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The Structural Equation Model of Educational Sustainable Development (Case Study: East Hormozgan Province Education System)

Yousef. Abdollahi¹, Mahmoud. Sabahizadeh^{2*}, Kolsum. Nami²

¹ PhD student, Department of Educational Management, Bandar Abbas Branch, Islamic Azad University, Bandar Abbas, Iran.

² Assistant Professor, Department of Educational Sciences, Bandar Abbas Branch, Islamic Azad University, Bandar Abbas, Iran.

* Corresponding author email address: mahmoudsabahi@yahoo.com

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ABSTRACT

Purpose: The objective of this study is to examine and model the structural equations of educational sustainable development within the education system of East Hormozgan Province. The study aims to identify key factors and relationships that contribute to the effective integration of sustainable development principles in education, based on a theoretical framework derived from existing literature.

Methodology: This applied research employs a survey method, targeting all secondary school managers and teachers in East Hormozgan Province, totaling 7,444 individuals. Using stratified random sampling, a sample size of 365 participants was determined through Cochran's formula. Data were collected using a questionnaire based on the theoretical framework and analyzed using SPSS 27 and LISREL 8.80 software. The study employed exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to validate the proposed model and assess the fit of the data.

Findings: The analysis revealed that all dimensions, including central phenomenon, causal factors, strategies, contextual factors, intervening factors, and outcomes, were effectively represented in the educational sustainable development model. High factor loadings and significant path coefficients indicated strong relationships between the variables. The findings also highlighted the critical role of economic, social, and environmental education in fostering sustainable development. The model demonstrated good fit indices, confirming its robustness and applicability for evaluating ESD initiatives.

Conclusion: The study confirms the importance of integrating sustainable development principles into the educational framework of East Hormozgan Province. The validated model provides a comprehensive approach to assessing and implementing ESD, emphasizing the need for holistic educational strategies and continuous professional development for educators. These findings offer valuable insights for policymakers and practitioners aiming to promote sustainable development through education.

Keywords: Education, Educational System, Sustainable Development, Educational Sustainable Development, Hormozgan.

1. Introduction

The concept of education for sustainable development (ESD) is rooted in the broader framework of sustainable development, which seeks to balance economic, social, and environmental dimensions to ensure the well-being of current and future generations (Golabchi et al., 2024; Lampā et al., 2013; Liu et al., 2016; Lok et al., 2021; Miri Rami et al., 2022; Sadat Mousavi & Ebrahimi, 2024). According to Dewhurst and Pendergast (2011), ESD aims to promote critical thinking, problem-solving, and participatory learning approaches that empower individuals to make informed decisions and take responsible actions for environmental integrity, economic viability, and a just society for present and future generations (Dewhurst & Pendergast, 2011).

Dima and Meghisan-Toma (2018) argue that implementing ESD requires a comprehensive understanding of the local context, as well as effective strategies for integrating sustainable development principles into the curriculum (Dima & Meghisan-Toma, 2018). Their research on implementing ESD highlights the importance of aligning educational policies and practices with sustainable development goals (SDGs), and emphasizes the role of teachers in facilitating this integration. Similarly, Drăghici (2019) emphasizes the transformative potential of ESD in shaping learners' attitudes and behaviors towards sustainability, advocating for educational reforms that prioritize sustainability across all levels of education (Drăghici, 2019).

The resilience of educational systems is another critical factor in achieving sustainable development. Dzyatkovskaya (2019) explores the concept of resilience in the context of ESD, highlighting the need for educational frameworks that can adapt to changing environmental, social, and economic conditions. This adaptability is essential for ensuring the continuity and effectiveness of ESD initiatives in the face of various challenges (Dzyatkovskaya, 2019).

In the context of higher education, Gulnasin (2023) discusses the role of information and communication technology (ICT) in promoting ESD, particularly in India. The National Education Policy (NEP) 2020 in India recognizes the importance of integrating ICT into education to enhance learning outcomes and promote sustainable development. The use of ICT in higher education can facilitate the dissemination of knowledge, promote collaborative learning, and support the development of critical skills necessary for sustainable development (Gulnasin, 2023).

