

Design and Validation of an Environmental Education Curriculum Model for Higher Education Based on the "Aker" Approach

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ABSTRACT

Purpose: The curriculum is a central element in any educational activity, and the present study aimed to design and validate an environmental education curriculum model for higher education based on the "Aker" approach.

Methodology: This study used a mixed-methods approach, where the qualitative sample consisted of academic and organizational experts familiar with the research field, and the quantitative sample included curriculum specialists, textbook authors of the Ministry of Education, and environmental experts. The qualitative and quantitative research samples comprised 22 and 191 individuals, respectively, selected according to the principle of theoretical saturation through purposive non-random sampling and Cochran's formula with convenience non-random sampling. The research tools were semi-structured interviews and researcher-made questionnaires in the qualitative and quantitative sections, respectively, whose psychometric indices were confirmed. Data were analyzed using coding in Nvivo software and exploratory factor analysis and structural equation modeling in SPSS and Smart PLS software.

Findings: The qualitative findings indicated that the environmental education curriculum model for higher education based on the "Aker" approach contained 87 concepts across 10 elements; namely, 13 concepts for program logic, 15 for program objectives, 13 for educational content, 7 for teaching and learning activities, 9 for instructor characteristics, 7 for educational materials and resources, 5 for educational space and setting, 8 for grouping, 4 for instructional time, and 6 for assessment. Additionally, the quantitative findings showed that the factor loadings, average variance extracted, and composite reliability of the elements were respectively higher than 0.40, 0.50, and 0.70. The fit of the environmental education curriculum model for higher education based on the "Aker" approach was appropriate, with all path coefficients being higher than 0.50 and significant at the 0.001 level.

Conclusion: According to the environmental education curriculum model for higher education based on the "Aker" approach and its concepts, planning for the design and application of an environmental education curriculum is essential.

Keywords: Curriculum, Environmental Education, Higher Education, "Aker" Approach.

1. Introduction

Today, the primary concern of thinkers and international organizations is to prevent the occurrence and increase of environmental problems. In this context, humans are considered both as influential agents and victims of this crisis. Therefore, according to the consensus among environmental experts, addressing the environmental crisis depends on reforming environmental education and changing human attitudes, perceptions, and knowledge about their fate and the environment. Acquiring environmental awareness is the first step towards sustainability and fundamentally a condition for the future survival of humanity, requiring an understanding of environmental principles and living in accordance with their care (Saeidi & Meiboudi, 2023). Given the importance of the environment for humans, scientists believe that the Earth has experienced numerous environmental events since its inception, some of natural origin and others of human origin. Environmental degradation and pollution of human origin can severely threaten the existence of humans and other species and disrupt the balance of nature. To restore natural balance, humans must inevitably change their lifestyle towards sustainable development, which can bring about major changes in current society and future generations (Moftooh et al., 2022). Achieving sustainable development in any society is related to the public awareness of that society, and education is one of the most important and effective ways to improve awareness and motivation. The main goal of environmental education is to sensitize individuals to physical, economic, biological, social, and political events and changes and their impact on the environment, enabling them to develop skills and methods for preserving the environment and solving its problems (de Andrade Guerra et al., 2018). Various definitions of environmental education have been provided, each expert offering their definition based on their perspective on the environment. For instance, environmental education aims to educate citizens who are aware of the biophysical environment and related issues and can contribute to their resolution and inspire others in this field. In another definition, environmental education is described as a learning process that enhances individuals' knowledge and awareness about the environment and related challenges, expands necessary skills and expertise for facing these challenges, and cultivates attitudes, motivations, and commitments that lead to informed decisions and responsible actions (van de Wetering et al., 2022).

