Article

Explaining the Sustainability of Universities through the Contribution of Students' Pro-Environmental Behavior and the Management System

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Abstract: As the sustainable university makes sustainability a central priority in its teaching and research, it is important to understand how universities are transitioning towards sustainability. Their pioneering of new practices, and their education of future generations, are giving sustainable universities a special ability to create and influence change. However, the effective implementation of sustainability policies in universities is highly dependent on the willingness and commitment of the management and students to engage in sustainable activities, and there is a lack of systematic effort in how best to map this interaction. To address this gap, this study mainly aimed to explain the sustainability process of universities by emphasizing the roles of students and the management system. A mixed method approach was used to achieve the goal. First, a qualitative content analysis of related research papers was performed through the PRISMA method to figure out the most important factors affecting the integration of sustainability into the university structure. The results of this section showed that six factors contribute to the effective implementation of sustainability in universities, which are: university culture, university leadership, sustainability education, sustainability knowledge, attitudes towards sustainability and commitment to sustainability. Then, structural equation modeling was used to ensure the validity of the model obtained from the qualitative section. The results indicated that both university leadership and culture positively influence the implementation of sustainability education in universities, which in turn has a positive effect on students' knowledge and attitudes towards sustainability. The students' sustainability knowledge and attitudes along with university leadership and culture showed a positive effect on their commitment to sustainability. Also, the students' commitment to sustainability issues had the most direct effect on their participation in sustainability-oriented activities, and then their sustainability attitude and knowledge, respectively. Finally, sustainability knowledge, attitude and participation in sustainability-oriented activities were significantly related to the integration of sustainability into the university structure. Transitioning to sustainable universities will make society greener and healthier, setting an example for other organizations and the results of this study will help policy makers, managers and students to understand how to contribute to this transition.

Keywords: sustainability of university; pro-environmental behavior; university leadership; management system; sustainability education

1. Introduction

Based on regional and international policymaking, universities accelerate the movement of human societies toward sustainable development by providing environmental information and training. However, the issues related to sustainability and sustainable development in higher education are still in their basic stages and face many challenges.

The challenges facing universities in implementing the principles of sustainable development in their structure include insufficient awareness, a lack of the university's attention to sustainability, no interest in voluntary sustainability-oriented involvement, a limitation of commitment and support of universities from education for sustainable development, a lack of cooperation between internal and external utilizers, the curriculum, activities in the university settings, communication with the outside community and evaluation and reporting.

In recent years, international organizations, especially UNESCO, have adopted and developed over 20 legal and macro-level declarations and documents aiming at the commitment of higher education centers to sustainable development and overcoming the challenges facing universities to integrate sustainable development into their structures. Many of these declarations and legal documents are based on a moral obligation to contribute to sustainable development through the university: "The common point among all declarations and policy-making is to emphasize the moral and spiritual responsibility of universities as pioneers in promoting sustainability" [1]. However, Bekessy et al. [2], in their analysis for 12 years of involvement of the RMIT University in sustainability-oriented activities, argued that "non-binding international declarations are not responsive to sustained institutional developments." Universities receive positive endorsements from prioritizing policies on action, and it seems that there is no incentive to meet these commitments and respond to public opinion. The failure to enforce slogans has led to the creation of an unjustified image for universities regarding sustainability, which has resulted in sending messages to other organizations and generally the whole community indicating that sustainability is not worthwhile for universities and they are unable to apply sustainability. Christensen et al. [3] examined the official university documents of the University of Aalborg, Denmark, during 1990–2007, indicating the gap between speech and practice. Accordingly, they asked the question, "How can it be taught without applying sustainability?" They found that "Just having a positive attitude toward sustainability is not certainly enough to create a lively and engaging working commitment which creates university-oriented sustainability activities for many years." These examples indicate that the basic issues of sustainable development do not end after taking the first steps of sustainable development and there is the need to constantly revise and identify new ways to re-engage in the sustainable development process.

With such a point of view, academics all over the world have tried to provide models by using various organizational and behavioral theories through which sustainability-oriented activities can be institutionalized in the structure of universities but, according to the authors' worldview, each model has highlighted one of the influencing variables and ignored other components. For example, Lukman and Glavic [4], Beringer and Adomsent [5], McNamara [6], Yen and Yen [7]), Robertson and Barling [8] emphasized the key role of university leadership and considered it as the initiator of all sustainability-oriented practices of universities. In contrast, Cebrian et al. [9], Tilbury [10], Krasny and Delia [11], Levy and Marans [12], Blake and Sterling [13] focused on the vital role of university culture and considered university collaboration as the milestone of this process. However, other scholars using behavioral theories (especially environmental planned behavior) have shown that in addition to the management elements of a university, the psychological characteristics of the stakeholders within the university (such as students' knowledge and attitudes towards sustainability practices) as leaders of changes also have an influential role in transitioning universities toward sustainability [14–22].

