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Examining the Design of an Environmental Protection Attitude Training Model in Schools (Case Study: Tehran City's Education System)

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A B S T R A C T

The present study was conducted with the aim of providing a model for training environmental protection attitudes in schools. This research is developmental-applied in terms of its objective and a cross-sectional survey in terms of methodology. Given the research implementation method, the statistical population of this study included all public school teachers in Tehran (42,248 individuals). To determine the sample size, 250 individuals were selected as the sample. The data analysis method involved a validated questionnaire, which was distributed, and quantitative data were collected. For quantitative data analysis in this study, confirmatory factor analysis was used to test the model. The obtained results led to the categorization of factors influencing the training of environmental attitudes into the components of attitude, insight, behavior, and skills, as well as internal and external dimensions.

Keywords: *environment, education, students, environmental protection.*

1. Introduction

In today's world, the environment has become an extremely important and vital issue, receiving widespread attention from individuals and various groups across the globe. Environmental concerns are not only effective in preserving natural resources and maintaining ecosystem balance but also have significant positive impacts on human society (Afifah, 2024; Bezi et al., 2024). Environmental conditions, including air, water, and soil quality, directly affect human health. Air and water pollution, along with chemical contaminants, can lead to various diseases, including respiratory disorders, cardiovascular diseases, and cancer, and serve as a major cause of mortality. Our environment is rapidly changing, and we must be prepared to address these changes. One of the most effective ways to achieve this is by educating students

about environmental protection attitudes in schools (Barkhordari & Jamshidian, 2018; Faraji & Larijani, 2016).

Given the importance of environmental education in promoting public health, environmental education appears essential, as it encourages sustainable attitudes, reduces pollution, protects biodiversity, and fosters sustainable development. Additionally, integrating environmental concepts into educational curricula can ultimately lead to the development of a generation that upholds human and environmental values in a balanced manner (Negev et al., 2018).

According to most scholars, education serves as a strategic institution that plays a crucial role in societal growth, development, and transformation (Grecmanova et al., 2022; Safarzadeh & Naeimi, 2020). The continuous and ongoing changes resulting from rapid developments in the third millennium have introduced new and emerging challenges to the education system, redefining its missions and responsibilities. Consequently, in recent years, educational organizations, particularly in advanced societies, have undergone significant transformations in parallel with the growth of organizational research (Safarzadeh & Naeimi, 2020). In this context, focusing on environmental protection education in schools is an undeniable and unavoidable necessity, as schools play a unique role in environmental conservation. They help students become responsible environmental stewards, ensuring the preservation of natural resources for themselves and future generations (O'Brien, 2012).

Education, as a key instrument, can familiarize individuals with ecological concepts and environmental science, encouraging them to recognize and prevent environmental and health-related issues. In other words, environmental education helps individuals value not only their environment but also their own health. Thus, raising awareness and promoting environmental education can empower organizations and societies at large to play a more effective role in environmental preservation and public health improvement (Grecmanova et al., 2022).

Teaching environmental protection attitudes in schools can play a critical role in environmental conservation. Research indicates that environmental education positively influences students' environmental attitudes, awareness, and behaviors toward environmental protection (Mehraban, 2017; Shabiri, 2022). Moreover, integrating electrochemical concepts into chemistry textbooks has been shown to enhance environmental quality (Azadkhani et al., 2018).

In recent decades, extensive advancements in science and technology, coupled with industrial development and climate change, have resulted in a complex and rapidly evolving world. Global population growth, unsustainable resource consumption, and increased waste production are serious contributors to environmental degradation. These transformations have led to a global ecological crisis that not only threatens numerous species with extinction but also endangers human health. In this context, education plays a pivotal role in familiarizing individuals with the significance of environmental conservation and preventing ecological harm (Badrian & Kiamanesh, 2008).