Isac et al. (2022) highlight the significance of teacher co-learning in enhancing professional action competence in ESD. Their study demonstrates that collaborative learning among teachers can lead to improved understanding and implementation of ESD principles in the classroom. This underscores the importance of professional development programs that foster collaboration and knowledge exchange among educators (Isac et al., 2022).

Karpan et al. (2020) present the conceptual principles of ESD, emphasizing the need for a holistic approach that integrates cognitive, affective, and behavioral dimensions of learning. Their research advocates for educational frameworks that promote interdisciplinary learning, critical thinking, and active participation in sustainable development initiatives. The conceptual principles outlined by Karpan et al. provide a foundation for designing and implementing effective ESD programs (Karpan et al., 2020).

Krayenkova (2023) discusses the formation of a sustainable education system for the young generation in the Republic of Belarus. The practical implementation of ESD in Belarus highlights the necessity of aligning educational policies with national sustainable development strategies. Krayenkova's research provides valuable insights into the challenges and opportunities associated with the systemic integration of ESD into national education systems (Krayenkova, 2023).

Molokova (2021) explores the role of higher education as a tool for sustainable development, emphasizing the importance of curricular transformation and the creation of sustainable campuses. Higher education institutions (HEIs) have a unique responsibility to lead by example in promoting sustainability through their teaching, research, and operational practices. The development of sustainable campuses can serve as a model for other institutions and communities (Molokova, 2021).

Salleh et al. (2019) identify critical success factors, benefits, and challenges associated with the development of higher education for sustainable development (HESD) models. Their research highlights the importance of institutional commitment, stakeholder engagement, and continuous assessment in achieving successful HESD implementation. The benefits of HESD include enhanced student learning outcomes, increased environmental awareness, and improved institutional reputation (Salleh et al., 2019).

Berchin et al. (2021) provide a comprehensive literature review on how HEIs promote sustainable development. Their findings indicate that HEIs play a pivotal role in

advancing sustainability through various strategies, including curriculum development, research initiatives, and community engagement. The review underscores the need for an integrated approach that encompasses all aspects of institutional operations (Berchin et al., 2021).

Berchin et al. (2017) further elaborate on strategies to promote sustainability in HEIs, emphasizing the importance of leadership, governance, and collaboration. Effective leadership and governance structures are essential for creating a supportive environment for sustainability initiatives. Collaboration with external partners, including industry and government, can also enhance the impact of sustainability efforts (Berchin et al., 2017).

Hallinger and Nguyen (2020) conduct a bibliometric review to map the landscape and structure of research on ESD. Their review identifies key trends, themes, and gaps in the ESD literature, providing a valuable resource for researchers and practitioners. The findings highlight the growing interest in ESD and the need for more research on effective implementation strategies (Hallinger & Nguyen, 2020).

Machado and Davim (2023) explore the role of sustainability in the modernization of higher education, focusing on curricular transformation and the development of sustainable campuses. Their literature review highlights the importance of integrating sustainability into the curriculum and creating learning environments that support sustainable practices. The modernization of higher education institutions is essential for preparing students to address global sustainability challenges (Machado & Davim, 2023).

Sharma et al. (2020) provide a systematic review on sustainable entrepreneurship education (SEE), proposing a framework for integrating sustainability into entrepreneurship education. Their analysis highlights the potential of SEE to foster innovative and responsible business practices that contribute to sustainable development. The framework emphasizes the importance of experiential learning, interdisciplinary approaches, and the development of entrepreneurial competencies (Sharma et al., 2020).

In summary, the integration of sustainable development principles into education systems is critical for fostering a culture of sustainability. This study aims to contribute to the growing body of knowledge on ESD by investigating the structural equations of educational sustainable development in the education system of East Hormozgan Province. The findings of this research will provide valuable insights for policymakers, educators, and researchers on effective

strategies for implementing ESD and promoting sustainable development at the local level. By aligning educational practices with sustainable development goals, we can create a more sustainable and equitable future for all.