The dark side of all these studies is the lack of simultaneous attention paid to the organizational and individual components to integrate sustainability into universities, while the effectiveness of the university, like any other organization, is a function of the interaction between organizational variables (such as leadership style, university culture, management strategies) and the behavioral intentions and behavior of academic actors [23,24]. In fact, the effective implementation of sustainability policies in universities is highly dependent on the active interaction between the management system and students to engage in sus-

tainable activities, but there is a lack of systematic effort in how best to map this interaction. Therefore, the need to develop a framework that simultaneously considers the factors influencing the integration of sustainability into the university structure at both individual (students) and organizational (management) levels is strongly felt.

In order to fill this research gap, by using a systematic method this study attempts to answer the following questions: What factors at the two levels of organizational management and student behavior influence integrating the principles of sustainability into universities? What are the causal relationships between these factors? How does academic culture affect student participation in sustainability-oriented activities? Is the theoretical framework formulated to increase the level of sustainability-oriented activities empirically supported? The results of the study contribute to developing a theoretical model of organizational behavior (especially in the university) and draw a road map for university managers to formulate the policies and programs of the university in order to achieve the development goals.

This paper is organized as follows: Section 2 presents a review of the literature related to the sustainability of universities. Section 3 states the development of the conceptual framework and the formulation of hypotheses. Section 4 describes the research methodology used to perform the analyses. Section 5 offers the findings of the study. Section 6 discusses the findings, and Section 7 shows the conclusions and future work. Finally, Section 8 states research limitations.

2. Literature Review

The concept of sustainability as we know it dates back to 1987 and the famous Brantland report [25]. The temporal and thematic trend shows that, during recent decades, a significant political effort and commitment towards sustainability has been observed in all countries of the world and an important tool for advancing sustainability goals has been introduced through education, including higher education [26]. Looking at the education for sustainable development milestones from 1992 to 2020, the increasing interest and efforts of the international community to use education as an engine driving change to make people's lifestyles more sustainable can be reflected [27]; at the 40th UNESCO World Conference in 2020, a new roadmap titled "Education for Sustainable Development: towards the achievement of the SDGs (ESD by 2030" represented the framework that showed the path to achieve the 17 SDGs by 2023 through sustainability education [28]. Thus, higher education and universities in particular are recognized as key agents in sustainability education that will contribute to the successful implementation of the United Nations Sustainable Development Goals (SDGs) by educating future leaders [23,29]. Various works and studies have been undertaken around the world in the field of integrating sustainable development goals in universities [27,30,31]. Evidence shows that over the past two decades research into and the practice of sustainability in higher education institutions has been increasing [32,33]. The countries that are leading in this field are Spain, the United Kingdom and the United States, respectively [27]. Some of the works focused on the implementation of the sustainability curriculum in universities, campus practices and outreach activities [34,35], while others assessed the impacts of universities in sustainability [36,37] and quantified the contribution of universities to sustainability [25]. To become sustainable universities and to have an impact on the growth of sustainable thinking in society, universities can contribute in: (1) research (SDG-related topics), (2) Education (encouraging students to participate in sustainability activities by increasing their knowledge and improving their attitudes towards sustainability), (3) Management and Governance (putting SDGs in university practices, management style and manager commitment) and (4) Leadership (commitment with the public) [29].

Studying these components and how they relate to each other is very important and has not been emphasized much in studies. In order to fill this gap, the current study seeks to develop a framework that can express the relationship between these components in a causal manner.

3. Developing a Conceptual Framework and Formulating Hypotheses

According to the experts, sustainability is a value, skill and way of thinking, and the focus of education for sustainable development is on nurturing people with the knowledge, skills and understanding needed to make decisions based on social, economic and environmental consequences and create opportunities for sustainability as an individual, family or organization [14]. On the other hand, it seems that the important dimensions of sustainability-oriented awareness are directly related to one's knowledge of sustainability, values, attitudes and behavioral beliefs, which are themselves influenced by various situational and environmental factors [38,39] that need to be reviewed.

3.1. The Factors Affecting University Movement toward Sustainability

Many studies were conducted related to the factors affecting the implementation of sustainability in higher education [4,5,13,40–44]. In these studies, factors such as university leadership, university culture, collaboration, commitment to sustainable development issues, education, knowledge and attitudes are considered as important factors in integrating sustainable development issues into the university structure. The results of these studies, along with their focus points, are presented in Table 1.

Table 1. Focus points of the studies related to the factors affecting the integration of sustainable development into higher education.

