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Designing a Higher Education Development Model for Achieving Sustainable Development: A Case Study of Technical and Vocational Universities in West Azerbaijan Province

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A B S T R A C T

Purpose: This study aimed to design a comprehensive higher education development model for achieving sustainable development in technical and vocational universities in West Azerbaijan Province.

Methods and Materials: This applied qualitative study was conducted in two complementary phases. In the first phase, a meta-synthesis approach based on the seven-step model of Sandelowski and Barroso was used to identify and integrate conceptual components extracted from previous studies. Relevant Persian and English studies published between 2005 and 2025 were systematically searched in valid scientific databases, and after screening and methodological quality assessment using the Critical Appraisal Skills Programme checklist, 46 studies were selected for final analysis. In the second phase, semi-structured interviews were conducted with 23 higher education experts selected through purposive and snowball sampling until theoretical saturation was achieved. The interview data were analyzed using thematic analysis. The credibility and dependability of the findings were examined through expert review, participant validation, independent coding, and coder agreement.

Findings: The inferential synthesis of the meta-synthesis and thematic analysis indicated that sustainable higher education development is a multidimensional construct requiring the integration of managerial, educational, environmental, research-based, entrepreneurial, and social mechanisms. The final model included five overarching dimensions: strategic sustainability management, environmental management, education and learning for sustainability, sustainable innovation and entrepreneurship, and social responsibility. These dimensions were organized into 28 organizing themes and 125 basic themes. The results indicated that the realization of sustainable development in technical and vocational universities depends on coordinated governance, green resource management, curriculum integration of sustainability, applied green research, university–industry collaboration, responsible consumption, student empowerment, environmental ethics, and continuous evaluation of sustainability programs.

Conclusion: The proposed model provides an evidence-based and context-sensitive framework for guiding policy-making, strategic planning, institutional governance, and operational improvement in technical and vocational universities. By integrating sustainability into management, education, research, infrastructure, entrepreneurship, and social responsibility, the model can support universities in becoming active drivers of sustainable regional development.

Keywords: *Sustainable development; higher education; technical and vocational universities; meta-synthesis; thematic analysis; sustainable university.*

1. Introduction

In recent decades, sustainable development has become one of the most influential paradigms in public policy, institutional governance, educational planning, and organizational transformation. The increasing intensity of environmental degradation, climate change, resource scarcity, social inequality, technological disruption, and labor-market instability has demonstrated that development cannot be reduced to economic growth alone. Rather, development must be understood as a multidimensional process that integrates economic viability, social justice, environmental responsibility, cultural responsiveness, and institutional resilience. In this context, education systems, especially higher education institutions, have acquired a central role because they are responsible not only for producing and disseminating knowledge, but also for shaping human capital, social values, professional competencies, and innovation capacities required for sustainable futures (Akinsemolu & Onyeaka, 2025; McCowan, 2023; Serafini et al., 2022).

Higher education institutions occupy a strategic position in the realization of sustainable development goals because they influence nearly all dimensions of social transformation. Universities educate future managers, teachers, engineers, entrepreneurs, policymakers, and citizens; therefore, the knowledge, attitudes, and competencies cultivated in universities can directly affect the direction of national and regional development. From this perspective, higher education is not merely a sector that must adapt to sustainability requirements, but a key institutional driver capable of accelerating sustainable development through teaching, research, governance, innovation, and community engagement (McCowan, 2023; Pacheco, 2022). The growing body of research on sustainable development in higher education shows that universities can contribute to sustainability by integrating sustainability into curricula, promoting responsible research, improving environmental performance, enhancing institutional governance, and strengthening partnerships with local communities and industries (Lim et al., 2022; Omazic & Zunk, 2021; Probst, 2022).

The concept of sustainability in higher education is broader than the inclusion of environmental topics in academic programs. It refers to a comprehensive institutional orientation in which sustainability principles are embedded in educational missions, research priorities, campus operations, administrative processes, financial structures, stakeholder relations, and social responsibility programs. Harvey et al. emphasize that defining sustainability in higher education requires attention to institutional values, practical actions, and measurable outcomes, because sustainability becomes meaningful only when it is translated into the daily functions of the university (Harvey et al., 2022). Similarly, systematic reviews have shown that sustainable higher education must be understood as a multidimensional system that links governance, curriculum, research, campus management, digital infrastructure, and societal impact (Bautista-Puig et al., 2020; Serafini et al., 2022). Accordingly, a sustainable university is not simply a university that teaches sustainability; it is an institution that organizes itself according to sustainability principles.

One of the most important dimensions of sustainable higher education is education for sustainable development. Education for sustainable development aims to equip learners with the knowledge, skills, values, and decision-making capacities needed to address complex sustainability challenges. In higher education, this requires moving beyond fragmented and theoretical instruction toward competency-based, interdisciplinary, practice-oriented, and problem-centered learning. Studies on sustainability competencies have highlighted systems thinking, anticipatory thinking, normative competence, strategic competence, collaboration, critical thinking, self-awareness, and integrated problem-solving as essential competencies for sustainability-oriented graduates (Hammer & Lewis, 2023; Michel et al., 2023). These competencies are particularly important because sustainability problems are complex, uncertain, and interconnected; therefore, students must learn how to

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analyze problems across social, economic, environmental, and institutional dimensions rather than through isolated disciplinary perspectives.

The integration of sustainability competencies into curricula has become an important concern for higher education institutions. Research indicates that students' interest in learning sustainability competencies is shaped by their perceptions of relevance, future professional needs, institutional support, and the practical orientation of educational programs (Hyytinen et al., 2023). Other studies have shown that universities face challenges in embedding sustainability in academic programs, including lack of faculty readiness, insufficient interdisciplinary coordination, weak institutional incentives, and limited alignment between sustainability learning outcomes and labor-market demands (Acevedo-Duque et al., 2023; Idoiaga Mondragon et al., 2023). Therefore, curriculum development for sustainability must be systematic, context-sensitive, and connected to the needs of both students and society. In this regard, studies conducted in Iran have also emphasized the necessity of integrating sustainable development into macro-level curriculum planning and higher education programs (Arefi, 2023; Sarzehi, 2021).

Teachers and faculty members play a decisive role in the successful implementation of education for sustainable development. Even when sustainability is included in formal policy documents or curriculum frameworks, its actual implementation depends largely on educators' beliefs, competencies, motivations, and institutional support. Acut et al. showed that teachers' intentions to integrate education for sustainable development into curricula are influenced by multiple determinants, including perceived usefulness, attitudes, institutional expectations, and professional readiness (Acut et al., 2025). This finding is especially relevant for higher education systems in which sustainability education is still developing and requires stronger professional development mechanisms. If faculty members are not adequately prepared to teach sustainability concepts, use participatory methods, and connect theoretical knowledge to real-world problems, sustainability education may remain superficial and symbolic rather than transformative.

Another critical dimension of sustainable higher education is the relationship between universities and the labor market. Sustainable development requires graduates who can respond to emerging economic, technological, environmental, and social needs. Finnveden and Schneider argue that industries increasingly require sustainability-related skills, indicating that higher education must align its programs with green competencies, responsible innovation, resource efficiency, and sustainable production systems (Finnveden & Schneider, 2023). This issue is particularly significant for technical and vocational universities, which are closely connected to workforce preparation, skill formation, applied technology, and industry collaboration. Unlike purely theoretical academic institutions, technical and vocational universities can directly link sustainability education with professional practice through workshops, laboratories, internships, applied research, green entrepreneurship, and university–industry partnerships.

Technical and vocational universities have a distinctive capacity to operationalize sustainable development because their educational mission is skill-based and practice-oriented. These institutions can develop green skills, promote sustainable technologies, support environmental entrepreneurship, reduce resource consumption in workshops and laboratories, and produce graduates capable of implementing sustainability principles in industrial and service sectors. However, this potential requires a coherent model that connects curriculum, management, research, infrastructure, finance, community engagement, and industry collaboration. Without such a model, sustainability-related activities may remain scattered, short-term, and dependent on individual initiatives rather than becoming part of institutional strategy. The importance of such integration is supported by studies that emphasize the role of sustainable communities, organizational strategies, and institutional coordination in higher education sustainability (Biancardi et al., 2023; Rodriguez-Zurita et al., 2025).

