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Designing an interpretive structural model of ecological literacy development challenges in secondary schools

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Background and Aim: As the first and most important educational institution of the country, the school plays a decisive role in teaching ecological literacy along with other organizations and educational tools. The purpose of this research was to design an interpretive structural model of the challenges of developing ecological literacy in secondary schools. **Methods:** The current research is of mixed type (qualitative and quantitative). In the first phase, a qualitative research method was conducted using thematic analysis, and in the second phase, a quantitative method was conducted based on interpretive structural modeling. The statistical community in both qualitative and quantitative sections, due to the expert-centeredness of the interpretive structural modeling approach, formed experts, which included school principals, teachers, environmental education experts, environmental education professors, and environmental elites. They were selected purposefully and until theoretical saturation was reached (22 people). Sampling method in the quantitative part, due to the expert-oriented approach of interpretive structural modeling, the experts were in the qualitative part (N=20). The measurement tool in the qualitative part was a semi-structured interview and in the quantitative part, a questionnaire. Validity and reliability of the data were confirmed. Two methods of thematic analysis (Max QDI software) and Interpretive Structural Modeling (ISM) (Excel software) were used to analyze the data. **Results:** 6 main themes of ecological literacy development challenges in secondary schools have been identified, which include human, infrastructure, economic, attitudinal, curriculum and political challenges. **Conclusion:** Human challenge and curriculum are in the independent cluster, that is, it has a great influence on other factors and other factors have little influence on it; The themes of infrastructure and curriculum are placed in the dependent cluster, that is, they are affected by other factors and have little effect on other factors; Economic and attitudinal themes are placed in the linked cluster, that is, they both influence other factors and are influenced by other factors.



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Introduction

One of the major and fundamental issues in the education of any society is the attention to the important and elevating concept of "values," and more importantly, the more difficult and complex discussion of "internalizing" values; because humans are significant, meaning the importance of values is in how they are related to humans. Beyond their material dimension, humans also have a spiritual dimension, and from this perspective, they need growth, progress, evolution, and elevation. Various factors can assist them on this path, with one of the important and effective factors being values. More important than values, as mentioned, is the "internalization" of values (Shah Sani et al., 2021). Values are agents of growth, perfection, elevation, and enable humans to achieve the ultimate goals of education and training. Also, values create internal motivation in individuals to perform activities and tasks, resulting in movement, transformation, and change in them. Given that "values" are manageable and emotionally charged, they are common among many individuals and groups, accompanied by external compulsion and used as judgment norms (Shamsi Papkiadeh, 2019).

If we adopt a systemic perspective on the issue of education and the development of beliefs, we realize that the inputs to the educational system, before entering this system, have undergone the most important initial stages, namely personality development, in the family. With entry into school, a new stage of this growth will continue. Naturally, the process of changing attitudes and behaviors in the school system is influenced by the school's human and physical environment, shaping the educational process (Estuar, 2012). Thus, without a doubt, one of the most fundamental missions of education system authorities is to govern values. In this journey, the greatest responsibility lies with the officials of the country's formal education system (Akbari Azmand et al., 2020). Today's adolescents will soon become citizens, and their decisions will not only affect their immediate environment but also the country and the world (Matos, 2022). Therefore, environmental education can initially start as formal education, creating changes in students' attitudes, knowledge, and skills related to the environment (Merit et al., 2022). The goal of environmental education is not just to have information about it but to develop attitudes and

behaviors for advancing and protecting the environment and methods to solve its problems (Van de Watering, 2022). Sears' studies indicate that there are four levels of change in individual behavior: first, an individual's knowledge must change, this change in knowledge causes a change in attitude, a change in attitude leads to a change in individual behavior, and a change in individual behavior leads to a change in group behavior. A change in an individual's attitude towards their personal knowledge requires more time. A change in attitude can affect their behavior and ultimately their group (social and organizational) behavior (Akbari Azmand, 2020).