Focus Points	Authors	Explanations
University leadership (UL)	Lukman and Glavic [4]; Beringer and Adomsent [5]; McNamara [6]; Yen and Yen [7]; Robertson and Barling [8]; Rahph and Stubbs [18]; Vincent and Mulkey [45]; Driscoll et al. [46]; Filho et al. [47]	University leadership plays a key role in moving the university toward sustainability through the integration of sustainability-oriented activities in the university setting performances, goals, policies and education.
University Culture (UC)	Blake and Sterling [13]; Tilbury [10]; Levy and Marans [12]; Cebrian et al. [9]; Krasny and Delia [11]	University culture influences the integration of sustainable development into the university structure through influencing the commitment to sustainability and partnership among utilizers.
Participation in Sustainability Activities (PS)	Disterheft et al. [48]; Hoover and Harder [49]; Halbe et al. [50]; Segalas et al. [51]; Litzinger et al. [52]; Mauser et al. [53]; Wegner [54]; Cars and West [55]; Jiménez et al. [56]; Amara and Chen [57]	Partnerships help develop people's creativity, share ideas, ensure the consideration of the views of the utilizers and create a shared view of sustainability-driven services at the university.
Commitment to Sustainability (CS)	Katiliūtė et al. [58]; Halpern et al. [59]; James and Card [60]; Eisen and Barlett [61]; Sibbel [62]; Casarejos et al. [63]	The idea of having committed people has been emphasized in all sustainability studies. They are often considered as the focal point of organizational change to achieve sustainability through participation in sustainability programs.
Sustainability-oriented Education (SE)	Bürgener and Barth [64]; Figueiró and Raufflet [65]	Sustainability education influences the implementation of sustainability in university settings by enhancing students' knowledge regarding sustainable development and influencing their attitudes toward environmental protection
Knowledge of Sustainability (KS)	Sidiropoulos [14]; Davis et al. [15]; Lozano [16]; Šūmane et al. [17]; Song et al. [18]; Ahamad and Ariffin [19]; Nichols and Mukonoweshuro [20]	Increasing students' knowledge regarding sustainable development and sustainability issues at universities can raise their concerns about environmental issues and other aspects of sustainable development.
Attitude toward Sustainability (AS)	Ahamad and Ariffin [19]; Adongo, Taale and Adam [21]; Estrada-Vidal and Tójar-Hurtado [22]; Sidiropoulos [14]	Attitudes also have an undeniable role in changing behavior toward the sustainability of universities. Changes in attitudes and values are fundamental guides to action-oriented sustainability behaviors.

3.2. University Leadership and Integrating Sustainable Development into the University Structure

Involvement in sustainability activities should be in a way that "sustainability" includes all university processes such as missions, education and research, management, external beneficiaries and the individual activities of the university community members [66]. Thus, universities should integrate sustainability into their strategies, the operations of the university setting and their routines to be recognized as sustainability leaders [5]. This requires deep collaboration within management and research departments, the curriculum and administrative activities so that sustainability-oriented approaches can be integrated into all aspects and activities of the university in a synergic way [10]. In this regard, university leadership plays a fundamental role [67].

University leadership toward sustainability is a clear method for universities to achieve sustainability through conservation rather than destructive activities, using natural systems and education in order to drive university and graduate activities toward a sustainable society [45]. University leadership helps integrate sustainable development into academic processes by devoting financial resources to sustainability services, promoting a collaborative culture and decision-making based on utilizers' engagement and collective vision, as well as providing the knowledge and information needed to engage in sustainability-oriented services by training programs [68]. In addition, the studies indicated that university leadership influences the increased commitment to sustainability-oriented issues [69–71]. Metcalf and Benn [67] and van Dierendonck et al. [72] argued that university management is effective in adopting and applying complex systems by meeting the employees' psychological needs (sustainability is recognized as a complex and multidimensional subject in various studies). The attitudes of senior faculty members toward sustainability influence the dynamics of the institution in using new structures and channels to achieve effective sustainability [13].

H1. *The university leadership of sustainability-oriented services has a positive and significant effect on the students' knowledge of sustainability.*

H2. *The university leadership of sustainability-oriented services has a positive and significant effect on the students' commitment to sustainability.*

H3. *The university leadership of sustainability-oriented services has a positive and significant effect on the integrating of sustainable development into university educational curricula.*

3.3. University Culture and the University's Sustainability

Edwards [73] defines organizational culture as the values, beliefs and common knowledge of an organization's employees. According to Gupta et al. [74], organizational culture encompasses the conscious and free effort of an organization's employees to integrate their personal capabilities into organizational knowledge through the processes of learning, sharing and knowledge creation. A strong organizational culture reinforces inter-organizational collaboration, coordinates the organization's goals with its employees and inspires employees to work hard to achieve organizational goals [15,75]. Therefore, organizational culture influences individual behaviors [14,76]. Having a strong organizational culture related to sustainable development enhances the level of participation in the operational divisions of the university, which, in turn, influences the success of university-oriented sustainability services [77]. When an innovation such as sustainable development is in the dissemination stage and is continuously used by members of the organization, it becomes part of the organizational culture of that institution, leading to the creation and development of new sustainable development programs [78,79]. In addition, the culture of university settings has empirically a great influence on the involvement of universities in sustainability processes; however, it is very difficult to move toward sustainability in universities [49].