2. Methods and Materials

This research is applied in nature and conducted using a survey method. The statistical population consisted of all secondary school principals and teachers in East Hormozgan Province (7,444 individuals). A stratified random sampling method was used. The sample size was determined to be 365 individuals using Cochran's formula. The research tool was a questionnaire based on a theoretical framework derived from the literature review. For face validity, the questionnaire was reviewed by a focus group (supervisor and advisor), and structural issues were corrected. For content validity, the questionnaire was reviewed by five experts in sustainable development and education, and their suggestions were incorporated. Construct validity (model) was assessed using factor analysis. Cronbach's alpha and composite reliability were used to determine the questionnaire's reliability. Since all dimensions had a Cronbach's alpha greater than 0.7, the questionnaire was deemed reliable. In the present study, exploratory factor analysis was used to identify the model governing educational sustainable development in the education system of East Hormozgan Province based on the theoretical framework. Confirmatory factor analysis was used for model fit and validation.

3. Findings and Results

The number of female respondents (191) was higher than that of male respondents (174). Among the principals, those from secondary schools had the highest number (13), and among the teachers, secondary school teachers were the majority (222). The most common work experience was between 10 to 20 years (179), and the least common was less than 10 years (31). The highest frequency of respondents' age was between 20 to 29 years (142), and the lowest frequency was 50 years and older (50). Among the respondents, those with a bachelor's degree were the majority (211), and those with a doctoral degree were the least (13).

Before performing exploratory factor analysis, the KMO index was determined, and Bartlett's test was conducted. Since the KMO index for the research dimensions significantly differed from 0.6, and the significance level of

Bartlett's test was less than 0.05, the data were suitable for factor analysis. The results of the exploratory factor analysis are presented below.

Table 1

Exploratory Factor Analysis of the Model Derived from the Theoretical Framework

Dimension	Index/Factor	1	2	3	4	5	6
Central Phenomenon	Education for Cultural Development	0.71					
	Education for Economic Development	0.95					
	Education for Social Development	0.90					
	Education for Environmental Development	0.85					
Causal Factors	Need for Sustainable Educational Development		0.96				
	Sustainable Education			0.87			
	Developmental Education			0.80			
	Orientation and Policies			0.71			
	Sustainable Monitoring and Evaluation System			0.82			
Contextual Factors	Sustainable Management				0.85		
	Participants and Their Relationships				0.96		
	Organizational Characteristics				0.86		
Intervening Factors	Individual Factors					0.80	
	Structural Factors					0.75	
Outcomes	Individual Outcomes						0.80
	Socio-cultural Outcomes						0.90
	Environmental Outcomes						0.92

By applying the varimax rotation command to examine the results of the exploratory factor analysis on the model, it was shown that all dimensions and their respective components (research questions) were categorized into six factors with a factor loading of more than 0.30. Therefore, it can be claimed that all identified factors can be considered part of the educational sustainable development model.

Initially, the results of the confirmatory factor analysis for each research dimension were separately confirmed using LISREL software.

As shown in Figure 1, causal factors, intervening factors, and contextual factors were entered into the model as independent variables, and the central phenomenon, strategies, and outcomes as dependent variables. The path coefficient of each variable is specified. The path coefficient indicates how much each variable affects the other variable. Also, since the absolute value of the t-statistic in all paths is greater than 1.96, the coefficient of that path is significant at the 0.05 error level.