Although environmental education has been incorporated into Iran's educational and curricular discussions for several years, it necessitates the design of a comprehensive curriculum, especially at the primary level. This type of education has been a focus of attention in most developing and even third-world countries in recent years. However, the terms "environment" and "education" were not used together until the mid-1960s, but developments in environmental education are the result of the thoughts of a group of thinkers, writers, and distinguished scholars of the 18th and 19th centuries (Mashaullahi Nzhad et al., 2019). Environmental education represents a trend in current-century education and serves as an important reaction to methods that pose barriers to damaging human interactions with the natural world. This education teaches the concept of individual responsibility (Hutcheson et al., 2018). The aim of environmental education is to increase each individual's awareness so that the person understands and strives to protect environmental values and supports biological processes through thought and reflection. In fact, 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 any society (Sarлак et al., 2019). Curriculum, as an interdisciplinary subject and topic, means the linkage and combination of curriculum content to integrate learners' learning experiences (Gholamian et al., 2019). The environmental curriculum has been a focus since the early 1960s, leading to the provision of content and materials based on the environment. The curriculum refers to the content and methods of formal and informal teaching, hidden and open teaching methods, and their assessment methods, through which learners acquire necessary knowledge and skills and change their attitudes and values (Mohkamkar et al., 2021). Many countries around the world have educational packages on the environmental curriculum, all of which provide interdisciplinary programs considered a knowledge theory and holistic approach in organizing curriculum content, employing a specific method and style in more than one scientific field to examine and analyze the subject, issue, and concept from different angles (Derman & Gurbuz, 2018). One of the fundamental challenges worldwide is designing an appropriate and straightforward curriculum for successful environmental education, and the environmental education curriculum, which refers to formal and informal content, process, content, overt and covert teachings learned by learners and based on which they acquire skills to better understand the value of the environment (Jones, 2023).

A significant part of existing environmental problems stems from a lack of necessary awareness and cultural weakness in human-nature relations, essentially constituting a cultural issue. Therefore, there is a need for national and international determination to strengthen the culture of environmental protection at different levels of societies, and it is absolutely obligatory for every individual to become aware of, understand, and develop values and perspectives for conservation and social justice, and to act individually or collectively to solve environmental problems and prevent their occurrence (Brewer et al., 2017). To confront environmental crises at the international level, environmental laws have been enacted. Also, environmental objectives and strategies form a major part of countries' development programs, and in this direction, countries have included environmental education more carefully in their curricula (Srbinovski et al., 2010). This research was conducted based on the "Aker" curriculum approach, which consists of 10 elements, and this approach is a conceptual approach and model, focusing on the overarching logic of the curriculum and what characteristics the curriculum elements will have. Aker believes that the core (logic) of a curriculum is usually related to learning objectives and content. This core generally entails changes for many other aspects of the curriculum. Considering the pivotal role of the curriculum's logic or rationale, which serves as the overall principle or main mission of the curriculum and acts as a guiding component in the curriculum decision-making process, it is possible to show the arrangement of curriculum elements in a specific way where all elements and components are connected and related around the main logic of the curriculum. The core and not the spider web strands refer to the ten parts of a curriculum, each concerning an aspect of learning and the learning program or curriculum of learners (Movludi et al., 2021).

Moftooh et al. (2022) conducted a study titled "Designing an Environmental Education Model for High School Students in the Education System with a Grounded Theory Approach: A Qualitative Study." Six selected codes were identified under the components (causal conditions, contextual conditions, intervening conditions, central phenomenon, strategies, and outcomes), along with 27 axial codes and 91 open codes. The results showed that the causal condition component included 3 axial codes, the contextual conditions component included 5 axial codes, the intervening conditions component included 5 axial codes, the central phenomenon component included 4 axial codes, the strategies component included 3 axial codes, and the