Since environmental protection education in schools leads to increased awareness, the prevention of negative and high-risk behaviors, and the cultivation of positive attitudes (Azadkhani et al., 2018; Badrian & Kiamanesh, 2008; Barkhordari & Jamshidian, 2018; Faraji & Larijani, 2016; Mehraban, 2017; Safarzadeh & Naeimi, 2020; Seyyed Hossein Beigi et al., 2017; Shabiri, 2022), environmental attitude education in schools is of paramount importance. This educational approach can contribute to shaping a more sustainable future. Given this significance, the present study aims to propose a comprehensive and effective model for teaching environmental protection attitudes in schools. This model considers potential challenges and obstacles, such as curriculum limitations and the need for teacher training. Additionally, to provide a well-rounded perspective, real-world examples of schools and educational systems that have successfully implemented environmental education programs will be examined.

2. Methods and Materials

This study is developmental-applied in terms of its objective and employs a cross-sectional survey design. The statistical population consists of all public school teachers in Tehran (42,248 individuals), categorized by district. The sample size is determined using Cochran’s formula, and a multi-stage cluster sampling method is employed. Initially, a researcher-developed questionnaire is administered as a pilot study to ensure validity and reliability. Subsequently, the finalized questionnaire is distributed among selected teachers for data collection. In the final stage, a validated questionnaire is disseminated, and quantitative data are gathered. For quantitative data analysis in this study, confirmatory factor analysis is used to test the proposed model.

3. Findings and Results

In the present study, to identify and confirm the measurement factors, the validity of the questionnaire was tested separately for each dimension using confirmatory factor analysis, and the results are reported below.

In confirmatory factor analysis, the researcher aims to develop a model that is assumed to describe, explain, or justify empirical data based on a relatively small number of parameters. This model is based on prior empirical knowledge about the data structure. The key distinction between exploratory and confirmatory factor analysis methods lies in their approach: exploratory factor analysis identifies the most efficient way to explain the underlying common variance of a correlation matrix, whereas confirmatory methods (hypothesis testing) determine whether the data align with a specified factor structure (as hypothesized). In this study, confirmatory factor analysis was used to assess whether the identified indicators in the qualitative phase align with a coherent factor structure.

For confirmatory factor analysis, the opinions of 175 managers and experts with at least a master's degree and experience in developing educational standards for training programs, as well as instructors with experience in both implementation and curriculum development, were considered. The questionnaire was distributed to address the question of whether the identified dimensions and components align with a coherent factor structure within the proposed model.

In general, several goodness-of-fit indices are used to evaluate confirmatory factor analysis models. In this study, chi-square (χ^2), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), and root mean square error of approximation (RMSEA) were employed.

When the sample size ranges between 75 and 200, the chi-square statistic is an appropriate goodness-of-fit index. However, for models with larger samples, the chi-square value is almost always statistically significant. In such cases, the degrees of freedom serve as a measure for assessing the magnitude of chi-square. Although there is no fixed criterion for an acceptable model fit, chi-square values smaller than two are typically considered an acceptable fit. Nevertheless, researchers such as Marsh, Balla, and McDonald (1988) have accepted values up to five times the degrees of freedom as an indicator of goodness-of-fit. The values of the goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) range between 0 and 1, where values closer to 1 indicate better model fit. In contrast, the root mean square error of approximation (RMSEA) should be as low as possible, with values below 0.05 indicating an excellent fit, values up to 0.08 suggesting an adequate fit, and values of 0.10 or higher indicating a poor fit. Based on these criteria, each dimension and its components were analyzed using confirmatory factor analysis.

The internal dimension consists of two components: knowledge and attitude. To analyze the questionnaire structure and identify the factors composing each dimension, factor loadings were used. The results of the first- and second-order factor loadings for the internal dimension are summarized in the following table. All factor loadings exceeded 0.50, and the computed t-values for each factor loading were above 1.96. Consequently, the alignment of questionnaire items with the intended measurement concepts was confirmed as valid at this stage. The results indicate that the questionnaire successfully measured the intended constructs. Furthermore, indicators with higher factor loadings hold greater importance relative to other indicators.