Governance is another essential component of sustainable development in higher education. Good governance provides the institutional conditions necessary for sustainability by promoting transparency, accountability, participation, responsiveness, strategic planning, and ethical decision-making. Omri and Mabrouk argue that good governance is central to achieving sustainable development goals because institutions that lack effective governance mechanisms are less able to implement long-term sustainability policies (Omri & Mabrouk, 2020). In universities, sustainable governance includes green administrative structures, transparent financial systems, evidence-based decision-making, participatory management, continuous evaluation, and institutional accountability. These elements are particularly important in contexts where universities face resource constraints,

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administrative fragmentation, and competing policy priorities.

In addition to governance, campus operations and environmental management constitute important aspects of sustainable higher education. Universities consume energy, water, materials, land, and financial resources, and they generate waste, emissions, and environmental impacts. Therefore, environmental management in universities requires policies and actions such as energy efficiency, renewable energy development, waste reduction, green procurement, sustainable building design, laboratory safety, and environmental monitoring. Future-oriented research on university sustainability scenarios shows that universities must move beyond symbolic environmental commitments and adopt long-term strategic approaches to sustainability transformation (Beynaghi, 2016). Moreover, studies in the Iranian higher education context indicate that sustainability dimensions differ across public and non-governmental universities and must be analyzed according to institutional structure, governance model, and operational capacity (Darabi et al., 2020).

Digital transformation also has implications for sustainable higher education. Learning management systems, open educational resources, digital platforms, and technology-supported learning can contribute to sustainability by expanding access, reducing dependence on printed materials, supporting flexible education, and facilitating international academic cooperation. Kerimbayev et al. highlighted the role of LMS Moodle in distance international education and cooperation among higher education institutions, demonstrating how digital infrastructure can support educational connectivity across contexts (Kerimbayev et al., 2016). Tavakoli et al. also emphasized the value of labor-market information-driven personalized open educational resource recommendation systems for lifelong learners, showing that digital tools can help align learning with evolving labor-market needs (Tavakoli et al., 2020). For technical and vocational universities, digital systems can support sustainability through e-learning, digital administration, online skill development, resource optimization, and data-driven planning.

In Iran, the issue of sustainable development in education and higher education has received increasing scholarly attention. Several studies have attempted to identify strategies, models, and components of sustainable educational development in national and regional contexts. Abdollahi et al. presented a paradigm model of sustainable educational development with emphasis on the local ecosystem of Iran's educational system, highlighting the importance of contextualized and ecosystem-based approaches (Abdollahi et al., 2024). Amian et al. modeled key factors of sustainable development education strategies at Farhangian University and showed that sustainable education requires integrated attention to organizational, educational, and strategic components (Amian et al., 2024). Kazemi et al. identified curriculum elements based on sustainable development in higher education, indicating the need to redesign educational content, learning objectives, and pedagogical approaches in line with sustainability principles (Kazemi et al., 2025). Jahanbakhsh et al. also proposed a higher education model for achieving sustainable development components in the Pars South region, emphasizing the importance of regional needs and local development conditions in higher education planning (Jahanbakhsh et al., 2024).

Despite the expansion of research on sustainability in higher education, several gaps remain. First, many studies focus on specific aspects of sustainability, such as curriculum, environmental management, governance, or student competencies, while fewer studies provide comprehensive models that integrate these dimensions into a coherent institutional framework. Second, much of the existing literature has been conducted in general university settings, whereas technical and vocational universities require special attention because of their direct relationship with skills training, applied technologies, industry needs, and regional development. Third, sustainable higher education models must be sensitive to local conditions, because the challenges and capacities of universities vary according to regional economy, culture, educational infrastructure, governance arrangements, and labor-market structure. Therefore, developing a localized model for technical and vocational universities can contribute both to theoretical understanding and practical policy-making in the field of sustainable higher education.

West Azerbaijan Province, as a region with specific educational, economic, cultural, industrial, and environmental characteristics, provides an important context for examining sustainable higher education development in technical and vocational universities. These universities can play a significant role in preparing skilled human resources, strengthening green entrepreneurship, supporting sustainable industry, promoting responsible consumption, and enhancing regional innovation capacity. However, fulfilling this role requires a comprehensive and evidence-

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based model that identifies the main dimensions and components of sustainable higher education development and explains how they can be operationalized in university management, education, research, infrastructure, and social responsibility. Such a model can help policymakers, university administrators, faculty members, and planners move from fragmented sustainability initiatives toward an integrated institutional strategy.

The aim of the present study is to design a higher education development model for achieving sustainable development in technical and vocational universities of West Azerbaijan Province.

2. Methods and Materials

Methodology constitutes the foundation of every science, and the credibility and value of scientific findings depend on the precision with which the method is selected and implemented. Every scientific study requires the use of systematic and reliable methods for data collection and analysis in order to achieve valid results. Therefore, a precise explanation of the research process is considered an important part of the research procedure. The present study was designed with a qualitative approach and conducted in two complementary phases with the aim of identifying and explaining the conceptual dimensions of the subject under investigation. In the first phase, the meta-synthesis method was used to extract and integrate the findings of previous studies, and in the second phase, semi-structured interviews and thematic analysis were employed to deepen and explain the extracted dimensions and components. The use of these two phases made it possible to systematically combine existing theoretical knowledge with experts' viewpoints and led to the development of a comprehensive evidence-based framework.

The present study is classified as applied research in terms of purpose, because its findings can provide a basis for analysis and for proposing scientific solutions in the field under study. In terms of method, this study falls within the framework of qualitative research and was conducted using meta-synthesis and thematic analysis methods. In this approach, first, the main concepts and components of the subject were extracted through a systematic review of scientific sources, and then these concepts were analyzed in greater depth using data obtained from interviews with experts. In the first phase of the study, which was conducted using the meta-synthesis method, the statistical population included all articles and scientific studies related to the research topic that had been published in valid scientific databases between 2005 and 2025. To identify these sources, a systematic search was conducted in the international databases Scopus, Web of Science, ERIC, Springer, and ScienceDirect, as well as in the Persian databases SID, MagIran, Noormags, and Civilica. The sampling process in this phase was purposive and was conducted based on the seven-step model of Sandelowski and Barroso. In the first step, an initial search of sources was conducted using specialized keywords, resulting in the identification of approximately 250 articles. In the second step, preliminary screening was performed; the titles and abstracts of the articles were reviewed to determine their relevance to the research topic, and irrelevant studies were excluded. In the third step, the full texts of the remaining articles were carefully reviewed, and the studies were evaluated based on methodological criteria. Criteria such as clarity of the research objective, appropriateness of the research method, specification of the population and sample, accuracy in data collection, and coherence in the analysis of findings were among the indicators considered at this stage.

To assess the quality of the selected studies, the Critical Appraisal Skills Programme (CASP) checklist was used. This instrument is one of the valid tools for evaluating the quality of qualitative studies and assesses indicators such as clarity of the research question, appropriateness of the research design, sampling procedure, data collection method, accuracy of data analysis, and validity of the results. Based on this assessment, only articles that obtained at least 75% of the required score entered the final stage of meta-synthesis. Ultimately, after fully applying the inclusion and exclusion criteria and reaching theoretical saturation, 46 articles were selected as the final sample and served as the basis for coding and concept extraction. The following table presents the inclusion and exclusion criteria for articles in the meta-synthesis phase.

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Table 1

Inclusion and Exclusion Criteria for Articles in the Meta-Synthesis Phase

Criterion	Inclusion Criterion	Exclusion Criterion
Article title	Related to the research topic	Unrelated to the research topic
Abstract	Indicates relevant objectives and findings	Lacks relevance to the topic
Article content	Includes analysis related to the topic	Lacks relevant analysis
Methodological quality	Score higher than 75% on the CASP tool	Score lower than 75%

After the final studies were selected, the process of coding and concept extraction was conducted, and similar concepts were classified into conceptual categories. To ensure the validity of the results of the meta-synthesis phase, several strategies were used. First, the process of searching and selecting sources was conducted systematically and step by step in order to reduce the possibility of bias in study selection. Second, the inclusion and exclusion criteria were determined in advance, and all articles were reviewed based on these criteria. Third, the methodological quality of the studies was assessed using the CASP checklist. Part of the results of the quality assessment of the selected studies is presented in the following table.