H4. *Organizational culture has a positive and significant effect on the students' participation in sustainability-oriented activities.*

H5. *Organizational culture has a positive and significant effect on the students' attitudes toward sustainability activities.*

H6. *Organizational culture has a positive and significant effect on the integration of sustainable development into university curricula.*

3.4. Participation and the University's Sustainability

In concepts of participation, participants are considered as the main drivers of the production of values where their interaction is essential for creating and designing the experiences [80]. The participation of the utilizers in the organization provides the context for practical suggestions for improving organizational activities and enhances their satisfaction with the decisions and organizational trust [81]. Participation seems to contribute to the work-sharing within the university setting and provide opportunities to meet and exchange ideas with new people [49]. On the other hand, cooperation can be effective in ensuring people's views are taken into consideration and creating a shared vision of sustainability and developing new ideas [43,82–84]. Therefore, participation is recognized as a prerequisite and an effective factor in achieving sustainability in the university [48,50–53,85–87].

H7. *Students' participation in sustainability-oriented activities has a significant and positive effect on university sustainability.*

3.5. Commitment to Sustainability and Sustainable Development

The idea of having committed people has been considered in almost all studies related to sustainability. These people are often considered as the focal point of organizational change to achieve sustainability through participating in programs. In supporting this issue, James and Card [60] found that individuals such as managers, faculty members, students and staff act as agents of change for sustainability plans in any university setting. These individuals contribute to the institutionalization of sustainability in the university structure by trying to integrate education for sustainable development into the curriculum [1,4,44,88,89]. The commitment to sustainability in educational settings changes the curriculum's orientation (rethinking and redesigning education), raising public awareness about the concept of sustainability and training the workforce to better understand education for sustainability and how to integrate it into the curriculum [90]. Generally, people who initiate change or can change sustainability are more committed to environmental issues and are more aware of the land, community life and the need for sustainability efforts [43,44,60,91].

H8. *Students' commitment to sustainability-oriented issues has a significant and positive effect on their participation in sustainability-oriented projects.*

3.6. Education, Knowledge, Attitude and the University's Sustainability

Sustainability education can influence learners' sustainability behaviors through knowledge transfer and sustainability values [64,65,92]. It should be noted that they are very important in creating sustainability behaviors based on a deep value system, knowledge, attitudes and individual values due to their potential impact on real behavior [93]. People's behavior is influenced by their attitudes. The attitudes influence the individuals' decisions and judgments in the environment and consequently predict behavioral intention and behavior [94,95]. It is found that environmental outputs depend increasingly on community attitudes [96]. Sustainability behaviors in university are no exception, as in many studies the knowledge and attitudes of the university community have been identified as very strong factors in implementing sustainability behaviors in universities [14,17–22,49]. Knowledge and attitudes in environmental issues are deeply and extensively intertwined. According to Bamberg [97], they reinforce each other in the context of sustainability behaviors (Figure 1). Asunta [98] found that the number of resources used by students to collect environmental information increases as their level of education increases. Also, Michalos et al. [99] compared the environmental protection behaviors of Canadian adults and showed that having a positive attitude toward the environment and

sustainable development is more effective in explaining sustainability-oriented behaviors for adults than environmental knowledge. However, the importance of knowledge and attitude as the guides of behavior was equally important for students.
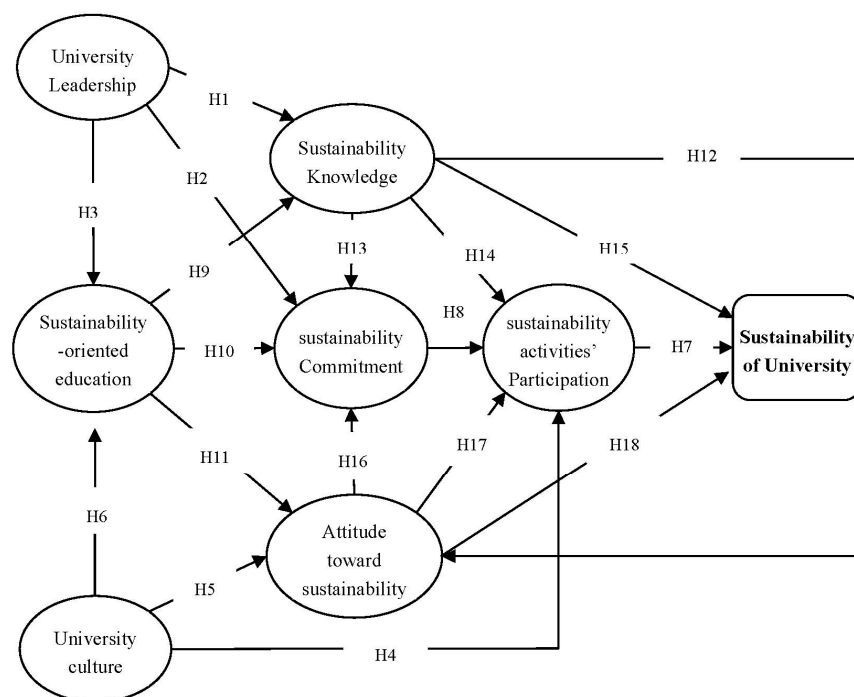

