = 0.21$). On the other hand, the mean score of ESDP was relatively high. ($M = 3.83$, $SD = 0.39$). Table 2 represents the results of descriptive analysis.

Table 2. Descriptive results.

Min	Max	M	SD
1.78	5.00	4.07	0.72
2.87	5.00	4.50	0.21
2.36	5.00	3.83	0.39

3.2. Predicting Teacher AtSD

The primary focus of this analysis was to see the possible predictors of teacher attitudes towards SD (AtSD). The first step was to verify that outcome had sufficient between-school variance to support multilevel analysis. The unconditional model of HLM analyses revealed that 8.8% of the variability in the outcome was sourced from between schools.

The next model evaluated the predictive power of teachers' experience, gender, SLE, and KaSD in explaining their attitude towards SD. A multilevel model in which teacher characteristic variables were entered at level 1 and the school environment entered at level 2 was examined for the outcome variable of teacher attitude towards SD. For this model, all continuous variables were added to the model as grand-centered. The analysis results indicated that all level 1 variables were significant predictors of teacher attitude towards SD except for gender. After including teachers' characteristics as predictors of teacher AtSD within schools, schools' variability in AtSD was reduced by 56.4%. As an additional result, SE was not a significant predictor or mediator for any teacher-related variables. The coefficients for these analyses are shown in Table 3.

Table 3. HLM model of teacher AtSD outcome.

Parameter	Coefficient	SE	<i>p</i>
Intercept, γ_{00}	4.632	0.075	0.000 ***
Experience, γ_{10}	0.008	0.004	0.047 *
Gender, γ_{20}	−0.059	0.049	0.231
SLE, γ_{30}	0.036	0.014	0.011 *
SE, γ_{31}	0.001	0.003	0.789
KaSD, γ_{40}	0.260	0.055	0.000 ***
SE, γ_{41}	−0.011	0.011	0.312

* $p < 0.05$, *** $p < 0.001$.

3.3. Predicting Teacher KaSD

Hierarchical linear modeling analyses were used to examine the teachers' knowledge about sustainable development (KaSD). Due to the nested structure of the data (e.g., teachers within schools), the analyses were performed using HLM 6.08 software. All continuous predictors were centered on their grand mean values, and gender was not centered in analyzing the views data.

The first model of the analysis was the unconditional model. This model, without any predictors, was used to calculate the intraclass correlation coefficient (ICC) score to see the quantity of variance between schools in total variance. ICC score was calculated as 0.034, meaning that 3.4% of the total variability in teacher KaSD scores can be attributed to the schools.

The next model was used to evaluate the predictive power of teachers' characteristics and school environment in explaining teacher KaSD. In this model, the teacher-level variables of experience, gender, and significant life experiences (SLE) were entered at level 1. After including teachers' characteristics as a predictor of teacher KaSD within schools, teachers' variability in teacher KaSD was reduced by 37.5%. For average schools, teachers' SLE is positively and significantly related to teacher KaSD, but experience and gender were not significantly related to teacher KaSD. However, the school-level predictor, school environment (SE), was not significantly associated with teacher KaSD. Also, it was not found as a mediator role between SLE and teacher KaSD. The coefficients for these analyses are shown in Table 4.

Table 4. HLM model of teacher KaSD outcome.

Parameter	Coefficient	SE	<i>p</i>
Intercept, γ_{00}	3.80	0.134	0.000 ***
SE, γ_{01}	−0.010	0.010	0.317
Experience, γ_{10}	0.003	0.006	0.669
Gender, γ_{20}	0.152	0.084	0.075
SLE, γ_{30}	0.127	0.025	0.000 ***
SE, γ_{31}	0.002	0.004	0.664

*** $p < 0.001$.

3.4. Predicting Teacher ESDP

Multilevel regression analyses were used to examine teacher ESD practices (ESDP) via HLM. As with teacher ESDP, the unconditional model was first examined to determine the proportion of variation in teacher ESDP that was attributable to school-level factors over that attributable to teacher-level factors. The ICC score was calculated as 0.289, meaning that 28.9% of the total variability in teacher ESDP scores can be attributed to the schools.

The second model was run to see the predictive power of teachers' experience, gender, SLE, KaSD, and AtSD in explaining their teacher ESDP. In this model, all continuous variables were grand mean centered except for AtSD. According to the analysis results, SLE and AtSD were found to be significant predictors of teacher ESDP. After including teachers' characteristics as predictors of teacher ESDP within schools, within schools' variability in AtSD was reduced by 57.76%. In the final model, the SE variable was added to the level 2 predictor to explain the variability of teacher ESDP and/or mediator roles between teacher ESDP and other teacher-related variables. The results showed that SE was not significantly related to teacher ESDP, and it did not have any mediator role between teacher ESDP and other predictor variables. In total, 46.6% of the variance in between school difference in teacher ESDP is accounted for by SE. The coefficients for these analyses are in Table 5.