outcomes component included 7 axial codes (Moftooh et al., 2022). Parhizkar and Fathi Vajargah (2022) conducted a study titled "Exploring the Lived Experiences of High School Students in Environmental Education Through the Hidden Curriculum to Provide Solutions for Enhancing Environmental Literacy." According to the results, the hidden curriculum of environmental education was provided in the areas of physical structure, social structure, bureaucratic structure, cultural structure, family structure, individual structure, and external organizational structure. Furthermore, findings indicated that, from the perspective of students' lived experiences of the hidden curriculum, the highest environmental literacy was obtained from the social structure (interaction with the teacher), followed by the family structure and bureaucratic structure (Parhizkar & Fathi Vajargah, 2022). Samadi (2022) conducted a study titled "Exploring the Dimensions and Components of Environmental Education in the Fundamental Reform Document of Education and its Validation." In the theoretical domain, the overarching theme identified was the revival of metaphysical environmental epistemology, which was addressed with three pre-organizing themes: monotheism-centeredness (with 9 basic themes), hereafter-centeredness (with 3 basic themes), and human-centeredness (with 5 basic themes). In the practical domain, the overarching theme identified was environmental competencies, addressed with three pre-organizing dimensions: cognitive (with 6 basic themes), affective (with three basic themes), and behavioral (with 13 basic themes). Data analysis based on expert judgments indicates that experts approved the themes identified in both theoretical and practical dimensions (Samadi, 2022).

Gani, Muthalib, Yusuf, and Gani (2023) conducted a study titled "Environmental Education Policy in Stakeholders' Behavioral Commitment to Environmental Sustainability," which was carried out as a review. Data were electronically searched using keywords relevant to the study's topic, and some schools were visited to collect information about educational policies regarding environmental policy frameworks. Based on available data and discussion about research findings, there is a very close relationship between environmental education policies in schools, individual attitudes, community behavior, and industrial behavior for maintaining a sustainable healthy environment (Gani et al., 2023). Obasi and Osah (2022) conducted a study titled "Curriculum Development Planning in Environmental Education for Environmental Citizenship Development among Primary School Students in Rivers

State, Nigeria." Findings indicated that the use of environmental education projects for developing environmental citizenship among students is low. Challenges against teaching environmental education include lack of school management commitment, insufficient time in the lesson schedule for integrating environmental education content into other subject areas, and teachers' inadequate knowledge of integration techniques (Obasi & Osah, 2022). Hernawan, Darmawan, and Ali (2021) conducted a study titled "Environmental Education Based on Local Values: Its Integration into the Indonesian Primary School Curriculum," which was carried out in Indonesia. Results showed that specific themes of environmental education based on local values and content should be included in the primary school curriculum for clearer understanding and comprehension of topics by students. Suggested thematic topics should include subjects related to overcoming environmental pollution, preventing global warming, wise use of environmental flora and fauna, and appropriate values required for environmental conservation and sustainability (Hernawan et al., 2021).

One of the researcher's concerns for addressing the environmental education curriculum model for higher education was that, given the importance of the environmental issue and the basic and universal support for it to preserve limited, important, and non-renewable resources and to prevent their wastage and pollution, one of the fundamental methods is environmental education. The goal of environmental education is to sensitize individuals to physical, biological, social, and political events and changes related to the environment. Therefore, the environmental education curriculum model is employed in higher education to educate environmentally conscious and concerned individuals about environmental issues for the job market. Another concern is that identifying and explicating the elements of environmental education in higher education at the national level will be a lever and key element for reforming and improving environmental education and learning in the country's workplaces and is expected to lay the groundwork for reforms of environmental education in Iran's public and private organizations. In this direction, a greater understanding of the elements of the environmental education curriculum model will provide a suitable perspective for senior decision-makers in higher education regarding the adoption of appropriate strategies. Additionally, research generally focused on environmental issues in schools and concentrated on the curriculum model based on primary and secondary schools, with very few

studies paying attention to environmental issues in higher education. Furthermore, the first step to improve the current state of environmental education in the country is the preparation of codified and specific educational objectives, and the presence of such objectives in an organized and codified manner prevents the wastage of time and energy and aids in education. Such objectives, in the form of a curriculum model, facilitate the institutionalization of environmental education for students. The above statements clearly indicate the necessity of addressing the environmental education curriculum model for higher education. Therefore, the present study seeks to answer the question of what the environmental education curriculum model for higher education based on the "Aker" approach is like and whether it has appropriate validity.