Schools and their educational environment can be very effective in achieving the aforementioned goals. The belief that schools transfer individual values was later supported by Morowiba: Environmental learning and its dimensions, in totality, create our personal beliefs, social values, and ultimately our inclinations towards the environment and our global neighbors (Vidgren, 1998).

"Harry Sheffield" in his theory about "the relationship of education with values" states: Since education is the medium for the transfer of valuable things, the content of education can be defined as "a collection of values." Therefore, the teaching of values is always an important part of the objectives of educational systems; as these systems, as an essential part of themselves, aim to transfer the culture and values to the next generation. However, what is important in this context is how the desired values can be internalized in students in alignment with the organization's values. For the organization, accepting its core values in individuals is important and includes part of the personal values of the individuals themselves, which are placed to facilitate the organization's core values (Eisner, 2002). However, Paul et al. (2019) in their research, which aimed to identify and develop the cross-cutting results of environmental education for adolescents in the twenty-first century, determined after their studies that the promotion of environmental education in some circumstances must be under the influence of motivational issues. They pointed out that the lack of appropriate reward and motivation systems in organizations causes significant problems in environmental education. From their perspective, the harms related to rewards are among the few significant

harms concerning environmental education. Brandel et al. (2019) in their research, which aimed to evaluate the effectiveness of environmental education programming, determined after their studies that management problems have caused environmental education to not be recognized as important and fundamental needs of societies.

Considering the importance and position of schools in advancing societal literacy and its extensive target community, schools, as the first and most important educational institution in the country, play a decisive role in teaching ecological literacy alongside other organizations and educational tools. Accordingly, the teaching of ecological literacy in schools and in their educational content and curriculum must be given attention. Overall, curricula in the field of fostering value, knowledge, and ecological understanding play a decisive role (Suridi, 2018). Therefore, curricula can significantly contribute to educating citizens through schools and the curriculum for the preservation of the ecosystem. On the other hand, Kosha et al. (2021) have stated that to have responsible citizens and achieve sustainable development, education must start from ages 11 to 12 years (approximately the beginning of middle school), as students of this age have developed the ability to understand, learn, and find solutions, and are at the beginning of the path of responsibility and law-abiding. Thus, their ecological education produces a generation that is aware, critical, and influential in bringing about constructive change in this field, which is better facilitated with precise planning, textbook composition, and encouraging students to critical thinking, gaining awareness, dialogue, and active participation. Based on this, the education of ecological literacy in middle schools must be given attention by the country's authorities, including the education officials, to hope for nurturing a generation that cares for the environment. A review of the literature shows that ecological literacy education has attracted the attention of various researchers who have examined its importance, quality enhancement, identifying obstacles, etc., from different perspectives. However, ecological literacy education in middle schools needs more comprehensive research and the development of a model to identify the challenges and limitations of developing ecological literacy in

middle schools. Therefore, the current research seeks to answer the question of what are the challenges of developing ecological literacy in middle schools?

Method

The present research is of a mixed type (qualitative and quantitative). In the first phase, the qualitative research method was employed using thematic analysis, and in the second phase, the quantitative method was based on interpretive structural modeling. The population in both the qualitative and quantitative parts consisted of experts, due to the expert-focused approach of interpretive structural modeling, including school principals, teachers, environmental education experts, professors in the field of environmental education, and environmental elites, who were purposively selected until theoretical saturation was achieved (22 individuals). The sampling method in the quantitative part also involved experts from the qualitative part (N=20).

Materials

1. Semi-structured interview: The measurement tool in the qualitative part was the semi-structured interview. For example, participants were asked: What are the challenges in developing ecological literacy in middle schools? What are the most important factors?