Table 2

Results of Quality Assessment of Studies Using the CASP Tool

No.	Source	Data Collection	Statistical Population	Research Design	Results	Score
1	(Acut, Lobo, & Garcia, 2025)	22	20	23	21	86
2	(Akinsemolu & Onyeaka, 2025)	20	18	22	23	83
3	(Biancardi et al., 2023)	20	21	20	22	83
4	(McCowan, 2023)	21	22	24	23	90
5	(Omri & Mabrouk, 2020)	20	18	19	21	78
6	(Probst, 2022)	21	19	22	21	83
7	(Tavakoli, Mol, & Kismihók, 2020)	23	23	25	24	95
8	(Lim et al., 2022)	21	20	23	21	85
9	(Beynaghi et al., 2016)	19	18	21	22	80
10	(Kazemi, Asareh, & Emamjomeh, 2025)	23	22	24	23	92
11	(Serafini et al., 2022)	18	20	20	19	77
12	(Pacheco, 2022)	17	19	21	20	77

The reliability of the meta-synthesis phase refers to the stability of the coding process and the classification of concepts. To assess this issue, a number of articles were independently coded by two researchers, and the level of agreement between them was calculated using Cohen's kappa coefficient. The kappa coefficient was calculated as 0.673, indicating an acceptable level of agreement between coders and, consequently, appropriate reliability of the analysis process.

The second phase of the study was conducted with the aim of deepening and explaining the findings of the meta-synthesis phase and identifying more precise dimensions of the subject. The statistical population of this section included experts and specialists familiar with the research domain. These individuals were mainly selected from among university faculty members and specialists in the relevant field. The sampling method in this phase was purposive with a snowball approach. In purposive sampling, the researcher selects individuals who possess the greatest knowledge, experience, and awareness of the research topic and can provide rich and valuable information. Subsequently, using the snowball method, the initial participants were asked to introduce other individuals with relevant expertise. This process continued gradually until the data reached theoretical saturation; that is, new information no longer led to the creation of a new concept or theme. The criteria for selecting participants included having a doctoral degree, having at least four years of professional experience in the relevant field, being between 35 and 65 years of age, having specialized familiarity with the research topic, and willingness to participate in the study. Based on these criteria, a total of 23 experts were selected as the final sample.

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The data collection instrument in this phase was the semi-structured interview. The interview guide was designed based on the findings of the meta-synthesis phase and included a set of open-ended questions that allowed participants to freely express their views. Each interview lasted an average of 30 to 60 minutes and, after obtaining the participants' consent, was recorded and then fully transcribed. The data obtained from the interviews were analyzed using thematic analysis. In this method, initial codes were first extracted from the interview texts; then similar codes were classified into basic themes, and finally, organizing and overarching themes were formed. Several strategies were used to enhance validity in the thematic analysis phase. First, the interview questions were designed based on the findings of the meta-synthesis phase in order to preserve the logical connection between the research phases. Second, the content validity of the questions was reviewed and revised through consultation with several experts. Third, to enhance interpretive credibility, part of the analysis results was provided to some participants so that the accuracy of the researcher's interpretations could be confirmed.

The reliability of thematic analysis was also assessed by comparing the coding performed by two researchers. Part of the data was independently analyzed by two coders, and the degree of agreement between them was calculated. The results are presented in the following table.

Table 3

Codes Extracted by Two Coders

Codes	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Coder 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Coder 2	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Based on this table, 20 cases of agreement and one case of disagreement were observed between the two coders. The result of this calculation indicated a 95% agreement rate between the coders, demonstrating the appropriate dependability of the coding and data analysis process. Accordingly, it can be stated that the results obtained from the qualitative analysis phase possess acceptable validity and reliability, and that the extracted conceptual framework was formed on the basis of valid data.

3. Findings and Results

To answer the research question concerning the identification of the dimensions and components of the higher education development model for achieving sustainable development, the meta-synthesis method was used. The meta-synthesis process in this study was conducted based on the seven-step model of Sandelowski and Barroso. In the first step, the research question was designed in such a way that it could identify the main dimensions of higher education development in line with the realization of sustainable development, as well as the components associated with each of these dimensions. The main objective of this phase was to extract the conceptual patterns available in the theoretical literature and to integrate the findings of previous studies.

In the second step, a systematic search of scientific sources was conducted. For this purpose, valid domestic and international databases were reviewed. At this stage, articles were retrieved using keywords such as "higher education development," "sustainable development in higher education," "sustainable university," "sustainable university management," and "green higher education." The time span for English-language studies was considered to be 2015 to 2025, and the time span for Persian-language studies was considered to be 2015 to 2025. After the initial search, a set of relevant articles was identified and then screened based on the inclusion and exclusion criteria. In the next stage, the extracted articles were reviewed in terms of title, abstract, content, and methodological quality. Studies that were not directly related to the research topic or lacked the required scientific quality were excluded from the analysis cycle. To assess the quality of the studies, the Critical Appraisal Skills Programme (CASP) tool was used. In this tool, each article was evaluated based on four main criteria: statistical population, data collection method, research design, and results. Only studies that scored above 75% entered the final analysis stage. Ultimately, 46 scientific sources, including 21 English articles and 25 Persian articles, were selected as the final sources.

In the fourth step, the information extracted from the selected studies was organized and classified. At this stage, all concepts, indicators, and factors related to sustainable higher education development were extracted from the scientific texts and considered as initial codes. These codes were then compared based on conceptual similarities and

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classified into common themes. This process led to the formation of a set of key concepts, each representing one of the dimensions of sustainable higher education development.

In the fifth step, data analysis was conducted through qualitative content analysis. At this stage, the codes extracted from the studies were carefully reviewed and classified into coherent concepts. Similar concepts were then integrated at a higher level, and the main dimensions of the sustainable higher education development model were formed. The data analysis showed that the existing theoretical literature introduces a set of managerial, educational, research-related, environmental, social, and economic components as key elements in achieving sustainable development in the higher education system.

The findings indicated that many studies emphasize the necessity of optimal resource management in universities. Optimal consumption of resources, reduction of energy waste, and use of modern technologies for resource management are among the components referred to in numerous studies. Moreover, the development of renewable energies in universities has been proposed as one of the most important strategies for reducing the environmental impacts of higher education. The use of solar panels, smart energy management, and reduction of the university carbon footprint are among the measures that can play an effective role in achieving sustainable development goals. On the other hand, the educational dimension is also recognized as one of the most important dimensions of sustainable development in higher education. Integrating sustainable development concepts into curricula, teaching environmental skills to students, and strengthening a culture of social responsibility within the university environment are among the components emphasized in many studies. This issue shows that universities, in addition to their educational role, can play an important role in shaping sustainable attitudes and behaviors in society. In the research dimension, the development of applied research in sustainability and support for responsible research are of particular importance. The results of the studies show that universities can play an important role in solving environmental and social problems by orienting their research activities toward these issues. Furthermore, the development of university–industry collaboration has been introduced as one of the key components in achieving sustainable development. Such collaborations can facilitate knowledge transfer, the development of green technologies, and the practical application of research findings.

The social dimension of sustainable higher education development also includes components such as student empowerment, promotion of ethical behaviors in the university environment, evaluation of the social impacts of university programs, and strengthening university–community engagement. This dimension indicates that universities must play an active role in social development and the improvement of quality of life in society, in addition to education and research. Ultimately, the analysis and integration of the findings of the studies showed that achieving sustainable development in higher education requires a comprehensive and multidimensional approach that simultaneously encompasses managerial, educational, research-related, environmental, social, and economic dimensions. Accordingly, a set of key dimensions and components was extracted, forming the conceptual framework of the higher education development model for achieving sustainable development. The following table presents the most important concepts extracted from the research literature.