Figure 1

Model with Standard Coefficients

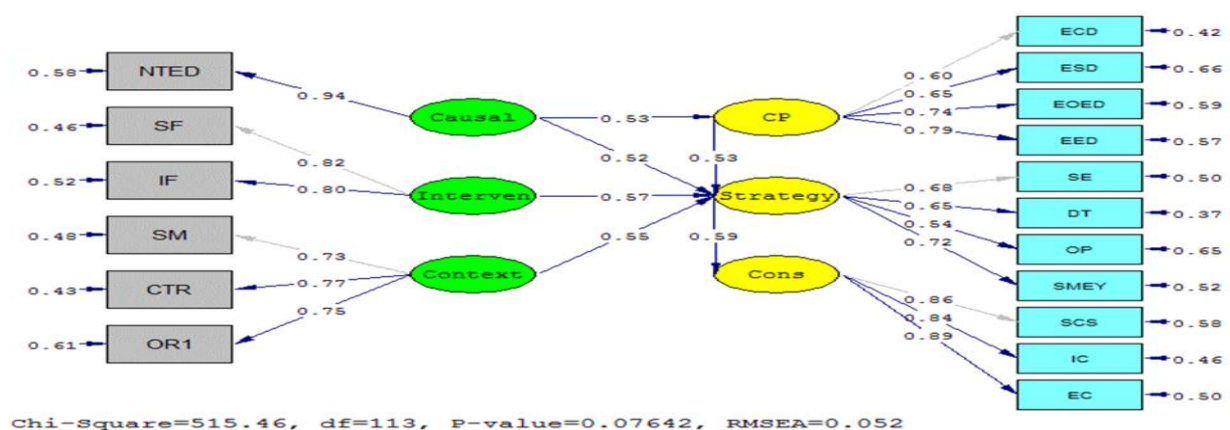


Table 2*Model Fit Indices*

Fit Index	χ^2/df	RMSEA	GFI	AGFI	NFI	NNFI	CFI
Desired Range	< 3	< 0.1	> 0.9	> 0.9	> 0.9	> 0.9	> 0.9
Results	2.42	0.052	0.95	0.93	0.92	0.92	0.96

The values of the fit indices listed in [Table 2](#) are within the desired range, indicating a good model fit, and the research model is confirmed. As previously mentioned, the relationships between variables are significant at the 95% confidence level. For model validation, the validity and

reliability of the instrument (questionnaire) were examined. For reliability, Cronbach's alpha and composite reliability tests were used, and for convergent validity, AVE and CR (composite reliability) were examined, as presented in [Table 10](#).

Table 3*Validity and Reliability of the Research Model*

Dimension	Cronbach's Alpha	CR	AVE
Central Phenomenon	0.87	0.95	0.66
Causal Factors	0.78	0.97	0.95
Strategies	0.85	0.92	0.84
Contextual Factors	0.88	0.93	0.86
Intervening Factors	0.82	0.90	0.68
Outcomes	0.85	0.88	0.84

[Table 3](#) shows that all conditions are met for all dimensions; therefore, the model has convergent validity. Additionally, Cronbach's alpha and composite reliability for all dimensions are greater than 0.7, ensuring the model's reliability.

4. Discussion and Conclusion

The findings of this study underscore the significance of integrating sustainable development principles into the educational framework of East Hormozgan Province. The structural equation modeling revealed that all dimensions, including the central phenomenon, causal factors, strategies, contextual factors, intervening factors, and outcomes, were effectively captured within the educational sustainable development model. These results align with the broader literature, emphasizing the critical role of education in fostering sustainable development ([Dewhurst & Pendergast, 2011](#); [Dima & Meghisan-Toma, 2018](#)).

The high factor loadings for the central phenomenon, particularly the aspects of education for cultural, economic, social, and environmental development, highlight the multifaceted nature of ESD. This finding is consistent with [Dewhurst and Pendergast \(2011\)](#), who noted that sustainable development education requires a holistic approach that addresses various dimensions of human development ([Dewhurst & Pendergast, 2011](#)). The strong emphasis on

economic and social development within the educational framework also mirrors findings by [Drăghici \(2019\)](#), who emphasized the importance of integrating economic sustainability into educational curricula to prepare students for the complexities of global economic systems ([Drăghici, 2019](#)).

Causal factors, notably the need for sustainable educational development, were found to be significant, corroborating the arguments presented by [Dzyatkovskaya \(2019\)](#) about the necessity of resilient educational frameworks ([Dzyatkovskaya, 2019](#)). The need for sustainable development in education systems is further echoed by [Isac et al. \(2022\)](#), who stressed the importance of teacher co-learning and continuous professional development to enhance teachers' competencies in ESD ([Isac et al., 2022](#)).

Strategies identified in this study, including sustainable education and developmental education, resonate with the strategies discussed by [Berchin et al. \(2017\)](#), who highlighted the role of higher education institutions in promoting sustainability through curriculum development and strategic initiatives ([Berchin et al., 2017](#)). The emphasis on sustainable monitoring and evaluation systems within this study's framework also aligns with the findings of [Salleh et al. \(2019\)](#), who pointed out the critical success factors in developing higher education for sustainable development

models, such as continuous assessment and stakeholder engagement (Salleh et al., 2019).