2. Researcher-made questionnaire: The measurement tool in the quantitative part was a questionnaire designed with an interpretive structural modeling approach and given to experts. For the validity and reliability of the tool, the full text of all interviews along with coding and initial codes were sent to the advisor and consultant, and their confirmatory and complementary opinions were used in all stages of implementation, coding, and extraction of initial codes. **Transferability:** To ensure transferability, the researcher presented the selection process and characteristics of participants, data collection, and analysis process so that readers can judge the applicability of the findings in other situations. **Confirmability:** To check the confirmability, the research process was shared with several research colleagues to verify and confirm the accuracy of the research process. **Dependability or stability:** In this section, a thorough review of the data by two external coders familiar with the process was used to increase the research

stability. According to the 4 criteria mentioned, the research findings possessed all four of Guba and Lincoln's (1994) criteria. Thus, the validity of the findings was confirmed.

Implementation

Data collection in the qualitative part was based on library studies, internet searches, and open interviews with experts and specialists. In the quantitative part, a pairwise comparison questionnaire of the components was designed based on the indicators extracted in the qualitative part and given to experts. Both thematic analysis (using MAXQDA software) and interpretive structural modeling (ISM) (using Excel software) were used for data analysis. Each of these methods is described in detail in the following sections.

Results

In terms of demographic characteristics, the homogeneity of the sample population was maintained in both the qualitative and quantitative parts. The main variables of the challenges in developing ecological literacy in middle schools were identified and extracted based on thematic analysis techniques. Table 2 shows the categorization of primary concepts into secondary and main concepts. Therefore, the data derived from thematic analysis and the formation of the thematic network indicate that the challenges of developing ecological literacy in middle schools consist of 6 main themes and 20 concepts. The results of the integration also showed that the themes derived from thematic analysis in this research are aligned with theoretical and research foundations (Table 1).

Table 1. Final coding of data

Row	Organizing themes	Main themes
1	Human Resource	Lack of specialized human resources in the field of ecological literacy in schools
2		Insufficient motivation of teachers in environmental development
3		Lack of encouragement for teachers regarding environmental protection
4		Lack of environmental concerns among educational administrators
5		Weak commitment of administrators and teachers to environmental compliance
6		Absence of environmental experts in middle schools
7	Infrastructure	Insufficient facilities for the development of students' ecological literacy in schools
8		Lack of adequate space in schools for environmental education
9		Absence of suitable facilities and spaces in regional schools
10	Economical	Weak educational budget allocation for expenses in the field of ecological literacy development
11		High cost of equipment and services required for developing ecological literacy
12	Attitude	Educational administrators' perception of the unimportance of developing ecological literacy as a separate subject
13		Weak perception of educational administrators regarding the importance of developing ecological literacy in students
14		Negative attitude of parents, students, and teachers towards allocating time for developing ecological literacy
15		Poor level of ecological literacy among parents
16	Curriculum	Lack of curriculum allocation for developing ecological literacy
17		Insufficient time in the curriculum for ecological literacy development
18	Political	Internal and external policies contradictory to environmental improvement
19		Politicization of decisions related to the environment
20		Higher priority of material benefits in the environment over its preservation for future generations

In Table 2, the challenges of developing ecological literacy in middle schools are extracted from experts' opinions for entry into

the interpretive structural modeling process for model design.

Table 2. Challenges of Developing Ecological Literacy in Secondary Schools

Label	Component
A	Human Resource
B	Infrastructure
C	Economical
D	Attitude
E	Curriculum
F	Political

For each pair of criteria, experts were asked to comment on the existence of a relationship between the two criteria. Four symbols were used to indicate the nature of relationships between two criteria i and j , which are: V: Factor in row i causes the realization of factor in column j (denoted by 1), A: Factor in column j

causes the realization of factor in row i (1), X: Both factors in the row and column cause each other's realization (i and j have a bidirectional relationship) (denoted by 2), O: No relationship exists between the row and column factors (denoted by 0). The final result of experts' opinions is formed as a matrix table (3).