Table 4

Concepts Extracted from the Theoretical Literature on Sustainable Higher Education Development

Concepts	Sources	Frequency
Optimal consumption of university resources	(Biancardi et al., 2023), (Harvey et al., 2022), (Omazic & Zunk, 2021), (Probst, 2022)	4
Teaching environmental skills	(Akinsemolu & Onyeaka, 2025), (Acevedo-Duque et al., 2023), (Hyytinen et al., 2023)	3
Life cycle assessment of projects	(Serafini et al., 2022), (Pacheco, 2022), (Lim et al., 2022), (Probst, 2022), (Bautista-Puig et al., 2020)	5
Redesigning the green administrative structure	(Omri & Mabrouk, 2020), (Biancardi et al., 2023), (Harvey et al., 2022), (Omazic & Zunk, 2021), (Darabi et al., 2020), (Beynaghi et al., 2016)	6
Reducing university waste	(Biancardi et al., 2023), (Serafini et al., 2022), (Lim et al., 2022), (Harvey et al., 2022)	4
Development of renewable energies	(Akinsemolu & Onyeaka, 2025), (Serafini et al., 2022), (Biancardi et al., 2023), (Beynaghi et al., 2016), (Lim et al., 2022), (Probst, 2022), (Omazic & Zunk, 2021)	7
Implementation of smart energy management	(Biancardi et al., 2023), (Harvey et al., 2022), (Serafini et al., 2022)	3

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Reducing the campus carbon footprint	(Akinsemolu & Onyeaka, 2025), (Serafini et al., 2022), (Biancardi et al., 2023), (Lim et al., 2022)	4
Responsible procurement of equipment	(Harvey et al., 2022), (Omri & Mabrouk, 2020), (Biancardi et al., 2023), (Omazic & Zunk, 2021), (Serafini et al., 2022)	5
Integration of sustainability courses	(Kazemi et al., 2025), (Acevedo-Duque et al., 2023), (Michel et al., 2023)	3
Designing low-consumption laboratories	(Biancardi et al., 2023), (Serafini et al., 2022), (Lim et al., 2022), (Harvey et al., 2022), (Probst, 2022), (Beynaghi et al., 2016)	6
Establishing a transparent financial structure	(Omri & Mabrouk, 2020), (Biancardi et al., 2023), (Harvey et al., 2022), (Omazic & Zunk, 2021)	4
Sustainability financial reporting	(Serafini et al., 2022), (Pacheco, 2022), (Darabi et al., 2020)	3
Optimization of digital systems	(Kerimbayev et al., 2016), (Tavakoli et al., 2020), (Lim et al., 2022), (Serafini et al., 2022), (Probst, 2022)	5
Development of applied green research	(Biancardi et al., 2023), (Serafini et al., 2022), (McCowan, 2023), (Probst, 2022)	4
Support for responsible research	(Michel et al., 2023), (McCowan, 2023), (Serafini et al., 2022), (Lim et al., 2022), (Pacheco, 2022), (Probst, 2022)	6
Teaching environmental entrepreneurship	(McCowan, 2023), (Akinsemolu & Onyeaka, 2025), (Rodríguez-Zurita et al., 2025)	3
Promoting ethical university behavior	(Harvey et al., 2022), (Omri & Mabrouk, 2020), (Biancardi et al., 2023), (McCowan, 2023), (Serafini et al., 2022)	5
Assessment of the social impact of programs	(McCowan, 2023), (Rodríguez-Zurita et al., 2025), (Biancardi et al., 2023), (Serafini et al., 2022), (Pacheco, 2022), (Lim et al., 2022), (Probst, 2022)	7
Enhancement of organizational resilience	(Beynaghi et al., 2016), (Omri & Mabrouk, 2020), (Biancardi et al., 2023), (Serafini et al., 2022)	4
Empowerment of sustainable students	(Hyytinen et al., 2023), (Michel et al., 2023), (Acevedo-Duque et al., 2023)	3
Designing green university buildings	(Biancardi et al., 2023), (Serafini et al., 2022), (Lim et al., 2022), (Harvey et al., 2022), (Beynaghi et al., 2016)	5
Expansion of university–industry collaboration	(Finnveden & Schneider, 2023), (McCowan, 2023), (Rodríguez-Zurita et al., 2025), (Biancardi et al., 2023), (Serafini et al., 2022), (Lim et al., 2022)	6
Promotion of equitable resource consumption	(Akinsemolu & Onyeaka, 2025), (Harvey et al., 2022), (Biancardi et al., 2023), (Serafini et al., 2022)	4
Establishment of a knowledge management system	(Michel et al., 2023), (McCowan, 2023), (Probst, 2022)	3

In the final phase of the analysis, the extracted concepts were classified into several main dimensions in order to determine the conceptual structure of the sustainable higher education development model. This classification was conducted based on the semantic similarity of the concepts and the content analysis of the studies. The result of this process showed that the main dimensions of the model include managerial, educational, research-related, environmental, and social dimensions, each of which encompasses a set of related components.

Table 5

Dimensions and Components of the Higher Education Development Model for Achieving Sustainable Development

Concepts	Sources (Codes–Conceptual Propositions)
Optimal consumption of university resources	Developing guidelines for water and electricity consumption; monthly monitoring of resource consumption in faculties; announcing consumption feedback to units; encouraging low-consumption units
Teaching environmental skills	Holding environmental skills workshops for staff and students; incorporating green skills into vocational courses; using practical environmental projects in classes; holding educational campaigns on campus; issuing environmental skills certificates
Life cycle assessment of projects	Requiring life cycle assessment in construction projects; analyzing energy and material consumption in projects; documenting the environmental impacts of projects; using LCA software
Redesigning the green administrative structure	Eliminating paper-based processes and replacing them with electronic systems; simplifying administrative workflow; reducing the number of in-person visits; creating a green administrative management unit or committee; revising regulations with a consumption-reduction approach
Reducing university waste	Waste separation at the source (classrooms, offices, cafeterias); installing separate waste bins in all buildings; signing contracts with recycling companies; reducing the use of disposable containers; implementing waste-reduction awareness programs
Development of renewable energies	Installing solar panels on buildings; using solar water heaters in dormitories and cafeterias; allocating an independent budget to renewable energy projects; collaborating with knowledge-based clean energy companies; monitoring the share of renewable energy in total consumption