2. Methods and Materials

2.1. Study Design and Participants

The present research, in terms of its objective, is applied and, in terms of data collection method and information, was conducted using an exploratory mixed-method approach. In other words, a mixed-method approach was employed for this study, where the qualitative population consisted of academic and organizational experts familiar with the research domain, and the quantitative population included curriculum specialists, textbook authors from the Ministry of Education, and environmental experts.

The research population in the qualitative section comprised a group of academic experts (faculty members specializing in curriculum planning and environmental studies at higher education institutions) and organizational experts (senior and middle managers and senior environmental specialists) related to the research topic. The desired qualifications for expertise in these individuals included: 1. Having education or scientific works related to curriculum model topics, 2. Having education or scientific works related to the "Aker" approach in curriculum models, 3. Having education or scientific works related to environmental education topics, and 4. Having education or scientific works related to environmental education in curriculum models. The research sample in the qualitative part included 22 individuals selected based on the principle of theoretical saturation and through purposive non-random sampling.

Additionally, the research population in the quantitative section included curriculum specialists, textbook authors, planners from the Ministry of Education, and environmental

experts. The research sample in the quantitative part was 191 individuals selected based on Cochran's formula and through convenience non-random sampling. The sampling method of the present research, considering the intended population and the COVID-19 pandemic, was convenience sampling. Due to the use of exploratory factor analysis and structural equation modeling in this study, there is no general agreement on determining the sample size, but most researchers in these analyses require 10 or 20 samples per variable, making a minimum defendable sample size of 200 individuals.

2.2. Data Collection

The research tool in the qualitative part was semi-structured interviews, and in the quantitative part, it was a researcher-made questionnaire, whose psychometric indices were confirmed. The researcher-made questionnaire comprised 88 items and 10 components or elements based on the "Aker" approach. This tool was created based on semi-structured interviews with academic and organizational experts and was formatted on a 5-point Likert scale (5 = very high, 4 = high, 3 = medium, 2 = low, and 1 = very low) to measure the statistical sample's opinions in the quantitative section regarding each of the components as follows:

- Program logic element: 13 items
- Program objectives element: 15 items
- Educational content element: 13 items
- Teaching and learning activities element: 7 items
- Instructor characteristics element: 9 items
- Educational materials and resources element: 7 items
- Educational space or setting element: 5 items
- Grouping element: 8 items
- Instructional time element: 4 items
- Evaluation element: 6 items

Table 1

Coding Results for the Program Logic Element

Codes	Frequency	Subcategory	Main Category
Environmental literacy enhancement (01, 03, 04, 05; 08, 010, 012, 013, 015, 016, 018, 021)	12	Individual needs	Need for progress and sustainable development
Improvement of environmental ethics (02, 03, 05, 06, 08, 09, 010, 014, 015, 019)	10		
Enhancement of individuals' environmental culture (01, 03, 05, 06, 07, 08, 09, 010, 011, 013, 014, 015, 019)	13		
Necessity of establishing constructive interaction between individuals and nature (05; 08, 09, 011, 013, 015, 016, 022)	8		
Necessity to combat environmental crises and challenges (01, 02, 03, 04, 05, 07, 08, 09, 010, 011, 013, 014, 015, 019, 021, 022)	16		
Need for individual sensitivity towards the environment (02, 06, 012, 013, 015, 017, 018)	7		

2.3. Data Analysis

Data were analyzed using coding in Nvivo software and exploratory factor analysis and structural equation modeling in SPSS and Smart PLS software.