Table 3. Self-Interactive Structural Matrix

Label	Component	A	B	C	D	E	F
A	Human Resource						
B	Infrastructure	A					
C	Economical	X	V				
D	Attitude	A	V	X			
E	Curriculum	A	A	A	A		
F	Political	X	V	V	X	V	

A: If cell (i and j) in the SSIM matrix takes the symbol V, the corresponding cell in the reachability matrix takes the number one, and its symmetrical cell, i.e., cell (j and i), takes zero. B: If cell (i and j) in the SSIM matrix takes the symbol A, the corresponding cell in the reachability matrix takes zero, and its symmetrical cell, i.e., cell (j and i), takes one. C:

If cell (i and j) in the SSIM matrix takes the symbol X, both the corresponding cell and its symmetrical cell in the reachability matrix take one. D: If cell (i and j) in the SSIM matrix takes the symbol O, both the corresponding cell and its symmetrical cell in the reachability matrix take zero.

Table 4. Initial Access Matrix

Label	Component	A	B	C	D	E	F
A	Human Resource	1	1	1	1	1	1
B	Infrastructure	0	1	0	0	1	0
C	Economical	1	1	1	1	1	0
D	Attitude	0	1	1	1	1	1
E	Curriculum	0	0	0	0	1	0
F	Political	1	1	1	1	1	1

After obtaining the initial reachability matrix, its internal consistency must be established. For example, if factor 1 leads to factor 2, and factor 2 leads to factor 3, then factor 1 should also lead to factor 3. If this is not the case in the reachability matrix, the matrix must be amended, and missing relationships added. Various methods have been proposed to make the matrix consistent, of which two general methods are mentioned here:

First method: Some researchers believe that after collecting experts' opinions and obtaining SSIM and reachability matrices, if inconsistency is observed within the reachability matrix, the questionnaire should be filled out again by experts. This process should continue until consistency is achieved. Second method: This method uses mathematical rules to create consistency in the reachability matrix, by raising the matrix to the power of $(K+1)$ where $K > 1$,

following the Boolean rule, where $1+1=1$ and $1 \times 1=1$. In this research, the first method was used. Since several experts were used to fill out the

questionnaires in this study, the mode method based on the highest frequency in each entry was used to form the final reachability matrix.

Table 5. Final Perceived Matrix

Label	Component	A	B	C	D	E	F	Influence
A	Human Resource	1	1	1	1	1	1	6
B	Infrastructure	0	1	0	0	1	0	2
C	Economical	1	1	1	1	1	0	5
D	Attitude	0	1	1	1	1	1	5
E	Curriculum	0	0	0	0	1	0	1
F	Political	1	1	1	1	1	1	6
	Dependency	3	5	4	4	6	3	

At this stage, with the final reachability matrix obtained, to determine the level of criteria, two sets are defined: the reachable set and the antecedent (prerequisite) set. The first row where the intersection of the two sets equals the reachable set will be assigned the first level of priority. After determining the level, criteria that

have been leveled are removed from the table, and this process is repeated until all remaining variables are leveled. Then, based on the determined levels and the final matrix, the ISM network structure is drawn. Thus, all criteria are leveled based on their penetration power and dependency, as presented in Tables (6) to (9).

Table 6. First Iteration of Segmenting Levels in Access Matrix

Label	Component	Output set	Input set	Common set	Level
A	Human Resource	1-2-3-4-5-6	1-3-6	1-3-6	
B	Infrastructure	2-5	1-2-3-4-6	2	
C	Economical	1-2-3-4-5	1-3-4-6	1-3-4	
D	Attitude	2-3-4-5-6	1-3-4-6	3-4-6	
E	Curriculum	5	1-2-3-4-5-6	5	1
F	Political	1-2-3-4-5-6	1-4-6	1-4-6	

Table 7. Second Iteration of Segmenting Levels in Access Matrix

Label	Component	Output set	Input set	Common set	Level
A	Human Resource	1-2-3-4-6	1-3-6	1-3-6	
B	Infrastructure	2	1-2-3-4-6	2	2
C	Economical	1-2-3-4	1-3-4-6	1-3-4	
D	Attitude	2-3-4-6	1-3-4-6	3-4-6	
F	Political	1-2-3-4-6	1-4-6	1-4-6	