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Implementation of smart energy management	Installing smart meters in buildings; scheduling automatic shutdown of equipment outside working hours; using smart heating/cooling management systems; periodic reporting of consumption patterns; setting energy consumption reduction targets
Reducing the campus carbon footprint	Developing green transportation (bicycles, shared shuttle services); restricting car parking in the central campus area; using hybrid/electric service vehicles; planting trees and developing carbon-sequestering green spaces; measuring and reporting the university carbon footprint
Responsible procurement of equipment	Developing green procurement criteria (energy consumption, lifespan, recyclability); requiring environmental assessment in tenders; prioritizing purchases from environmentally friendly producers; documenting green procurement records; monitoring the quality and durability of purchased equipment
Integration of sustainability courses	Adding sustainable development topics to general courses; designing specialized courses centered on sustainability; requiring one sustainability-related course in each field of study; revising curricula based on sustainability criteria; using real sustainability examples in course content
Designing low-consumption laboratories	Using low-consumption laboratory equipment; designing optimized ventilation and lighting; developing energy consumption guidelines for laboratories; training users on optimal use; monitoring energy and material consumption in laboratories
Establishing a transparent financial structure	Providing annual financial reports to all members of the university community; clarifying the budgets of construction and research projects; creating an online system for viewing budget lines; documenting the budget allocation process; conducting internal and external oversight of expenditures
Sustainability financial reporting	Allocating an independent budget line for sustainability programs; reporting the percentage of the budget spent on sustainability; publishing an annual report on sustainability financial performance; assessing the return on investment of green projects; aligning expenditures with sustainable development goals
Optimization of digital systems	Reducing duplication in parallel software systems; integrating educational, research, and administrative systems; improving network speed and stability; reducing the need for printing through digital services; training users for maximum use of systems
Development of applied green research	Defining research priorities in the field of sustainability; financially supporting green research projects; encouraging theses on environmental topics; collaborating with environmental organizations for joint research; publishing results in specialized sustainability journals
Support for responsible research	Developing a code of ethics for environmental research; requiring ethical assessment of sensitive projects; supporting research with positive social impact; ensuring transparency in project funding sources; responsibly reporting research results to society
Teaching environmental entrepreneurship	Incorporating green business topics into entrepreneurship courses; holding environmental startup events; supporting student teams with green ideas; connecting with investors in the field of green technology; establishing an environmental growth center/accelerator
Promoting ethical university behavior	Developing and communicating a sustainability code of ethics; addressing anti-environmental behaviors (littering, wastefulness); encouraging responsible behavior in events and programs; teaching environmental ethics upon students' entry; installing ethical messages in public spaces
Assessment of the social impact of programs	Measuring local community satisfaction with university activities; examining the university's economic impact on the region; assessing the social effects of development projects; using periodic surveys of stakeholder communities; reflecting evaluation results to management for policy correction
Enhancement of organizational resilience	Developing a crisis management plan (floods, earthquakes, power outages); training staff and students to deal with crises; conducting periodic crisis simulation exercises; creating backup infrastructures (servers, emergency power); designing processes for educational continuity during emergencies
Empowerment of sustainable students	Holding sustainability skills courses for students; involving students in real sustainability projects; creating environmental student clubs; granting credit/certificates for green student activities; supporting scientific associations active in sustainability
Designing green university buildings	Using standard thermal insulation; maximizing the use of natural light; installing double-glazed windows and smart systems; designing green spaces with low-water-use species; obtaining green building certificates where possible
Expansion of university–industry collaboration	Signing memoranda of understanding with green industries; defining joint research and development projects in sustainability; creating student internship programs in green companies; inviting industry managers for lectures and workshops; creating a joint university–industry innovation unit
Promotion of equitable resource consumption	Holding awareness campaigns on equitable consumption; installing consumption labels on equipment (optimal/high consumption); teaching responsible consumption in orientation programs; implementing incentive schemes for low-consumption units; publicly informing users about the real cost of consumed resources
Establishment of a knowledge management system	Creating a shared repository of green documents and experiences; recording and sharing successful sustainability experiences; developing standard procedures based on experiences; holding lessons-learned sessions after projects; encouraging members to contribute to the knowledge base

The results of the meta-synthesis show that achieving sustainable development in higher education requires a comprehensive and integrated approach in which managerial policies, educational programs, research activities, and environmental and social measures are implemented in a coordinated manner. Such an approach can provide the basis for the formation of sustainable universities; universities that, in addition to producing knowledge, play an active role in solving environmental and social problems and act as drivers of sustainable development in society. Subsequently, thematic analysis was used to further examine and explain the specialized components dependent on the conditions of West Azerbaijan Province. Accordingly, in the next phase of the study, and in order to explain the meta-synthesis findings

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more precisely, a qualitative approach and thematic analysis based on semi-structured interviews were used. This section of the study was designed with a focus on the 25 aforementioned components in order to use the views, experiences, and perceptions of educational experts to develop the final model. As a result, the components in this section were developed directly based on the themes extracted from the thematic analysis of the interviews and in accordance with the cultural, social, and educational conditions of West Azerbaijan Province.

Table 6

Basic Themes and Extracted Codes from the Experts' Perspective

Extracted Codes	Basic Theme
Developing official guidelines for water and electricity consumption; monthly monitoring of resource consumption; setting an annual consumption-reduction target; periodic reporting to management	Sustainable management of university resources
Holding green skills workshops; incorporating environmental content into courses; implementing practical environmental projects; assessing green skills learning	Teaching environmental competencies
Requiring environmental assessment of projects; conducting sustainable cost–benefit analysis; documenting assessment results; using sustainability indicators in project approval	Sustainability assessment of projects
Eliminating paper-based processes; implementing electronic administrative systems; forming a green management committee; revising regulations with a sustainability approach	Green administrative governance
Establishing a waste separation system; signing recycling contracts; reducing plastic consumption; teaching waste separation	Sustainable waste management
Installing solar panels; allocating a budget for clean energy; measuring the share of renewable energy; implementing joint green energy projects	Development of renewable energies
Installing smart meters; automatic control of heating/cooling systems; periodic reporting of energy consumption; defining energy efficiency indicators	Smart energy management
Annual calculation of the carbon footprint; development of clean transportation; planting trees and expanding green spaces; reducing the use of private vehicles	Carbon footprint reduction
Defining environmental criteria in tenders; prioritizing the purchase of low-consumption equipment; assessing product lifespan; reporting the share of green procurement	Green procurement and purchasing
Designing a course unit related to sustainability; revising syllabi with a sustainable approach; using green case studies; evaluating the learning of sustainability concepts	Integration of sustainability into the curriculum
Using low-consumption equipment; developing guidelines for optimal material consumption; monitoring laboratory energy consumption; training users	Green laboratories
Publishing annual financial reports; providing online access to budget information; documenting project costs; conducting periodic internal audits	Financial transparency and accountability
Allocating a sustainability budget line; attracting external financial resources; economic evaluation of green projects; reporting the return on green investment	Financing sustainability programs
Developing integrated systems; reducing paper printing; training users to use digital systems; monitoring IT infrastructure performance	Sustainable digital infrastructures
Allocating green research grants; prioritizing sustainable topics; publishing applied results; collaborating with environmental institutions	Applied sustainability research
Developing a research ethics code; requiring ethical approval; ensuring transparency of financial sources; honest reporting of results	Research ethics and responsibility
Holding green startup events; supporting green business ideas; creating a specialized growth center; connecting with green investors	University-based green entrepreneurship
Developing an environmental ethics charter; implementing awareness campaigns; encouraging responsible behavior; providing orientation training	Culture of environmental ethics
Surveying local stakeholders; measuring the social impact of projects; reporting social responsibility; revising programs based on feedback	Assessment of social impacts
Developing a crisis management plan; conducting emergency drills; creating backup infrastructure; training for crisis preparedness	Organizational resilience
Participating in green projects; supporting environmental associations; offering incentives for sustainable activities; holding sustainability skills courses	Student empowerment
Using standard thermal insulation; maximizing natural light; using low-consumption materials; complying with green building standards	Green building infrastructures
Signing memoranda of understanding with green industries; defining joint projects; providing green internship opportunities; transferring sustainable technology	Sustainable university–industry collaboration
Implementing consumption-reduction campaigns; installing energy consumption labels; teaching optimal consumption; offering consumption-reduction incentives	Culture of responsible consumption
Creating a repository of green experiences; documenting projects; holding knowledge-transfer sessions; continuously updating organizational knowledge	Organizational knowledge management
Measuring water and air quality; analyzing consumption data; periodic environmental reporting; identifying critical points	Monitoring environmental impacts
Developing LMS; producing digital content; reducing printed resources; providing students with online access	Sustainable e-learning
Defining key performance indicators (KPIs); annual evaluation of programs; receiving stakeholder feedback; correcting and revising policies	Evaluation and improvement of sustainability programs

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Table 7

Extracted Basic, Organizing, and Overarching Themes

Basic Themes	Organizing Theme	Overarching Theme
Sustainable management of university resources Green administrative governance Financial transparency and accountability Financing sustainability programs Organizational knowledge management Evaluation and improvement of sustainability programs Organizational resilience	Strategic sustainability management	Higher education development model for achieving sustainable development
Sustainable waste management Development of renewable energies Smart energy management Carbon footprint reduction Green building infrastructures Green laboratories Monitoring environmental impacts Green procurement and purchasing	Environmental management	Higher education development model for achieving sustainable development
Teaching environmental competencies Integration of sustainability into the curriculum Sustainable e-learning Student empowerment	Education and learning for sustainability	Higher education development model for achieving sustainable development
Applied sustainability research Research ethics and responsibility Sustainability assessment of projects University-based green entrepreneurship Sustainable university–industry collaboration	Sustainable innovation and entrepreneurship	Higher education development model for achieving sustainable development
Culture of environmental ethics Culture of responsible consumption Assessment of social impacts Sustainable digital infrastructures	Social responsibility	Higher education development model for achieving sustainable development