3. Findings and Results

In the qualitative part of the research, the main focus was on exploring and discovering factors affecting the theme and components related to the "environmental education curriculum model for higher education based on the 'Aker' approach." Accordingly, for initial and axial coding in the first stage, data at the sentence and phrase level were examined for each of the texts, and conceptual codes were extracted from the transcripts. In the next stage, through refinement and reduction, they were organized into categories and named after continuous review. Initial and axial coding ceased when a meaningful classification was achieved after several reviews of the document transcripts. The spider web model of the "Aker" curriculum was selected as the study framework to explore the characteristics of environmental education curriculum elements in higher education. Given the research objective, this model provides the opportunity to examine the most important curriculum elements and offers a powerful tool for exploring the ten elements of the curriculum. Based on this, the "Aker" model, which includes 10 elements as follows: 1. Program logic, 2. Educational objectives, 3. Educational content, 4. Teaching and learning activities, 5. Instructor characteristics, 6. Educational materials and resources, 7. Educational space or setting, 8. Instructional time, 9. Grouping, and 10. Evaluation, with coding results for the "program logic" element as an example presented in [Table 1](#) and the final results from the qualitative part presented in [Table 2](#).

Improvement of environmental ethics (02; 04, 06, 012, 013, 015, 017, 018)	8	
Total Codes	74	
Population growth and the loss of food security (01, 02, 03, 04, 05, 08, 010, 012, 013, 014, 015, 016, 018, 020, 021)	15	Social needs
Endless consumption of materials and energy (01, 02, 03, 04, 06, 012, 013, 015, 017, 018, 019)	11	
Necessity to preserve resources for future generations (01, 02, 03, 04, 06, 012, 013, 015, 017, 018, 019)		
Necessity to preserve plant and animal species and prevent their extinction as a collective responsibility (01, 02, 03, 04, 06, 08, 010, 012, 013, 015, 017, 018, 019, 020)	14	
Necessity for human societies to achieve comprehensive progress and development (02, 05, 08, 012, 015, 017, 018, 019)	8	
Collective responsibility in preserving the environment and avoiding its destruction (01, 02, 04, 06, 07, 08, 010, 012, 013, 014, 015, 017, 018, 019, 020)	15	
Necessity for a new social and cultural lifestyle adapted to environmental developments (01, 03, 04, 05, 07, 08, 011, 014, 015, 016, 020, 021)	12	
Necessity to employ environmentally compatible modern technologies (04, 07, 08, 011, 013, 014, 016, 019, 020)	9	
Collective responsibility to address environmental problems and crises (01, 02, 03, 04, 05, 07, 08, 011, 014, 015, 016, 017, 020, 021, 022)	15	
Higher education's mission in training specialists with high environmental literacy (03, 04, 07, 010, 013, 016, 018, 020)	8	
Total Codes	107	

Table 2

Coding Results for the Environmental Education Curriculum Model for Higher Education Based on the "Aker" Approach

Curriculum Element	Open and Axial Code
Program Logic	The necessity and need for the country to achieve comprehensive sustainable development
Program Objectives	Ultimate goal: Achieving environmental literacy to preserve the environment; utilizing it for sustainable development. Intermediate objectives: Practical environmental ethics, environmental culture, and becoming a committed and responsible citizen. Specific or behavioral objectives: Love and passion for nature, valuing and respecting the environment; addressing environmental problems; interacting with the environment; discovering environmental issues, adhering to environmental health principles; understanding individual and societal needs related to the environment; collaborating with various institutions to preserve the environment.
Educational Content	Selection principles: Scientific validity, compatibility with local, national, and cultural standards, alignment with learners' interests and needs, active and problem-centered, and compatibility with modern technologies. Organization principles: Comprehensiveness, vertical, horizontal, and integrative connections. Nature (What is it?): A set consisting of environmental knowledge, attitudes, and skills.
Teaching and Learning Activities	Principles: Learner-centered with an emphasis on participatory methods based on creative and critical thinking, special attention to information and communication technologies. Methods: Individual and group, active participation, exploratory, project-based, problem-solving, using modern educational technologies.
Instructor Characteristics	Belief and ethical competencies and professional competencies
Educational Materials and Resources	Selection principles: Non-prescriptive, diverse and abundant, primary, compatible with other curriculum elements, appealing and of interest to students, facilitating the teaching and learning process. Nature (What is it?): Physical (non-digital) and non-physical (digital) educational materials.
Educational Space and Setting	Space as the location for curriculum implementation, space as the learning environment
Grouping	Principles: Educational and social objectives. Methods: Groups of 2 to 4 or any other grouping method suitable for the conditions and available resources.
Instructional Time	Principles: Flexibility, according to learners' wants and needs, suitable for educational content, opportunities for learner engagement with content. Characteristics: Allocating time for formal education through prescriptive content and time for informal education through non-prescriptive content.
Evaluation	Principles: Process-oriented, suitable for curriculum elements, suitable for conditions and learner needs, based on learners' knowledge, attitudes, and skills. Methods: Performance tests, self-assessment, projects, problem-solving, observation of behavior in natural situations.