Table 8. Third Iteration of Segmenting Levels in Access Matrix

Label	Component	Output set	Input set	Common set	Level
A	Human Resource	1-3-4-6	1-3-6	1-3-6	
C	Economical	1-3-4	1-3-4-6	1-3-4	3
D	Attitude	3-4-6	1-3-4-6	3-4-6	3
F	Political	1-3-4-6	1-4-6	1-4-6	

Table 9. Fourth Iteration of Segmenting Levels in Access Matrix

Label	Component	Output set	Input set	Common set	Level
A	Human Resource	1-6	1-6	1-6	4
F	Political	1-6	1-6	1-6	4

At this stage, considering the levels of variables and the final reachability matrix, a preliminary model is drawn and refined by

removing transitivity in the initial model to arrive at the final model.

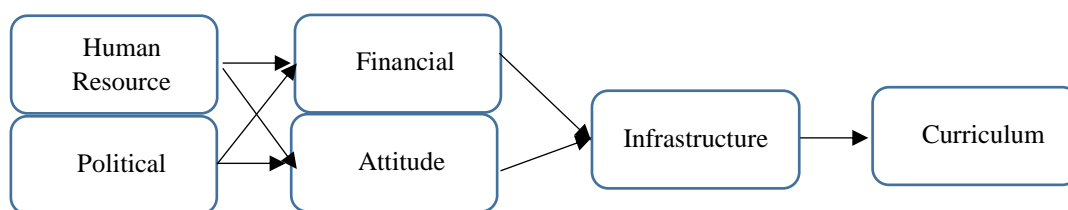


Figure 1. Interpretive Structural Model of Challenges in Developing Ecological Literacy in Secondary Schools

Finally, variables are classified into four groups. The first group includes autonomous variables (Area 1) with low influence and dependency. The second group includes dependent variables (Area 2) with low influence and high dependency. The third group includes linkage variables (Area 3) with high influence and high dependency. The fourth group includes independent variables (Area 4) with high influence and low dependency. Accordingly, human components and curriculum are in the independent cluster, meaning they have a significant impact on other factors and are minimally affected by other factors. Infrastructure and curriculum are in the dependent cluster, meaning they are influenced by other factors and have little impact on other factors. Economic and attitudinal factors are in the linkage cluster, meaning they both influence and are influenced by other factors.

Conclusion

The aim of this research was to design an interpretive structural modeling of the challenges in developing ecological literacy in middle schools. Based on the results, 6 main themes of challenges in developing ecological literacy in middle schools have been identified. The human challenge and the curriculum are situated in an independent cluster, meaning they have a significant impact on other factors, and other factors have little impact on them. Infrastructure and curriculum are placed in the dependent cluster, meaning they are influenced by other factors and have little impact on others. Economic and attitudinal challenges are in the linkage cluster, meaning they both influence and are influenced by other factors.

According to the research results, the human challenge was recognized as one of the known challenges in the field of ecological literacy

development in middle schools. In this context, the absence of specialized human resources in ecological literacy in schools, lack of sufficient motivation among teachers for environmental development, lack of encouragement of teachers towards environmental protection, absence of environmental concerns among educational administrators, weak commitment of administrators and teachers to environmental compliance, and the absence of environmental experts in middle schools are recognized challenges. In this regard, Assad et al. (2022) and Michael et al. (2022) identified competent and knowledgeable human resources as prerequisites for environmental education, and Bertling et al. (2022) and Simmons (2022) introduced teachers as the most important individuals in environmental education and the promotion of ecological literacy. It can be stated that effective human resources in developing students' ecological literacy include capable environmental teachers in schools and the presence of environmental experts in schools as advisors and supervisors who are directly involved with students. Unfortunately, such resources are currently lacking in the country's education system, and if present, are very few. This issue has led to environmental education in middle school (Human and Environment textbook) being conducted by other teachers and this unit being perceived as a less important course. However, given the emerging importance and necessity of developing knowledge and ecological literacy among students, efforts to improve the knowledge and motivation of teachers in teaching ecological issues to students seem necessary.