Table 5. HLM model of teacher ESDP outcome.

Parameter	Coefficient	SE	<i>p</i>
Intercept, γ_{00}	3.784	0.093	0.000 ***
SE, γ_{01}	0.018	0.010	0.081
Experience, γ_{10}	0.001	0.003	0.961
Gender, γ_{20}	0.025	0.053	0.638
SLE, γ_{30}	0.099	0.019	0.000 ***
SE, γ_{31}	0.002	0.004	0.593
KaSD, γ_{40}	0.032	0.046	0.486
SE, γ_{41}	−0.004	0.010	0.697
AtSD, γ_{50}	0.321	0.096	0.002 **
SE, γ_{51}	0.012	0.020	0.544

** $p < 0.01$, *** $p < 0.001$.

4. Discussion

As mentioned before, education for sustainable development (ESD) encourages the knowledge, skills, attitudes, understandings, and practices required for a sustainable future [7]. Teachers of a sustainable world should possess this requirement in sustainable development (SD) knowledge and sustainability-friendly attitudes and practices for a sustainable future. In this research, how teachers' SD knowledge, attitude toward SD, and SD practices are interrelated, and to what extent external factors in terms of significant life experiences (SLE) and school physical environment predict this variable was investigated throughout the commitment theory. Relevant literature documented sustainable development goals; however, existing research lacks evidence about educators' knowledge, attitudes, and practices related to SD and ESD and their predictors. On the other hand, environmental education research, regarded as a trigger for SD, highlighted educators' ecological knowledge, attitudes, and practices by modeling many variables. This study aimed to fill the gap in the literature regarding ESD practices, attitudes, and knowledge by using environmental education research. Considering the connection between environmental issues and SD and the scarcity of SD research, this study has utilized the outcomes related to environmental knowledge, attitudes, and practices.

First, the present study's findings revealed that science teachers in Turkey have a positive attitude and are aware of SD issues. This is similar to research findings in different countries [38,58–60]. This can be considered a positive finding for implementing ESD in the school setting. The primary condition of implementing ESD activities is to know SD and have a positive attitude toward it. Both increase the probability of dealing with SD issues in the classroom setting.

4.1. Knowledge about Sustainable Development (KaSD)

As Lewin proposed, ESD practice can only occur if the current internal (P) and external (E) factors surrounding the behavior are supportive. Considering one of the personal factors, knowledge about sustainable development (KaSD) plays a crucial role in making familiar young children with the concept of SD [5]. In the current study, the findings revealed a significant relationship between teachers' SLEs and KaSD. In other words, teachers' KaSD was predicted by their SLEs. Previous research indicated that environmentally friendly practices are associated with environmental knowledge, leading to environmental attitudes [25,26,40]. When discussing the predictors of KaSD, SLE may refer to historical causation about developmental antecedents such as life events influencing a teacher's current knowledge. Several studies [41–46] reported identifying correlations between the SLEs of individuals and their environmental values. Relevant literature [61,62] suggested that SLE triggers environmental knowledge that turns into affinity with sustainable development knowledge. Examining the relationship between SLE and KaSD may deepen our understanding of orienting childhood experiences towards sustainability.

The current study also investigated whether or not the school environment (SE) of schools may be regarded as a facilitator that predicts teachers' KaSD. The results indicated

that SE does not predict the SD knowledge of teachers. Accordingly, it can be concluded that schools do not play a mediator role in predicting SD knowledge. The productive environment of schools relating to SD indicators might be an excellent example of environmental facilities [35], but the findings did not support it in this study. It may be related that physical facilitators do not attract enough attention, are few, are out of sight, and the training program is not supportive.

4.2. Attitudes towards Sustainable Development (AtSD)

It is reasonably well accepted that a shift inspires behavioral change in attitude, reflected in behavior [26]. In this study, teachers' attitudes are considered a P-factor regarding the theory of commitment. Therefore, possible predictors of teachers' attitudes towards SD (AtSD) were investigated in the current study. The results revealed that teachers' KaSD was meaningfully and positively associated with their AtSD. If a teacher has a high level of knowledge about SD, s/he has a high level of attitude towards SD. Stutzman & Green [63] regarded knowledge as a precondition attitude. When the teachers' attitudes toward SD were examined, it was seen that most of the research was conducted in the field of environmental education [25,26,38,64–66] except for a few related to sustainable development [67,68]. When the attitudes towards sustainable development were examined, the common side of these studies conducted with different samples [67,68] is that attitudes towards SD are high. Furthermore, knowledge was regarded as one of the predictors of attitude by several studies, with the results of the current study indicating SD knowledge of teachers as a predictor of their SD attitudes [25,26,40]. The current study aims to contribute to relevant literature discussing teachers' variables that predict these attitudes. On the other hand, SLEs were discussed as predictors of teachers' AtSD. Findings revealed that SLEs, in terms of living as a child, parents' education status, membership in non-governmental organizations, etc., predicts teachers' AtSD. Although sustainable development research does not provide enough proof related to this positive relationship, environmental education literature provides a substantial amount of data about the relationship between SLEs and environmental attitudes [41–46].