Achieving sustainable development in the higher education system requires simultaneous attention to a set of managerial, economic, environmental, and organizational dimensions that are manifested in the form of policies, programs, and executive measures within the university environment. In this regard, sustainable management of university resources is considered one of the most important pillars of organizational sustainability. This concept refers to a set of systematic strategies and actions designed and implemented with the aim of using the financial, human, physical, and natural resources of the university optimally and responsibly. Universities, as institutions that generate knowledge and train specialized human resources, play an important role in modeling efficient resource management. Sustainable resource management in the university environment requires strategic planning, continuous monitoring of resource consumption, and the implementation of corrective policies to reduce waste and increase efficiency. Attention to the management of water, energy, and consumable materials in universities can prevent resource wastage and enhance organizational productivity. One participant stated in this regard: “In our faculty, we tried to carefully monitor the consumption of water, electricity, and workshop equipment so that the limited resources of the university would not be wasted and we could plan for the coming years.” Field experiences also show that recording and analyzing resource consumption can lead to cost reduction and increased efficiency; as one interviewee noted: “When we regularly recorded and analyzed the consumption of workshop materials and energy, we realized that with a little management, costs could be reduced and university productivity could be increased.”

Alongside resource management, green administrative governance is also regarded as one of the key components in moving universities toward sustainable development. This approach emphasizes the reform of administrative structures and processes with the aim of reducing environmental impacts and increasing organizational responsibility. The use of digital technologies to reduce paper consumption, the implementation of administrative automation systems, and the creation of electronic archives are among the measures that can increase the efficiency of the administrative system and reduce resource consumption. In addition, creating managerial structures for planning and supervising

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environmental activities, forming green management committees, and developing indicators for evaluating environmental performance are among the actions proposed within the framework of green administrative governance. Practical experiences also show that moving toward electronic processes can bring about significant changes in organizational behavior; as one manager stated: "We tried to make the faculty's administrative processes more electronic so that paper consumption would decrease and decisions would be made with a more responsible view toward the university environment." It has also been emphasized that attention to environmental consequences in managerial decision-making can gradually strengthen a culture of environmental responsibility within the university administrative system.

Financial transparency and accountability are also among the important components of good governance in universities. Financial transparency means providing accurate, accessible, and understandable information about how financial resources are allocated and spent so that different stakeholders can evaluate the financial performance of the organization. The existence of financial reporting systems, publication of annual reports, and creation of electronic systems for accessing financial information can help increase trust and improve managerial decision-making. Financial accountability also refers to managers' responsibility regarding the way resources are managed and the outcomes of financial decisions, and it requires effective oversight mechanisms such as auditing and financial controls. In this regard, one interviewee stated: "When reports on costs and revenues were transparently provided to managers and even some units, trust increased and decisions were made more logically." It has also been emphasized that providing transparent information about how financial resources are spent can increase the trust of staff and other stakeholders and provide the basis for more accurate financial planning.

Financing sustainability programs is also one of the important requirements for achieving sustainable development in universities. The implementation of many sustainability-related projects, including energy optimization, development of green infrastructures, and implementation of educational and research programs in the field of the environment, requires sufficient and sustainable financial resources. Allocating a specific budget line for sustainability programs in the university's financial structure is a sign of organizational commitment to achieving sustainable development goals. In addition to internal resources, the use of external financial resources, such as collaboration with industry, governmental organizations, and supporting institutions, can also play an important role in financing sustainability projects. One participant stated in this regard: "To implement some projects, we had to use collaboration with industry and even students' vocational projects to create new financial resources for the university." Practical experiences also show that relying solely on governmental financial resources can prevent the implementation of many development projects; as one interviewee noted: "If the university only waits for government funding, many environmental and infrastructure improvement projects will not be implemented at all."

Organizational knowledge management is another important component of sustainable development in universities. This concept refers to the process of identifying, recording, storing, and transferring organizational knowledge and experiences, and it can contribute to improved decision-making and increased innovation in the organization. Documenting experiences obtained from educational and research projects and activities, creating information banks, and holding scientific meetings and educational workshops are among the actions that can facilitate knowledge transfer within the organization. In this regard, one interviewee stated: "We have valuable experiences in workshops and vocational projects that, if not recorded and transferred, will practically be lost when people leave." It has also been emphasized that documenting the experiences of professors and instructors can help transfer knowledge to future generations and prevent the loss of knowledge capital.

Continuous evaluation and improvement of sustainability programs are also among the important elements of sustainable university management. The implementation of sustainability programs without regular evaluation mechanisms cannot lead to desirable outcomes. Defining performance indicators to measure the achievement of goals, collecting relevant data, and analyzing results can help identify the strengths and weaknesses of programs. In this regard, the participation of university stakeholders is also highly important, and receiving feedback from staff and students can contribute to program improvement. One interviewee stated in this regard: "Every program we implement at the university must be reviewed after some time to see whether it has really had an effect or has only been a symbolic activity." It has also been emphasized that continuous evaluation of programs makes it possible to correct and improve performance.

Organizational resilience is also considered one of the important characteristics of sustainable universities. This concept refers to the organization's ability to adapt to changing conditions, cope with crises, and maintain continuity of activities. Universities may face challenges such as financial crises, technological disruptions, or social and health crises, and therefore they need flexible structures and crisis management programs. Field experiences also show that flexible planning can make it possible to continue educational and research activities even under difficult conditions. In this regard, one participant noted: "A successful university is one that can adapt itself under conditions of budget shortages or rapid changes and continue vocational education without interruption."

Alongside managerial and organizational dimensions, attention to environmental issues is also one of the important elements of sustainability in universities. Sustainable waste management is one of the most important measures in this area. Educational and research activities in universities lead to the production of various types of waste, including ordinary, laboratory, and electronic waste, and proper management of these wastes is highly important for environmental protection. Reducing waste generation at the source, separating recyclable materials, and safely managing hazardous waste are among the strategies considered in this area. Practical experiences also show that proper management of workshop waste can prevent environmental problems; as one interviewee stated: "A large amount of waste is produced in technical workshops, and if it is not properly managed, it both creates costs and harms the environment."

Another important measure in the field of sustainability is the development of renewable energies in universities. The use of solar energy and other clean energy sources can help reduce dependence on fossil fuels and lower energy costs. Installing solar panels in university buildings, in addition to supplying part of the required energy, can also be used as an educational and research opportunity for students. One participant stated in this regard: "Technical universities are the best place for the experimental use of solar panels, because we both teach and create a practical model for students."

Smart energy management is also one of the important tools for reducing energy consumption in universities. The use of energy consumption monitoring systems, building management systems, and smart equipment can provide the possibility of precise control over energy consumption and reduce the university's operational costs. Executive experiences also show that installing smart control systems can result in a significant reduction in energy consumption; as one participant noted: "When we installed smart electricity and lighting control systems, energy consumption in educational buildings decreased noticeably."

Finally, measures such as reducing the carbon footprint, developing green buildings, creating green laboratories, monitoring environmental impacts, and implementing green procurement policies are among other important strategies for moving universities toward sustainable development. These measures not only help reduce the environmental impacts of university activities, but can also turn the university into a practical model for other social institutions on the path toward sustainable development. Field experiences also show that appropriate building design, proper management of laboratory materials and equipment, and attention to the environmental impacts of activities can play an important role in improving the quality of the university environment and increasing resource efficiency. Accordingly, achieving sustainability in universities requires a comprehensive and integrated approach in which managerial, financial, environmental, and cultural dimensions are addressed in a coordinated manner. Such an approach can provide the basis for improving university performance and enabling universities to play an effective role in achieving sustainable development goals.