Findings indicated that the environmental education curriculum model for higher education based on the "Aker" approach contained 87 concepts across 10 elements; namely, 13 concepts for program logic, 15 for program objectives, 13 for educational content, 7 for teaching and learning

activities, 9 for instructor characteristics, 7 for educational materials and resources, 5 for educational space and setting, 8 for grouping, 4 for instructional time, and 6 for assessment.

The spider web model of the environmental education

curriculum for higher education based on the "Aker" approach is presented in Figure 1.

Figure 1

The Model of Virtual Education with Respect to Educational Equity Using a Phenomenological Approach in Golestan Province Schools



In the quantitative part of the research, 191 questionnaires were selected for analysis, with 57.59% of the respondents being male and 42.41% female. Results for factor loadings, average variance extracted, and composite reliability of the

elements in the environmental education curriculum model for higher education based on the "Aker" approach are presented in Table 3.

Table 3

Factor Loadings, Average Variance Extracted, and Composite Reliability of Elements in the Environmental Education Curriculum Model for Higher Education Based on the "Aker" Approach

Open and Axial Code	Factor Loading	Average Variance Extracted	Composite Reliability
Program Logic	0.52	0.57	0.88
Program Objectives	0.49	0.56	0.85
Educational Content	0.63	0.67	0.87
Teaching and Learning Activities	0.57	0.76	0.85
Instructor Characteristics	0.46	0.76	0.86
Educational Materials and Resources	0.51	0.76	0.79
Educational Space and Setting	0.67	0.74	0.84
Grouping	0.60	0.59	0.95
Instructional Time	0.56	0.60	0.89
Evaluation	0.54	0.57	0.89

Findings showed that the factor loadings, average variance extracted, and composite reliability of the ten elements based on the "Aker" approach were respectively higher than 0.40, 0.50, and 0.70. The results of the model fit

of the environmental education curriculum for higher education based on the "Aker" approach are presented in [Table 4](#).

Table 4

Fit Results of the Environmental Education Curriculum Model for Higher Education Based on the "Aker" Approach

Open and Axial Code	Communalities	R ²	GOF
Program Logic	0.57	0.47	0.55
Program Objectives	0.56	0.54	
Educational Content	0.67	0.34	
Teaching and Learning Activities	0.76	0.65	
Instructor Characteristics	0.76	0.34	
Educational Materials and Resources	0.76	0.36	
Educational Space and Setting	0.74	0.78	
Grouping	0.59	0.42	
Instructional Time	0.60	0.59	
Evaluation	0.57	0.67	

Findings indicated that the fit of the environmental education curriculum model for higher education based on the "Aker" approach was appropriate. A GOF (Goodness of Fit) value of 0.55 was determined; considering that values of 0.01, 0.25, and 0.36 are regarded as weak, medium, and strong values for the GOF index, it can be concluded that overall, the proposed curriculum model for environmental

education in higher education had a strong and acceptable fit.

Results of the structural equation modeling of the elements in the environmental education curriculum model for higher education based on the "Aker" approach are presented in [Table 5](#).