Figure 1. Conceptual Framework of the study to achieve university sustainability.

H9. *Sustainability-oriented education has a positive and significant effect on students' knowledge of sustainability.*

H10. *Sustainability-oriented education has a positive and significant effect on students' commitment to sustainability.*

H11. *Sustainability-oriented education has a positive and significant effect on students' attitudes towards sustainability-oriented services.*

H12. *Students' attitudes toward sustainability-oriented services improve through increasing students' knowledge of sustainability.*

H13. *Students' knowledge of sustainability increases their commitment to sustainability.*

H14. *Students' knowledge of sustainability has a positive and significant effect on their participation in sustainability-oriented activities.*

H15. *Students' knowledge of sustainability has a positive and significant effect on the sustainability of universities.*

H16. *Students' attitudes toward sustainability have a significant effect on their commitment to the sustainability of universities.*

H17. *Students' attitudes toward sustainability have a significant effect on their participation in sustainability-oriented activities.*

H18. *Students' attitudes toward sustainability have a significant effect on the sustainability of universities.*

4. Methodology

4.1. Research Design

We used an exploratory sequential mix-methods research design in which we implemented qualitative and quantitative strands with the purpose of using the follow-up quantitative data to generalize the initial qualitative result. Qualitative content analyses were adapted to identify the factors influencing the sustainability process of universities through systematic review as proposed by Zimon et al. [100] and Mishra et al. [101]. Systematic review has become a major methodology in the discipline and is a way of synthesizing scientific evidence to provide a reproducible design, while seeking to include all published evidence on the topic and appraising the quality of this evidence [102]. Also, it is proven that conceptual frameworks can be derived from systematic literature reviews [27]. We also used the PRISMA flow-chart [103] to refine and select related articles that were most consistent with the research title and questions (Figure 2). The review analyzed 2532 peer-reviewed research studies in the time period 2005–2021. After two stages of screening and eligibility, finally 46 suitable articles were identified for the final analysis. To analyze the reviewed studies, we used NVivo10 software through the content analysis method. By coding processes, we could extract the factors influencing sustainability in the academic environment from the mentioned studies and categorize and label them into seven factors (Table 1 and Figure 1).
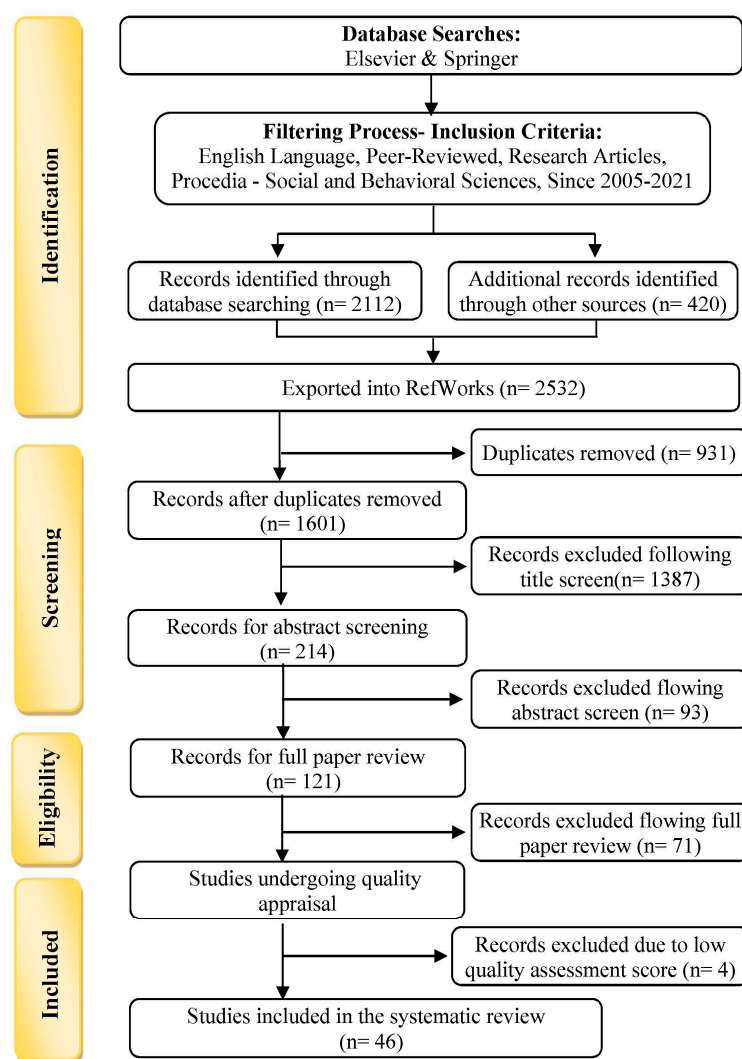