In the process of analyzing and presenting the higher education development model for achieving sustainable development, with a focus on technical and vocational universities in West Azerbaijan Province, 125 basic themes were first identified. These themes included a wide range of behaviors, skills, attitudes, and educational and cultural methods. The basic themes were located in the domains of social participation, communication skills, social belonging, responsibility, social vitality, policymaking, environment, and governance, and each specifically responded to part of the needs of higher education development for achieving sustainable development. Through the examination and analysis of the basic themes, and by using thematic analysis and integrating the concepts presented in related scientific and research sources, overlapping or related themes were consolidated into 28 organizing themes. The purpose of this phase was to simplify and systematize the components and conceptual dimensions and make them usable for the higher education development model for achieving sustainable development. As a result, these 28 organizing themes provide a focused and systematic framework for the higher education development model for achieving sustainable

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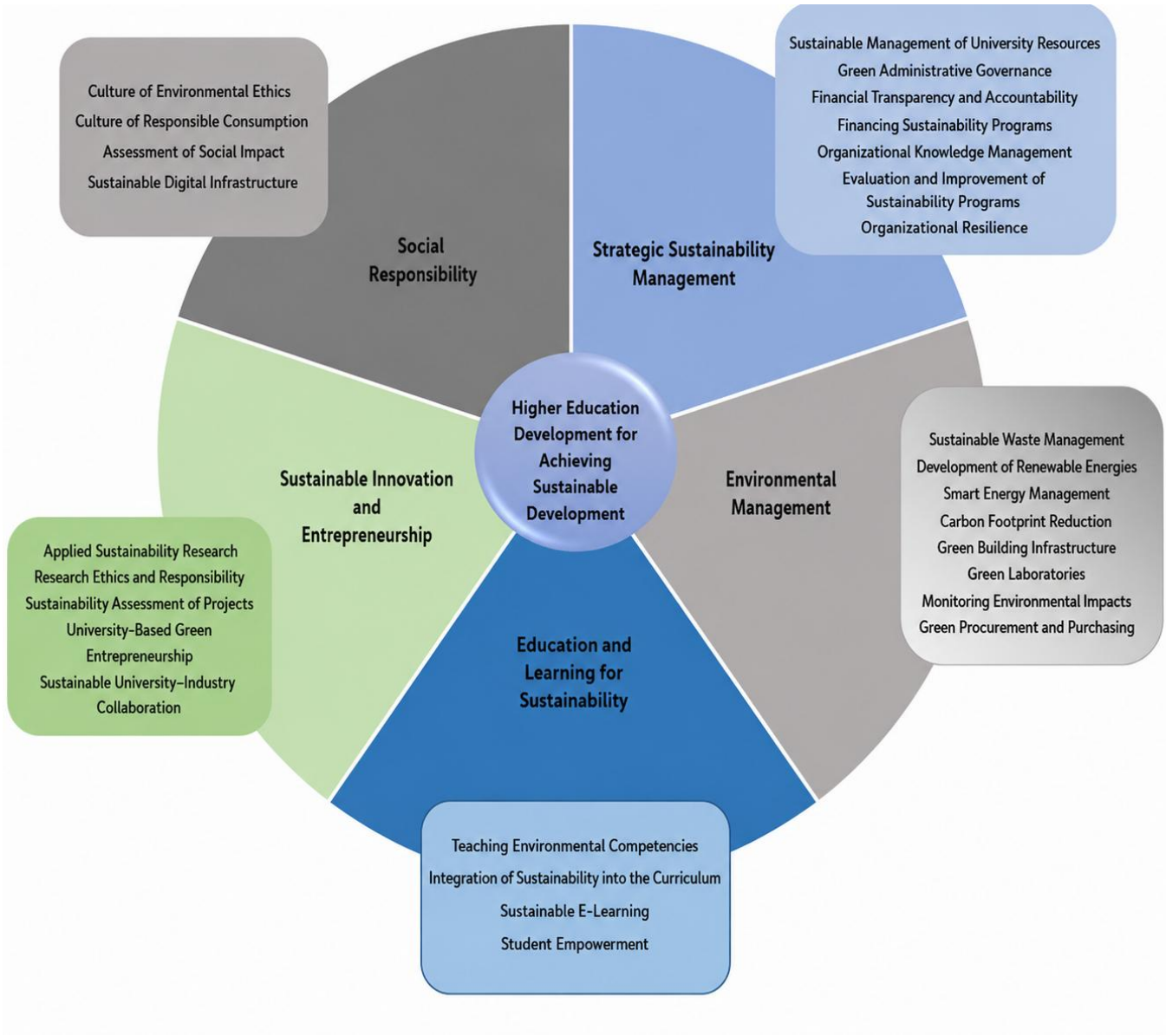
development. This model, particularly for educational policymakers, instructors, and university administrators, serves as a practical tool for prioritizing and integrating cultural, educational, and instructional strategies.

Figure 1

Higher Education Development Model for Achieving Sustainable Development



4. Discussion and Conclusion

The present study was conducted with the aim of designing a higher education development model for achieving sustainable development in technical and vocational universities of West Azerbaijan Province. The findings indicated that the proposed model consists of five overarching dimensions: strategic sustainability management, environmental management, education and learning for sustainability, sustainable innovation and entrepreneurship, and social responsibility. These dimensions were organized into 28 organizing themes and 125 basic themes, demonstrating that sustainable higher education development is a multidimensional, systemic, and context-dependent phenomenon. The results show that achieving sustainability in higher education cannot be limited to curriculum reform or environmental activities alone; rather, it requires the simultaneous integration of managerial governance, resource management, educational transformation, applied research, green entrepreneurship, university–industry collaboration, student empowerment,

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ethical culture, digital infrastructure, and social impact assessment. This multidimensional structure is consistent with previous studies that have emphasized the cross-cutting role of higher education in achieving the Sustainable Development Goals and its influence on education, research, institutional management, and community engagement (McCowan, 2023; Pacheco, 2022; Serafini et al., 2022).

One of the main findings of the study was the identification of strategic sustainability management as a core dimension of the model. This dimension included components such as sustainable management of university resources, green administrative governance, financial transparency and accountability, financing sustainability programs, organizational knowledge management, continuous evaluation and improvement of sustainability programs, and organizational resilience. The prominence of this dimension indicates that sustainability in universities begins with strategic governance and institutional commitment. Without stable governance structures, transparent financial mechanisms, evidence-based decision-making, and continuous evaluation systems, sustainability programs may remain fragmented and symbolic. This finding aligns with the view that good governance is a prerequisite for the effective realization of sustainable development goals, because institutions require accountability, transparency, participation, and long-term planning to implement sustainability policies successfully (Omri & Mabrouk, 2020). The finding also supports studies in the Iranian higher education context, which have emphasized that sustainable educational development requires a coherent paradigm, local ecosystem orientation, and strategic alignment between educational policy and institutional capacity (Abdollahi et al., 2024; Amian et al., 2024; Jahanbakhsh et al., 2024).

The inclusion of financial transparency, sustainability financing, and resource management within the strategic management dimension also suggests that sustainable university development depends on the responsible allocation and use of resources. This result is consistent with studies showing that sustainability in higher education institutions is closely linked to institutional strategies, administrative structures, and responsible management of financial, physical, and informational resources (Biancardi et al., 2023; Harvey et al., 2022). In particular, the findings highlight the need for universities to move beyond short-term project-based sustainability actions and establish integrated systems for monitoring, budgeting, reporting, and evaluation. This result is also supported by research indicating that sustainability in higher education must be embedded in institutional routines and governance mechanisms rather than treated as an additional or peripheral activity (Omazic & Zunk, 2021; Probst, 2022). Therefore, the strategic sustainability management dimension of the proposed model can be interpreted as the institutional foundation upon which other dimensions of sustainable higher education depend.

The second major dimension identified in this study was environmental management. This dimension included sustainable waste management, renewable energy development, smart energy management, carbon footprint reduction, green building infrastructure, green laboratories, environmental impact monitoring, and green procurement. The importance of this dimension indicates that universities, as large organizational systems, must manage their environmental footprint through concrete operational measures. Technical and vocational universities are especially relevant in this regard because they often use workshops, laboratories, technical equipment, energy-intensive facilities, and material-based training environments. Therefore, environmental management in such institutions is not merely a symbolic responsibility but an operational necessity. This finding is consistent with previous research that has highlighted the importance of environmental performance, resource efficiency, waste reduction, and sustainable campus operations in higher education institutions (Biancardi et al., 2023; Lim et al., 2022; Serafini et al., 2022). It also supports the view that universities should function as living laboratories in which sustainability principles are practiced, observed, assessed, and improved.