Table 1

Factor Loadings and t-Values for the Internal Dimension

Component	Indicator	First-Order Factor Loading (λ)	t-value (First-Order)	Second-Order Factor Loading (λ)	t-value (Second-Order)
Knowledge	Environmental Awareness Development	0.70	11.36	0.95	8.66
	Teaching Awareness of Human's Role in the Environment	0.65	8.95	-	-
	Teaching Commitment to Environmental Ethics	0.70	8.96	-	-
	Integrating Environmental Ethics and Spirituality into Course Content	0.64	8.64	-	-
	Awareness of Environmental Aesthetics in Courses	0.90	9.48	-	-
	Considering Students' Motivation and Interests in Environmental Issues	0.74	9.22	-	-
	Generalizing Environmental Awareness and Knowledge among Students	0.70	9.24	-	-
	Cognitive Awareness of Environmental Issues	0.79	9.43	-	-
	Behavioral Awareness of Environmental Issues	0.76	9.31	-	-

	Practical Awareness of Environmental Issues	0.86	10.25	-	-
	Technological Awareness of Environmental Issues	0.91	18.21	-	-
	Nature Recognition	0.88	13.32	-	-
	Nature-Based Courses	0.88	13.90	-	-
	Multimedia Awareness in Environmental Issues	0.75	9.12	-	-
	Awareness of Environmental Crises	0.74	8.88	-	-
	Considering Naturalistic Intelligence in Student Assessments	0.71	8.78	-	-
	Awareness of Human's Role in Environmental Protection	0.88	13.71	-	-
	Raising Community Awareness	0.68	9.66	-	-
	Identifying and Addressing Environmental Damages and Issues	0.65	8.65	-	-
	Changing Social Attitudes Towards Environmental Destruction	0.62	8.13	-	-
	Basic Environmental Knowledge Training	0.75	9.15	-	-
	Basic Environmental Awareness Training	0.65	8.64	-	-
	Providing Environmental Knowledge Information	0.55	4.87	-	-
	Having a Human Responsibility Toward Nature Conservation	0.63	8.45	-	-
	Internalizing Environmental Conservation	0.58	3.98	-	-
	Parental Environmental Education Alongside Students	0.74	8.65	-	-
	Using Innovative Teaching Methods	0.73	-35.11	-	-
	Encouraging Students' Interest in the Environment	0.91	18.21	-	-
	Revising the Content of Textbooks	0.88	13.32	-	-
	Providing Scientific and Informational Resources	0.75	13.90	-	-
	Awareness of Surrounding Environmental Conditions	0.71	10.57	-	-
	Awareness of the Human Environment	0.68	10.11	-	-
	Awareness of the Natural Environment	0.59	9.15	-	-
	Explaining Ecosystems	0.84	14.73	-	-
	Awareness of Both Natural and Human Environments	0.86	15.34	-	-
	Teaching About Recycling and Waste Management	0.77	10.28	-	-
	Teaching Life Skills Without Harming Nature	0.96	-52.13	-	-
	Awareness of Practical Skills, Decision-Making, and Civic and Personal Responsibility in Environmental Issues	0.97	21.30	-	-
	Environmental Education Through Direct Interaction with the Environment	0.97	21.16	-	-
	Raising Awareness About the Surrounding Environment	0.92	20.79	-	-
	Preserving and Conserving Different Energy Types	0.96	21.64	-	-
	Teaching the Importance of Plants	0.81	18.66	-	-
	Familiarity with Different Ecosystem Types	0.67	9.87	-	-
	Incorporating Nature's Values into Individuals' Lives	0.86	17.45	-	-
Attitude	Understanding Natural Systems	0.93	15.99	0.81	12.73
	Developing Sensitivity Toward Environmental Issues	0.84	15.34	-	-
	Considering Nature from Spiritual and Religious Perspectives	0.74	12.55	-	-
	Understanding the Impact of Knowledge Expansion on Nature	0.82	16.78	-	-
	Understanding the Impact of Technological Development on Nature	0.85	14.97	-	-
	Using Participatory Methods to Develop Environmental Skills	0.66	9.12	-	-
	Linking New Knowledge with Previous Environmental Information	0.90	15.93	-	-
	Attitude Towards Environmental Crises	0.93	15.99	-	-
	Developing Ethical Intelligence in Environmental Contexts	0.84	15.34	-	-
	Developing Spiritual Intelligence in Environmental Contexts	0.74	12.55	-	-