Figure 2. PRISMA flow-chart (Adapted from, [103]).

Based on the literature review, a set of eighteen hypotheses was derived and then a conceptual framework was developed (Figure 1). To test the hypotheses of the study, we followed a quantitative research method. Data were collected through a questionnaire whose questions were designed in the form of a ten-point scale (very low = 1 to very high = 10) for the latent variables. A part of the questionnaire consisted of instructions for respondents to answer the questions of each section. Then, the questionnaires were distributed among the graduate students of Bu-Ali Sina University and we asked them to answer the questions based on their experiences of sustainability-oriented activities in the university setting. The scores obtained from each respondent were used as a criterion for subsequent analyses.

4.2. Statistical Population and Sample

The statistical population included the agricultural students at Bu-Ali Sina University, Hamedan, Iran (N = 1810), among whom 289 students were selected through proportional stratified sampling (gender and educational level). Information about the statistical population and sample is presented in Table 2. It should be noted that students had to meet at least one of the following conditions in order to complete the questionnaire: (1) they had to have passed the Sustainable Development course; (2) they had to have been involved in agricultural activities at the university farm; (3) they had to have carried out at least one applied research study on sustainable development-related issues. The return rate of the questionnaires was 95.84%. Twelve questionnaires were incomplete and were excluded from the analysis process. The mean age of the respondents was 22.64 years. Considering gender, 47.41% were male and 52.59% female. In addition, 54.32% were undergraduates, 30.79% were graduates and 14.89% were PhD students.

Table 2. Information about the size of the population and selected sample.

Characteristic	Dimensions	Statistical Population	Sample	Percent
Gender	Female	951	152	52.59
	Male	859	137	47.41
	Sum	1810	289	100
Degree	Undergraduate	987	157	54.32
	Graduate	558	89	30.79
	PhD student	265	43	14.89
	Sum	1810	289	100

4.3. Variable Measurements

A sector-based evaluation instrument was used to evaluate university sustainability [87]. It was based on a systematic approach designed to evaluate sustainability in all parts of a university. In fact, this instrument can assess sustainability in different parts of a university and provide a comparison with other sections. It should be noted that in order to increase the content validity of this part of the questionnaire given the conditions governing Bu-Ali Sina University and before sending the questionnaires to students, we distributed the questionnaires among 97 faculty members who specialized in sustainable development so that they could state their opinions on the items. The final questionnaire was compiled after obtaining their opinions and removing inappropriate items. The indicators used to assess university sustainability are shown in the Appendix A. The questionnaires designed by Linnenluecke and Griffiths [104] and Adams et al. [105] were used to evaluate the university's organizational culture for integrating sustainable development into its structure. The researcher-made questionnaire based on relevant research records was used to measure the variables of commitment to sustainability, knowledge, attitude and participation in sustainability-oriented activities. The terms used for each section are presented in Table 4.

4.4. Statistical Analysis

Structural equation modeling (SEM) was used to estimate the theoretical model of the research (Figure 1) empirically (Figure 2) through LISREL8.8 Software. Structural equation modeling is a method used to illustrate, estimate and test hypotheses about the causal relationship between explicit and implicit variables. This approach has two stages of measurement and structural models [106]. In the first step, the validity of the observable variables used to measure latent variables is evaluated through Confirmatory Factor Analysis (CFA). At this stage, Composite Reliability (CR), Average Variance Extracted (AVE) and diagnostic validity are evaluated. Then, the causal relationships between the latent variables, hypotheses testing and the acceptability of the proposed model are empirically tested.

5. Results

5.1. Validity and Reliability

Composite reliability (CR) and Cronbach's alpha coefficient (α) were used to evaluate reliability. Average Variance Extracted (AVE), Average Sharing Variance (ASV) and diagnostic validity were used. If the AVE value is greater than 0.4, the CR value is greater than 0.6 and Cronbach's alpha is greater than 0.7, then the validity and reliability of the research instrument are acceptable [107]. The results of the evaluation of these indices in Table 3 indicate the high reliability and validity of the measurement instrument.