The environmental management dimension also confirms the importance of future-oriented planning in universities. Beynaghi emphasized that universities must move beyond temporary sustainability initiatives and develop long-term scenarios for institutional transformation in the post–education for sustainable development era (Beynaghi, 2016). In the present study, the inclusion of components such as renewable energy, smart energy management, carbon reduction, and environmental monitoring indicates that sustainable higher education requires both technological innovation and behavioral change. Furthermore, green procurement and green building infrastructure show that sustainability must be embedded in administrative decisions, physical development, and infrastructure planning. These findings are consistent with studies that have identified multiple dimensions of sustainability in Iranian higher

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education and have shown that sustainability requires simultaneous attention to structural, operational, and institutional elements (Darabi et al., 2020). Therefore, environmental management in the proposed model can be regarded as the operational and infrastructural expression of sustainability in the university context.

The third dimension of the model was education and learning for sustainability, which included environmental competency education, integration of sustainability into curricula, sustainable e-learning, and student empowerment. This finding confirms that the educational mission of universities remains central to sustainable development. Higher education institutions must prepare students not only with technical knowledge but also with sustainability competencies, ethical awareness, systems thinking, and the ability to solve complex real-world problems. This result aligns with studies that emphasize the role of sustainability competencies in higher education and identify competencies such as systems thinking, strategic thinking, normative competence, anticipatory competence, and collaborative problem-solving as essential outcomes of sustainability-oriented education (Hammer & Lewis, 2023; Michel et al., 2023). The findings also support studies showing that students' interest in sustainability competencies is shaped by perceived relevance, institutional support, and the connection between learning and future professional roles (Hyytinen et al., 2023).

The integration of sustainability into curricula was one of the most important organizing themes in this dimension. This result is aligned with studies that have emphasized the need to redesign higher education curricula based on sustainable development principles (Arefi, 2023; Kazemi et al., 2025; Sarzehi, 2021). It is also consistent with research showing that education for sustainable development faces challenges in higher education, including disciplinary fragmentation, limited faculty preparation, and insufficient institutional support (Acevedo-Duque et al., 2023; Idoiaga Mondragon et al., 2023). The inclusion of teachers' and instructors' roles is also important, because the successful implementation of sustainability education depends on educators' willingness and capacity to integrate sustainability into teaching. This interpretation is supported by Acut et al., who showed that teachers' intentions to integrate education for sustainable development are influenced by attitudes, perceived behavioral control, institutional expectations, and professional readiness (Acut et al., 2025). Therefore, the education and learning dimension of the proposed model highlights the need for curriculum redesign, faculty development, student participation, and competency-based learning.

The fourth dimension identified in the study was sustainable innovation and entrepreneurship. This dimension included applied sustainability research, research ethics and responsibility, sustainability assessment of projects, university-based green entrepreneurship, and sustainable university–industry collaboration. This finding is particularly important for technical and vocational universities because these institutions have a direct connection with skill training, applied technologies, labor-market needs, and regional industry. The presence of university–industry collaboration in this dimension suggests that sustainability in technical and vocational higher education must be connected to real production systems, employment pathways, green technologies, and regional economic development. This finding aligns with Finnveden and Schneider's argument that industries increasingly require sustainability skills and that higher education must respond to these changing competence needs (Finnveden & Schneider, 2023). It also supports studies emphasizing that service learning, community engagement, and external collaboration can strengthen sustainable development in higher education (Rodriguez-Zurita et al., 2025).

The identification of applied sustainability research and responsible research as key themes also confirms that universities must orient their research activities toward solving environmental, social, and economic problems. This finding is consistent with studies showing that higher education institutions and research centers have increasingly incorporated the Sustainable Development Goals into research agendas and institutional priorities (Bautista-Puig et al., 2020). Moreover, the inclusion of green entrepreneurship suggests that sustainability should not only be taught theoretically but should also be converted into innovative action, business creation, and practical problem-solving. In this respect, the findings are aligned with studies that view green education as a mechanism for achieving the Sustainable Development Goals by transforming knowledge into responsible action and sustainable innovation (Akinsemolu & Onyeaka, 2025). The model therefore emphasizes that technical and vocational universities can become regional engines of sustainable innovation if they connect research, entrepreneurship, skill training, and industry collaboration.

The fifth dimension of the model was social responsibility, which included the culture of environmental ethics, responsible consumption, assessment of social

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impacts, and sustainable digital infrastructure. This finding indicates that sustainable higher education must extend beyond campus operations and academic programs to include ethical culture, social accountability, stakeholder engagement, and responsible institutional behavior. Universities must assess how their programs affect local communities, regional development, students' values, and social well-being. This result is consistent with the argument that the impact of higher education on sustainable development is cross-cutting and extends into social inclusion, civic engagement, knowledge production, and community transformation (McCowan, 2023). It also aligns with studies that define sustainable communities in higher education as institutional environments in which social responsibility, participation, and shared values support long-term sustainability (Biancardi et al., 2023).

The placement of sustainable digital infrastructure within social responsibility is also meaningful. Digital systems can reduce paper consumption, expand access to learning resources, support flexible education, and improve institutional communication. The findings are consistent with research on learning management systems and international cooperation in higher education, which shows that digital platforms can support educational connectivity and resource efficiency (Kerimbayev et al., 2016). Similarly, labor-market information-driven open educational resource systems indicate that digital technologies can support lifelong learning and align education with changing professional needs (Tavakoli et al., 2020). Therefore, in the proposed model, digital infrastructure functions not only as a technical tool but also as a sustainability mechanism that supports access, efficiency, responsiveness, and institutional responsibility.

Overall, the findings of the present study confirm that sustainable development in technical and vocational higher education requires an integrated model that connects governance, environment, education, innovation, entrepreneurship, and social responsibility. The extracted five-dimensional model is consistent with the broader literature showing that sustainability in higher education is systemic, interdisciplinary, and institution-wide (Lim et al., 2022; Omazic & Zunk, 2021; Probst, 2022). At the same time, the model contributes to the literature by emphasizing the specific needs of technical and vocational universities in West Azerbaijan Province. These institutions require a model that is not limited to theoretical sustainability education but is capable of guiding practical actions in workshops, laboratories, curricula, green technology, university–industry relations, resource management, and regional development. Accordingly, the proposed model can be considered both a conceptual framework for future research and a practical guide for university managers and policymakers seeking to institutionalize sustainability in technical and vocational higher education.

The present study has several limitations. First, the qualitative nature of the research limits the statistical generalizability of the findings, although the study sought to enhance credibility through meta-synthesis, expert interviews, and thematic analysis. Second, the empirical phase was limited to experts familiar with technical and vocational higher education in West Azerbaijan Province, and the findings may not fully represent the conditions of all universities or regions. Third, although the study identified dimensions, components, and themes of the model, it did not quantitatively test the relationships among these components or assess their relative importance through statistical modeling.

Future studies are suggested to validate the proposed model quantitatively using methods such as structural equation modeling, confirmatory factor analysis, or the Delphi technique. Comparative studies can also be conducted across different provinces, types of universities, and educational systems to examine the applicability of the model in diverse contexts. In addition, future research can prioritize the identified components using multi-criteria decision-making methods and investigate how each dimension of the model affects institutional sustainability performance, student competencies, environmental outcomes, and university–industry collaboration.

From a practical perspective, university policymakers and administrators are advised to use the proposed model as a roadmap for institutional sustainability planning. Technical and vocational universities should establish sustainability committees, revise curricula based on sustainability competencies, develop green workshops and laboratories, monitor energy and resource consumption, strengthen university–industry partnerships, and design mechanisms for evaluating the social and environmental impacts of their programs. In addition, faculty development programs, student participation structures, digital learning systems, and transparent financial reporting mechanisms should be strengthened to ensure that sustainability becomes an integrated and operational part of university governance and educational practice.

Authors' Contributions

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Authors equally contributed to this article.

Declaration

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

Transparency Statement

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

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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