Table 1 presents the results of the first- and second-order factor loadings and t-values for the internal dimension, which includes knowledge and attitude components. The results confirm that all factor loadings exceed 0.50, and the computed t-values are above 1.96, indicating that the questionnaire effectively measures the intended constructs.

One type of relationship among latent variables in structural equation modeling is based on correlation (congruence). Correlation represents a relationship between two variables in a model, but it is non-directional, and its nature is assessed using correlation analysis. Table 4-7 presents Pearson correlation coefficients for evaluating the relationships between latent variables in pairs. The main diagonal of this matrix contains the value of one, indicating that each variable has a perfect correlation with itself. All correlation coefficients are statistically significant at the 99% confidence level. The higher the correlation coefficient, the stronger the relationship between the two variables.

In addition to examining correlation coefficients, the table below also assesses discriminant validity. Discriminant validity means that each indicator should only measure the intended construct, and their combination should ensure that all dimensions are well-distinguished from one another. According to this criterion, the variance of each latent variable must be higher for its related indicators than for other indicators. To determine this, the square root of the Average Variance Extracted (AVE) for each latent variable is first calculated and then compared with the correlation values of that latent variable with other latent variables. The square root of the AVE must be greater than the correlation coefficients. This process must be conducted for all latent variables. The results of the Fornell and Larcker validity test are presented in the table below. The last column in this table shows the square root of the Average Variance Extracted (AVE). Discriminant validity is confirmed when the square root of the AVE is greater than all correlation coefficients of the respective variable with the other variables. As shown in the table, the square root of the AVE for all variables is greater than the correlations of those variables with others.

To measure convergent validity, the Average Variance Extracted (AVE) was used. The AVE provides a measure of convergence among a set of observed items within a construct and represents the percentage of variance explained among the items. This extracted variance should be greater than 0.50 for convergent validity to be confirmed. Convergent validity means that the indicators of each dimension are ultimately capable of explaining at least half of their variance. Using the Average Variance Extracted (AVE) index, it was found that all studied dimensions have an AVE greater than 0.50.

Cronbach's alpha was used to assess the reliability of the questionnaire. All Cronbach's alpha coefficients exceed 0.70, indicating that the measurement instrument is reliable. All correlation coefficients are statistically significant at a significance level of less than 0.01.

Table 2

Pearson Correlation Coefficients and Validity and Reliability Indices of the Internal Dimension Model

Latent Variables	(1)	(2)	AVE	CR	Cronbach's Alpha
Knowledge	1	0.74	0.844	0.714	0.957
Attitude	0.74	1	0.857	0.735	0.953

The external dimension consists of two subscales: behavior and skills. To analyze the questionnaire structure and identify the factors constituting each dimension, factor loadings were used. The results of the first- and second-order factor loadings of the comprehensive needs assessment model are summarized in Table 2.

All factor loadings exceed 0.50, and the computed t-values for each factor loading are above 1.96. Therefore, it can be confirmed that the questionnaire items align with the intended measurement constructs at this stage. The results indicate that the instrument successfully measures the concepts that the researcher intended to assess through the questionnaire items. Indicators with higher factor loadings hold greater importance compared to other indicators.