Table 5

Results of Structural Equation Modeling of Elements in the Environmental Education Curriculum Model for Higher Education Based on the "Aker" Approach

Open and Axial Code	Standard Coefficient	t-Value	P-Value	Result
Program Logic	0.68	7.94	0.001	Confirmed
Program Objectives	0.73	9.06	0.001	Confirmed
Educational Content	0.58	67.07	0.001	Confirmed

Teaching and Learning Activities	0.80	39.33	0.001	Confirmed
Instructor Characteristics	0.58	96.68	0.001	Confirmed
Educational Materials and Resources	0.60	17.70	0.001	Confirmed
Educational Space and Setting	0.88	15.97	0.001	Confirmed
Grouping	0.65	23.18	0.001	Confirmed
Instructional Time	0.76	18.54	0.001	Confirmed
Evaluation	0.83	8.38	0.001	Confirmed

Findings demonstrated that in the environmental education curriculum model for higher education based on the "Aker" approach, the path coefficient of all elements was higher than 0.50 and significant at the 0.001 level.

4. Discussion and Conclusion

Environmental policies in the country necessitate the promotion of environmental awareness and education at all levels of the Iranian society. Among the influential factors in expanding and strengthening environmental knowledge, higher education systems and universities, as the country's centers of education and research, bear significant responsibility. The higher education system must make extensive efforts to engage all societal levels to develop solutions, transfer knowledge, and provide the necessary education for changing environmental attitudes and behaviors. This is only possible through the preparation and implementation of structured educational and curricular programs related to environmental issues. An appropriate curriculum should not only consider the internal policies of organizations but also global realities and the conditions of the current world. One such issue in the current century is the environmental crisis, which the higher education curriculum must address appropriately to act in solving this crisis. Accordingly, this research attempted to explore the characteristics of the desired environmental education curriculum elements based on the "Aker" approach.

The research result is the presentation of a proposed curriculum model for environmental education in higher education, consisting of ten elements based on the "Aker" approach. In other words, findings showed that the environmental education curriculum model for higher education based on the "Aker" approach had 87 concepts across 10 elements; including 13 concepts for program logic, 15 for program objectives, 13 for educational content, 7 for teaching and learning activities, 9 for instructor characteristics, 7 for educational materials and resources, 5 for educational space or setting, 8 for grouping, 4 for instructional time, and 6 for evaluation. Other findings indicated that the factor loadings, average variance extracted, and composite reliability of the elements were

respectively higher than 0.40, 0.50, and 0.70. The fit of the environmental education curriculum model for higher education based on the "Aker" approach was appropriate, with all path coefficients being higher than 0.50 and significant at the 0.001 level. These findings are consistent with previous studies (Hernawan et al., 2021; Moftooh et al., 2022; Obasi & Osah, 2022; Parhizkar & Fathi Vajargah, 2022; Samadi, 2022).

In this model, with a holistic approach, individual and social needs for environmental preservation should be considered with the ultimate goal of achieving sustainable development. To achieve this, the curriculum content should be a collection of environmental knowledge, attitudes, and skills of high scientific validity and relevance, aligned with local, national, and cultural standards, student interests and needs, and presented in an active, problem-based, and context-oriented manner, especially aligning with modern technologies. Based on the obtained results, teaching and learning activities should be in accordance with learner-centered principles, emphasizing participatory methods based on creative and critical thinking, special attention to information and communication technology, and implemented through various individual and group methods, active participation, exploratory, project-based, problem-solving, using modern educational technologies; particularly, teaching and learning methods should include methods that enable students to learn how to learn through cooperation and intellectual discipline. The educational space or setting refers to the learning environment that encompasses the entire globe. The grouping element also plays an important role as it provides the opportunity for active student participation in the educational process and access to social skills and effective learning. Instructional time, as "assignment time," is a period for an educational activity related to learners' readiness for learning, leading to actual learning, and featuring characteristics such as formal and informal, flexible, according to students' wishes and needs. Evaluation should be a continuous process focusing on students' progress, using various tools like behavior and performance observation, self-assessment, etc. Based on the

findings of this research, the following recommendations are offered for users of research results:

Based on the characteristics obtained for the "program logic" element in the environmental education curriculum model, the individual and social needs of students should be more prominently considered by officials and stakeholders, and effective measures for environmental education and learning in universities and higher education institutions should be taken. As one of the goals of higher education is to contribute to sustainable development, and this is only possible through structured and planned education.