Table 3. The correlation coefficient among the latent variables, along with validity and reliability of the research instrument.

Var.	AVE	CR	α	1	2	3	4	5	6	7	8
UC (1)	0.480	0.864	0.870	**0.692**							
UL(2)	0.428	0.781	0.880	0.242 **	**0.654**						
PS (3)	0.495	0.823	0.830	0.626 **	0.402 **	**0.703**					
CS (4)	0.416	0.809	0.890	0.687 **	0.422 **	0.662 **	**0.644**				
KS (5)	0.434	0.695	0.800	0.576 **	0.330 **	0.523 **	0.623 **	**0.658**			
AS (6)	0.601	0.858	0.910	0.610 **	0.335 **	0.570 **	0.631 **	0.636 **	**0.775**		
SE (7)	0.426	0.781	0.810	0.261 **	0.417 **	0.551 **	0.240 *	0.329 **	0.417 **	**0.652**	
US (8)	0.462	0.768	0.720	0.464 **	0.251 **	0.396 **	0.625 **	0.492 **	0.500 **	0.417 **	**0.679**

Note: UC (university culture), UL (university leadership), PS (participation in sustainability activities), CS (commitment to sustainability), KS (knowledge of sustainability), AS (attitude toward sustainability), SE (sustainability education), US (university sustainability). Bold items are the Average Squared Shared Variance (ASV) between the constructs and other constructs. For discriminant validity, the number of bold items should be more than the number of correlations in each column. ** p-value is less than 0.01 ($p < 0.01$), * p-value is less than 0.05 ($p < 0.05$).

The highlighted cases are the second root of the Average Shared Variance (ASV) between the structures and observable variables used to measure them. The faint-colored cases are the correlation between the research variables. For diagnostic validity, the rate of the highlighted cases should be greater than that of the correlation value in each column.

The results of the correlation coefficient in Table 3 show that organizational culture is positively correlated with attitude towards sustainability (r = 0.610) and student participation in sustainability-oriented activities (r = 0.626). This means that a powerful academic culture based on accountability, transparency of decisions, intimacy among members, consultation with stakeholders, collective decision-making and transferring affairs to students significantly contributes to improving their attitudes toward environmental protection and sustainable consumption. Subsequently, an improved attitude toward the environment leads to increased levels of student participation in sustainability activities (Table 3). These findings are consistent with the previous results of Davis et al. [15], Sidiropoulos [14], Tseng and Chiang [77], Lozano et al. [78] and Hoover and Harder [49] showing that organizational culture is linked to implementing sustainability activities in universities and incorporating them into sustainable development.

Also, university leadership is positively correlated with sustainability education (r = 0.417) and students' commitment to sustainability (r = 0.422). This means that sustainability education at the university and commitment to sustainability are directly and significantly linked to the university leadership carrying out sustainability-oriented activities such as holding scientific conferences related to sustainable development issues, establishing knowledge-based companies at the university, recruiting qualified faculty members who are familiar with sustainability topics and linking the university to industry. In fact, the attention of the university leadership to sustainability-oriented issues is a clear reason for universities to achieve sustainability through sustainability education and to reinforce students' commitment to sustainability. These findings confirm the previous results of Metcalf and Benn [67], Waldman and Galvin [69], Campbell [70], Angus-Leppan et al. [71], Yen and Yen [7] and Robertson and Barling [8] showing that there is a positive relationship between university leadership and students' commitment to sustainability issues.

There is a significant positive relationship between the sustainability knowledge of university students and their attitude toward sustainability (r = 0.636). This means that by increasing students' knowledge about sustainability, their attitudes towards sustainability will be more positive and vice versa. It can be argued that there is a direct relationship between students' knowledge and attitudes about sustainability. These findings support the results of the research of Bamberg and Schmidt [97] showing that sustainability knowledge and attitudes strengthen each other in the movement toward sustainability behaviors.

The commitment to sustainability has the strongest relationship with university sustainability (r = 0.636). This means increasing the level of university commitment to some environmentally friendly practices such as plant and animal species conservation, collective planning, motivating all university members (students, managers, employees, faculty members, researchers) to behave sustainably, the campus' environment health, biological pest control and networking among those educational institutions that put sustainable development issues at the forefront of their agendas leads to improved levels of sustainability in the academic environment. In fact, committed individuals are the center of gravity of the university's movement toward sustainability. This is also confirmed through the studies of Barlett et al. [91], James and Card [60] and Wright and Wilton [44]. They argue that those who start changes towards sustainability are more committed to environmental issues.