According to the research results, the curriculum challenge was among the known challenges in the area of ecological literacy

development in middle schools. Education is one of the most suitable ways to achieve economic, social, cultural, and political development. Educational institutions in their plans should pay attention to the protection of the human environment. Therefore, incorporating related concepts into the curriculum at different educational levels will cause students to perceive environmental protection not just as a lesson but as a human duty and responsibility from the beginning and during their character formation. Students in schools are taught to learn knowledge and values and apply them in their daily lives (Niroo, 2013). The aim of environmental education is to enlighten each individual's knowledge so that the person understands the values of the environment, protects it, and supports it by thinking and delving into biological processes. Given the growing importance of the environment in today's societies, environmental education is an integral and inseparable part of the life of young people in every country. Educational institutions in their plans should pay attention to environmental protection. Therefore, incorporating environmental concepts into textbooks at different educational levels makes students perceive environmental protection from the beginning and during character formation not just as a lesson but as a human duty and responsibility. Students in schools are taught to learn knowledge and values and apply them in their daily lives, which highlights the significant and fundamental role of textbooks and curriculum planners. Among different social groups, students play a key role in preserving the environment. Students have a special status in relation to the environment for several reasons: firstly, their current behavior affects the environment they live in now. Secondly, as the next generation that will play the role of the educated class in society, they will attain sensitive jobs that are important for environmental protection (Salehi, 2013). The results of the research by Dibayi and Elahi Janian (2009) in the field of environmental education indicate that although the content used in middle school textbooks is of interest and preference to students, it is not beneficial. The studies of Sharina et al. (2011) showed that a separate environmental curriculum provides superficial environmental knowledge. Environmental knowledge should cover depth,

and the development of environmental programs and education through integration can achieve this goal. The research of Mitsuyuki (2017) showed that the educational actions of today's schools must be sustained to ensure focused environmental education in the future. Therefore, it is first necessary to understand the unsolvable internal contradictions in environmental education.

However, the theoretical foundations and field study regarding capacities and known challenges such as curriculum, infrastructure, economic, and attitudinal challenges in the development of ecological literacy in schools in this research, indicate that to align with environmental issues and problems, appropriate strategies with a participatory approach should be developed. This would increase the sense of belonging and ownership among all stakeholders regarding the environment, and strengthen institutional capacity-building at all organizational, active, spatial, and locational levels in educational programs and education authorities in the country. Education and the designed curricula can be approached from two perspectives: pragmatic and value-oriented. Adopting either of these approaches requires the integration of knowledge concepts and skills that will transform educational and training programs in line with the needs of the new era. In strategic management for the success of an organization, internalizing or reducing the existing weaknesses in the organization is important, as implementation requires awareness of the strengths and weaknesses of the system. Planning to standardize educational curricula and improve infrastructure, economic, and attitudinal challenges, and special attention to environmental education is an appropriate way to address the upcoming weaknesses in developing ecological literacy. Therefore, our country, to converge with the global movement and achieve the goals of the 1404 Vision Document and other higher-level documents, especially the Fifth Development Plan (Construction) that has based the development and economy of the country on knowledge-based development and knowledge-based economy, should utilize the presence of scientific, research resources, and experts in environmental education, as well as strong communication networks, technology transfer, and appropriate educational models in the field of environment. This provides a suitable

opportunity to keep pace with the educational programs of countries while considering ethnic and cultural issues in the country. Therefore, efforts to address the observed challenges and planning for the quantitative and qualitative improvement of teachers in the field of environmental issues should be more focused, and collaboration in preparing a media program is also among the strategies that can be considered.

Conflict of Interest

According to the authors, this article has no financial sponsor or conflict of interest.