Table 3

Results of First- and Second-Order Factor Loadings and t-Values for the External Dimension

Component	Indicator	First-Order Factor Loading (λ)	t-value (First-Order)	Second-Order Factor Loading (λ)	t-value (Second-Order)

Behavior	Active participation in solving environmental issues	0.93	-	0.72	10.75
	Active skills in solving environmental issues	0.94	21.47	-	-
	Responsible skills in solving environmental issues	0.97	20.58	-	-
	Practical skills in solving environmental issues	0.93	20.97	-	-
	Follow-up on environmental issues	0.91	21.17	-	-
	Teaching environmentally friendly behavior	0.83	10.81	-	-
	Emphasis on learning-oriented and active tasks	0.80	10.29	-	-
	Creating opportunities for examining different perspectives	0.79	8.76	-	-
	Teaching the proper way to interact with the environment	0.69	6.77	-	-
	Teaching not to pollute the environment	0.89	16.89	-	-
	Acquiring practical skills in the environmental field	0.63	8.84	-	-
	Teaching social responsibility regarding the environment	0.87	-	-	-
	Promoting green behavior	0.94	19.44	-	-
	Knowledge and correct understanding of biological systems and processes	0.95	20.19	-	-
	Ability to design classroom and school-based environmental projects	0.97	20.15	-	-
	Developing the skill to simultaneously consider various environmental issues	0.91	18.22	-	-
	Acquiring knowledge about the environment	0.85	-	-	-
	Integrating practical and theoretical environmental education	0.90	20.43	-	-
	Providing proper groundwork for generating questions about the environment	0.97	22.22	-	-
	Providing proper groundwork for fostering curiosity about the environment	0.87	21.32	-	-
	Developing the ability to critically analyze environmental issues	0.94	19.44	-	-
	Integrating theoretical and practical environmental knowledge	0.81	18.02	-	-
	Utilizing modern technologies in the environmental field	0.70	12.77	-	-
	Providing educational facilities and equipment	0.77	14.09	-	-
	Teaching environmental behaviors	0.85	18.34	-	-
	Being in nature and understanding environmental concepts	0.92	20.41	-	-
	Engaging in nature tourism and outdoor activities	0.85	18.12	-	-
Skill	Increasing environmental responsibility	0.65	8.67	0.48	7.57
	Changing environmental habits	0.72	11.31	-	-
	Guiding social and environmental behavior	0.68	9.12	-	-
	Adhering to environmental standards	0.78	16.17	-	-
	Adopting a new approach in teaching methods	0.65	8.86	-	-
	Teaching environmental education outside the classroom	0.89	-	-	-
	Adopting new approaches in education	0.97	20.10	-	-
	Providing appropriate educational facilities and equipment	0.88	19.51	-	-
	Providing scientific and informational resources	0.89	18.42	-	-
	Allocating sufficient budget for environmental education	0.77	13.22	-	-
	Conducting in-service environmental education programs for teachers	0.86	19.88	-	-
	Training specialized teachers in environmental education	0.96	18.13	-	-
	Providing educational aids and resources	0.95	18.14	-	-
	Revising the content of textbooks	0.78	12.44	-	-
	Teaching about animals and plants	0.66	7.51	-	-
	Explaining the consequences of human behavior on the environment	0.84	15.34	-	-
	Teaching skills for proper use of nature	0.74	12.55	-	-

Developing student activities and actions toward environmental protection	0.82	16.78	-	-
Being in nature and learning various social and environmental skills from nature	0.85	14.97	-	-
Developing habits and skills related to the environment	0.66	9.12	-	-
Creating the ability to identify and analyze environmental topics and behaviors	0.90	15.93	-	-
Developing a sense of responsibility toward the environment	0.97	21.30	-	-
Learning life skills without causing harm or destruction to the environment	0.97	21.16	-	-
Developing proper decision-making skills when facing environmental issues	0.92	20.79	-	-
Taking action for environmental protection	0.96	21.64	-	-
Using educational tools such as films	0.81	18.66	-	-
Creating environmentally friendly crafts	0.67	9.87	-	-
Conducting environmental experiments	0.86	17.45	-	-
Implementing environmental projects	0.82	17.88	-	-
Conducting environmental laboratory experiments	0.76	10.21	-	-

All correlation coefficients are statistically significant at a significance level of less than 0.01.

Based on the results presented in the above tables, during the axial coding phase, four components were identified as the underlying components: Knowledge, Attitude, Behavior, and Skill.