Contextual factors, such as sustainable management and organizational characteristics, were found to be essential for the successful implementation of ESD. This is supported by Karpan et al. (2020), who emphasized the need for holistic educational frameworks that integrate cognitive, affective, and behavioral dimensions (Karpan et al., 2020). The study's findings regarding the significant role of participants and their relationships reflect Kravenkova's (2023) observations on the necessity of aligning educational policies with national sustainable development strategies (Kravenkova, 2023).

Intervening factors, including individual and structural factors, were significant in this study, highlighting the multifaceted challenges faced in implementing ESD. These results are in line with Gulnasin (2023), who discussed the role of ICT in addressing some of these challenges in higher education in India. The application of ICT in ESD could be a potential strategy to overcome structural barriers and enhance educational outcomes (Gulnasin, 2023).

Outcomes of the study, such as individual, socio-cultural, and environmental outcomes, demonstrate the broad impact of ESD on various aspects of society. These findings align with Machado and Davim (2023), who discussed the role of sustainability in the modernization of higher education and its broader societal impacts (Machado & Davim, 2023). The positive outcomes related to individual development also resonate with Sharma et al. (2020), who highlighted the role of sustainable entrepreneurship education in fostering responsible and innovative business practices (Sharma et al., 2020).

The confirmatory factor analysis results and the satisfactory fit indices indicate that the proposed model is robust and applicable for assessing educational sustainable development. The significant path coefficients and the high t-values further validate the relationships between the model's components, suggesting that the model can effectively guide the implementation and evaluation of ESD programs in East Hormozgan Province.

Despite the comprehensive approach taken in this study, several limitations must be acknowledged. Firstly, the study's reliance on self-reported data from managers and teachers may introduce bias, as respondents might provide socially desirable answers. Secondly, the study was conducted in a specific geographical region, which may limit the generalizability of the findings to other regions or contexts. Additionally, the cross-sectional nature of the

study does not allow for the examination of changes over time or the long-term impacts of ESD initiatives. Furthermore, while the study employed robust statistical methods, the complexity of sustainable development education might require more nuanced qualitative approaches to capture deeper insights.

Future research should consider longitudinal studies to examine the long-term effects of ESD initiatives on both students and educators. Such studies could provide valuable insights into the sustainability of educational outcomes over time. Additionally, expanding the research to include multiple regions with diverse socio-economic contexts would enhance the generalizability of the findings and provide a more comprehensive understanding of ESD implementation. Researchers should also consider mixed-method approaches, combining quantitative and qualitative data, to capture the complexities and nuances of ESD in different educational settings. Furthermore, exploring the role of emerging technologies, such as ICT, in facilitating ESD could offer innovative solutions to some of the challenges identified in this study.

Based on the findings of this study, several practical recommendations can be made for policymakers, educators, and institutions. Policymakers should prioritize the integration of sustainable development principles into national and regional educational policies, ensuring that ESD is embedded across all levels of education. Training programs for educators should be developed to enhance their competencies in ESD, emphasizing collaborative learning and continuous professional development. Schools and higher education institutions should adopt comprehensive strategies that address all dimensions of sustainability, including economic, social, and environmental aspects. Implementing robust monitoring and evaluation systems will be crucial for assessing the effectiveness of ESD initiatives and making necessary adjustments. Additionally, leveraging ICT and other innovative technologies can enhance the delivery and impact of ESD programs, making them more accessible and effective.

In conclusion, the integration of sustainable development principles into the educational system of East Hormozgan Province has demonstrated significant potential in fostering a culture of sustainability. The findings of this study provide valuable insights for enhancing ESD implementation, contributing to the broader goal of achieving sustainable development at the local and national levels. By addressing the identified limitations and building on the suggestions for future research and practice, stakeholders can further

strengthen the impact of ESD and promote a more sustainable and equitable future for all.

Authors' Contributions

The first author was responsible for conducting the interview and collecting data, and the other authors were responsible for analyzing the data and writing the 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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Ethics Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the interview and participated in the research with informed consent.

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