The school-related variable of this study, SE, was not significantly related to AtSD. This means that SE is not a predictor of SD attitudes. Much like the results related to KaSD, physical facilitators that do not attract enough attention are few, are out of sight, and the training program is not supportive are possible reasons.

4.3. Education for Sustainable Development Practices (ESDP)

Next, the ESDP of teachers was reviewed based on their KaSD, AtSD, SLEs, and the physical environment of the school (SE). According to the results, KaSD and SE were not found as significant in explaining ESDP. On the other hand, SLEs and AtSD were found as responsible for ESDP. It means that teachers with positive attitudes towards SD are likely to practice ESD issues more, although SD issues do not facilitate SD practices. When the relevant literature is examined, it will be seen that the lack of a relationship between knowledge and practice is not surprising. It has been reported in various studies that there is an indirect rather than a direct relationship between knowledge and practice. Some studies have observed that knowledge about environmental problems does not directly affect environmental practices (i.e., [25,65,69–71]). Environmental education research highlighted the relationship between knowledge, attitude, and practices (i.e., [72]).

Teachers' knowledge about SD did not have a significant effect on their behavior. Boubonari et al. [64] stated that the increase in knowledge is associated with increased positive attitudes towards the environment, similar to this study's results. Still, the behavior is not associated with knowledge. Likewise, Esa [38] reported a link between knowledge and attitude, knowledge and practice, and practice and attitude. Thus, teachers who value the balance between environmental, socio-cultural, and economic issues are likely to show more ESD practices in their schools. These results are also not surprising because Thompson and Barton [73] stated that positive attitudes enrich practice. These findings coincide with

studies that found a significant relationship between attitude motives and environmentally friendly behavior [74,75]. To summarize, in light of environmental education research, attitudes towards sustainable development predict sustainable development practice.

On the other hand, the school's physical environment is not a predictor of ESD practices. These findings also revealed that any facility-like educational materials are not intervened with SD practices. Similarly, the mediation model results indicated that the school physical environment does not mediate the relationship between significant life experiences, SD attitude, and practices. Hallfredsdottir [76] reported that sustainability-related facilities available in the schools, such as recycle bins, could encourage pro-environmental actions. Mogensen and Mayer [77] pointed out that physical facilities like recycling bins or outdoor areas to play in schools may lead to educational gains in increasing knowledge, attitudes, and practices. In this regard, it is an unexpected result; however, how teachers are aware of these facilities and how they include them in the educational program should be investigated. By the way, it should be considered that schools could be built where practices promoting a sustainable future can be examined. In addition, it may be possible to use sustainable materials in schools (e.g., recycled paper products, reused bottles, boxes, etc.) [78].

5. Conclusions and Recommendations

This study has examined to what extent teachers can apply sustainability in the classroom, the predictors that affect these practices, and whether SLE contributes to teachers' ESDP. It was also examined whether the school environment mediates these predictors. It has resulted that SLE contributes to teachers' knowledge, attitudes, and ESDP. Teachers' exposure to sustainable lifestyle practices in their own lives to develop their capacities contributes to their school patterns [79]. As a result, the contribution of SLE, which is formed by basic factors such as education level, parent education levels, experiences in nature, time and places spent with nature as childhood, and membership in NGOs, to knowledge, attitude, and ESDP has emerged very clearly. Teachers with SLEs know more about SD. The attitudes of teachers with extensive knowledge are also higher. A higher attitude means more ESDP. In many qualitative studies conducted in this area, it has been reported that SLEs of individuals support environmentally friendly behaviors [41,43,46,48,80]. However, unlike qualitative studies, the lack of quantitative studies and the lack of studies conducted with science teachers in particular highlight the importance of the findings of this study. At this point, it is evident that there is a need for new studies to reveal these relationships' effects on children in the long term. For further studies resulting from these findings, it would be interesting to repeat or redesign this study by collecting qualitative data, for example, through interviews and classroom observations. In this way, the study results may be enriched and may have the opportunity to examine more deeply.

On the other hand, schools' environments were examined and analyzed within a narrow framework. More research is needed to expand this framework or add different variables for the school level. Teachers are also affected by the school administrative structure. According to Fullan [81], norms, values, and structures significantly influence how teachers teach individually. For this reason, it is vital to consider the ESD approach as a part of school culture. It is valuable in this respect to examine school variables in detail.

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