References

- Akbari Armand, M., Babaie, F., Mohammadi, A., & Moharamnejhad, N. (2020). Nuclear energy and Environmental Quality Approach to Data Integration. *Sustainability, Development & Environment*, 1(4), 33-43.
- Asad, A. Hidayati, S. & Fridiyanto, F. (2022). Education and Human Resources: Retaining Future Human Resources' Behaviours to Nature through Environmental Education. *Journal of Higher Education Theory and Practice*, 22(2), 128-141.
- Bertling, J. G. & Moore, T. C. (2022). Educational approaches within US art teacher education: The status of ecological and environmental education. *International Journal of Education through Art*, 18(3), 359-376.
- Brandl, R. Alvarado, A. & Peltomaa, A. (2019). Evaluating efficacy of environmental education programming. *School Science and Mathematics*, 119(2), 83-93.
- Dibayi, SH. & Lahijanjan, A. M. (2009). "Investigation of secondary school curriculum with emphasis on environmental education", *Quarterly of Environmental Sciences*, 6(3), 184-177 [In Persian].
- Eisner, E.W. (2002). *The Educational Imagination: On the Design and Evaluation of School Programs* (3rd Ed.). Upper Saddle River, NJ: Merrill Prentice Hall
- Koosha, S., Alekajbaf, H., & Taheri, P. (2021). Challenges of Environmental Education for Sixth Grade Elementary Students from the Perspective of International Human Rights and Iranian Law. *Environmental Education and Sustainable Development*, 10(1), 143-159. doi: 10.30473/ee.2021.54659.2254
- Maciel, K. F. K. Fuentes-Guevara, M. D. da Silva Gonçalves, C. Mendes, P. M. de Souza, E. G. & Corrêa, L. B. (2022). Mobile mandala garden as a tool of environmental education in an early childhood school in Southern Brazil. *Journal of Cleaner Production*, 331, 129913.
- Matos, S. Silva, A. R. Sousa, D. Picanço, A. R. Amorim, I. Ashby, S. & Arroz, A. M. (2022). Cultural probes for environmental education: Designing learning materials to engage children and teenagers with local biodiversity. *Plos one*, 17(2), e0262853.
- Merritt, E. G. Stern, M. J. Powell, R. B. & Frensley, B. T. (2022). A systematic literature review to identify evidence-based principles to improve online environmental education. *Environmental Education Research*, 28(5), 674-694.
- Mitsuyuki, I. (2017). "Beyond the Limitations of Environmental Education in Japan". *Educational Studies in Japan: International Yearbook*, March, 11, 3-14.
- Ostovar, S., Shah Wali, M. & Samani, S. (2012). Examining the environmental attitudes of middle and high school students of educational schools in Kish Island. The first national conference on environmental protection and planning.
- Powell, R. B. Stern, M. J. Frensley, B. T. & Moore, D. (2019). Identifying and developing crosscutting environmental education outcomes for adolescents in the twenty-first century (EE21). *Environmental Education Research*, 1-19.
- Shah Sani, Shahrazad., Amir Azdi, Fatemeh., Al Barzi, Mahbubeh, and Khazuri, Fahima. (2021). Analyzing the critical discourse of the 6th elementary research and thinking textbook and explaining the mechanism of their socialization components. *Curriculum Research*, 11(2): 67
- Shamsi Pakiade, S. Z., & Sarmadi, M. S. (2019). Internalization of environmental values in the education system. *Human & Environment*, 17(2), 65-78.
- Simmons, D. (2022). Can Providing an Outdoor Education Activity Booklet that Meets State Standards of Learning Increase Environmental Education in the Classroom? digitalcommons.hamline.edu, 21(3), 319-326.
- Suraydi, B. Ekayanti, F. & Amalia, E. (2018). An Integrated Curriculum at an Islamic University: Perceptions of Students and Lecturers. *Eurasian Journal of Educational Research*, 74, 25-40
- Van de Wetering, J. Leijten, P. Spitzer, J. & Thomaes, S. (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology*, 101782.
- Widegren, O. (1998). The New Environmental Paradigm and Personal Norms. *Journal of Environmental and Behavior*. 30, 75-100.