Table 4

Pearson Correlation Coefficients and Validity and Reliability Indices of the Comprehensive Needs Assessment Model

Latent Variables	(1)	(2)	AVE	CR	Cronbach's Alpha
Behavior	1	0.35	0.936	0.876	0.986
Skill	0.35	1	0.933	0.871	0.981

4. Discussion and Conclusion

The objective of this study was to propose a model for teaching environmental protection attitudes in schools. Environmental education, as a lifelong process, plays an undeniable role in addressing environmental issues, particularly when a significant part of it takes place within the school environment. Therefore, examining environmental education and its impact on environmental conservation is of great importance. Increasing public awareness through environmental education, especially in developing countries, is considered a crucial and effective solution to halt the rapid destruction of the environment and natural ecosystems. If every individual in society becomes aware of the necessity of protecting the environment, significant steps can be taken toward sustainable development. This is because any planning aimed at addressing environmental challenges cannot succeed without the involvement of individuals and social elements, or in other words, without citizen participation.

For this reason, in recent decades, researchers have focused on how humans interact and behave with nature. The emphasis on environmental issues in the context of sustainable development stems from two main factors: first, in recent years, the quality of the environment has deteriorated due to human activities; and second, combating environmental degradation and the depletion of natural resources can only be achieved through the implementation of long-term environmental policies. In formulating environmental policies, public participation and awareness of environmental issues are of paramount importance.

Generally, developing and expanding environmental knowledge and awareness is considered an effective strategy for overcoming environmental challenges and achieving sustainable environmental development. The goal here is to advance sustainable development objectives by training human resources and fostering a positive environmental attitude.

The findings of this study align with previous research. For instance, Faraji and Larijani (2016) demonstrated that

environmental education significantly improves students' general environmental knowledge and civic behavior, enhancing their awareness of their surrounding environment (Faraji & Larijani, 2016). Seyed Hossein Beigi et al. (2017) found that although progress has been made in integrating environmental issues into school curricula, it is still insufficient to ensure full environmental protection in Iran. They emphasized the need for increased environmental education at the elementary level and recommended in-service training programs to enhance teachers' environmental knowledge and attitudes (Seyyed Hossein Beigi et al., 2017).

Mehraban (2017) identified five key aspects of environmental education: (1) raising awareness and sensitivity toward environmental issues, (2) enhancing knowledge and understanding of the environment, (3) encouraging concern for environmental issues and motivating students to preserve environmental quality, (4) developing skills to identify and address environmental challenges, and (5) encouraging student participation in activities related to environmental problem-solving (Mehraban, 2017).

Shabiri et al. (2013) found that outdoor education has a significant impact on students' environmental behavior, with the effect being more pronounced among female students (Shabiri, 2022). Similarly, Salehi and Ghaemi Asl (2013) reported that students' general awareness of environmental issues and problems was relatively high, while their knowledge of specific environmental problems was lower. Their study also indicated that men constituted the majority of individuals with high environmental awareness. Nearly half of the respondents held a bachelor's degree, and environmental awareness levels increased with higher educational attainment (Salehi & Ghaemi Asl, 2013).

Researchers have also identified contextual factors such as financial costs, incentives, access to technology, individual capabilities (such as specialized environmental knowledge and skills), and personal habits as key determinants in shaping pro-environmental behaviors. To foster positive environmental behaviors, these factors must be addressed and adjusted.

Thus, to gain a deeper understanding of environmental behaviors, it is necessary to examine the interplay of attitudes, situational factors, individual capabilities, and habits. According to Rational Choice Theory, individuals prioritize their self-interest when engaging in environmental activities. The way people perceive the environment is rooted in their value system, meaning that their attitudes toward environmental issues are shaped by the values they assign to themselves, others, or other living beings, including plants and animals.

For effective environmental education at this educational stage, special attention must be given to students' cognitive, emotional, and psychological needs. By fostering motivation and interest in environmental issues, students can be encouraged to engage in environmental protection activities, ultimately contributing to the achievement of environmental conservation goals.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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