Given the proposed model, it is recommended that cognitive objectives or educational program objectives in the environmental education curriculum be considered as a basic and simple subject so that complex discussions and their relationship with humans are deemed important. Also, the affective objectives of environmental education should be considered as an educational approach that acquaints students with various values, positive ethical behaviors and tendencies such as responsibility, commitment, and environment-friendly behavior. In the psychomotor objectives domain, appropriate learning opportunities should be used for direct experience acquisition, enabling learners to perform appropriate and worthy actions and reactions with the environment.

Based on the characteristics of the educational content element, it is suggested that in the development and organization of this element, different curriculum structuring approaches and integrative, linear, spiral, and hierarchical approaches appropriate for different conditions and subjects, as well as various educational levels, be used to assist in acquiring useful learner experiences and improving their learning quality.

Considering the characteristics of the teaching and learning activities element, since these activities are the practical or operational part of the curriculum, students should have the opportunity to gain useful and effective learning experiences through them. Therefore, it is recommended that teaching and learning methods of exploratory, problem-solving, project-based types, and those aligned with students' interests and needs, be selected. Also, some of these activities should be formally conducted in class and some informally in nature and the environment with the cooperation and participation of all students.

Regarding the instructor characteristics element, it is mentioned that officials should be careful in selecting instructors who are of acceptable scientific, ethical, and belief competencies, act as responsible facilitators and

supporters, are sensitive to students' needs and interests to increase their motivation and eagerness to learn, and can analyze environmental issues, select appropriate teaching approaches, and use them correctly.

Another element of the proposed environmental education curriculum in higher education is the educational materials and resources element. Based on the results obtained, it is recommended that in selecting this element, principles such as diversity and abundance, primary and validity, and necessary connection with other curriculum elements (objectives, content, teaching and learning activities) be considered. Also, it should be available to students in both physical or non-digital forms such as printed materials and educational videos, and non-physical or digital forms such as visual and auditory media, internet resources, and social networks.

Based on the characteristics of the educational space or setting element in the environmental education curriculum, planners and officials should consider this element as a learning environment and venue for activities and learning experiences, and in their forecasting and decision-making, consider both classroom space and outside classroom settings (natural environment) because the educational environment in environmental education extends to the entire Earth.

Based on the research findings on the grouping element in the environmental education curriculum, it is recommended to planners and educational affairs managers at universities to always consider this element from two perspectives: one, social objectives including the development of a sense of duty and group loyalty, a feeling of belonging to the group, and strengthening multiple interactions, and the other, educational objectives including qualities such as judgment and evaluation of ideas, thoughts, and examining and confronting learners' progress.

Regarding the instructional time element, which serves as "assignment time" for an educational activity related to learners' readiness for learning and leads to actual learning, it is recommended to planners and stakeholders to consider characteristics such as formality and informality, flexibility, according to the wishes and needs of students, in their decision-making.

Based on the results obtained for the evaluation element, it is suggested that in implementing this element, principles such as process-orientedness and based on learners' knowledge, attitudes, and skills be considered, and various methods like performance tests, behavior observation, self-

assessment, etc., be used to accurately judge the extent of students' learning.

Authors' Contributions

In this study, the authors had equal collaboration.

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 declare that there was no conflict of interest.

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Ethical Considerations

In this study, ethical considerations were observed, and all samples from both qualitative and quantitative sections were informed about them.

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