5.2. A Measurement Model of Latent Variables

The findings of the research measurement model (Table 4) and the reported value of the fit indices for confirmatory factor analysis (Chi-Square = 218.62, df = 124, *p*-value = 0.000, RMSEA = 0.046 CFI = 0.93, NFI = 0.89, GFI = 0.93, AGFI = 0.91, PGFI = 0.60) indicated that the data are statistically in line with factor structure and latent variables. Thus, it can be said that the selected observable variables to measure the latent variables of the research were sufficiently accurate and their validity and reliability were confirmed. Thus, they can be used as a suitable tool for measuring the variables of academic culture, university leadership, collaboration and commitment to sustainability, sustainability knowledge, attitudes toward sustainability and sustainability education.

Table 4. The output of the measurement model for the latent variables along with their items.

Item	Variable	Factor Loading *	t-Value
	The patience of university staff in answering students' questions	0.76	11.28
	Transparency of decisions made by university management	0.77	11.08
	Intimacy among university members including management, staff, faculty members and students	0.64	9.06
UC	Holding forums to exchange ideas with students	0.72	10.46
	Considering the students' attitudes and decisions in university decision-making	0.55	7.63
	Assigning some of the university affairs to students	0.77	11.23
	Considering the students' attitudes and decisions in university decision-making	0.61	8.57

Table 4. *Cont.*

Item	Variable	Factor Loading *	t-Value
UL	Holding scientific conferences on sustainability issues	0.46	5.92
	Considering some open days at the university where local communities can engage with the university	0.60	8.32
	Establishing knowledge-based companies at the university	0.69	9.58
	Attracting qualified faculty members who are familiar with sustainability	0.67	9.35
	Providing the necessary infrastructure to establish a link between the university and industry	0.79	11.56
PS	Collective decision-making at the university	0.59	7.70
	Responsibility among the university community members	0.85	13.03
	Paying attention to intramural utilizers as university partners	0.74	10.74
	Debating on sustainability issues within the university community	0.69	9.81
	Involvement of intramural utilizers in sustainability activities	0.62	8.57
CS	University commitment to protect plant and animal species	0.65	9.12
	University commitment to collective planning	0.66	9.16
	The motivation of intramural members related to performing sustainability-oriented services	0.65	9.11
	University commitment to the health of the university setting	0.66	9.20
	University commitment to the biological control of pests	0.70	9.99
	Increased attention to capacity building and networking among educational institutions	0.54	7.15
KS	Knowing about environmental crisis management	0.73	7.90
	Familiarity with technologies compatible with sustainability	0.58	7.64
	Learning how to create a dynamic interaction between society and the environment	0.66	8.84
AS	Respect for nature	0.80	12.61
	Sensitivity to environmental pollution	0.77	11.64
	Ethical commitment to overcome unsustainable services	0.81	12.39
	Management and other intramural members' concern regarding the ability of posterity to meet their needs	0.72	10.50
SE	Integrating sustainable development into practical assignments	0.41	4.99
	Classroom discussion related to sustainability issues	0.58	7.69
	Teaching knowledgeable decision-making to students	0.76	10.69
	A movement toward nurturing and enhancing the students' creativity levels	0.74	10.39
	Enhancing the students' vulnerability levels	0.71	10.15

* It's standardized Factor Loading.

5.3. Structural Model and Hypothesis Testing

After estimating the measurement model, the latent variables were inserted into the structural equation. The results indicated that the fit indices for the structural model were acceptable, which represented the appropriate compatibility of the structural model. The fit indices indicated that significant residuals were not left in the data texture, while the causal relationships were well explained and the measurement error in the model was well controlled ($x^2/df = 1.95$, p-value = 0.000, RMSEA = 0.007, IFI = 0.97, CFI = 0.97, NFI = 0.94, NNFI = 0.96, GFI = 0.90). These findings indicated that the proposed model (Figure 3) could explain the sustainability-oriented activities and sustainability at the Bou-Ali Sina University of Hamedan. The output of the structural model in Figure 2 indicates that the variables of sustainability knowledge (t = 4.03, β = 0.67), attitude toward sustainability (t = 3.81, β = 0.58) and participation in sustainability-oriented activities (t = 4.73, β = 0.71) had a direct, significant impact on sustainability at the Bu-Ali Sina University of Hamedan. Among these variables, student participation in sustainability-oriented activities has the most direct effect on university sustainability. Intellectual and practical participation inside the campus environment enables students and managers to exchange ideas about sustainability, which in turn develops new ideas and ensures that students' views are taken into account and a shared vision of sustainability is achieved. Therefore, participation is recognized as an essen-

tial prerequisite and an effective factor in achieving sustainability at Bu Ali Sina University. These findings confirm the results of Gudz [82], Kurland [43], Hoover and Harder [49], Disterheft et al. [48], Sammalisto et al. [85], Halbe et al. [50] and Mauser et al. [53] showing the critical role of collaboration and participation in sustainability-oriented activities in pushing organizations toward achieving sustainability.
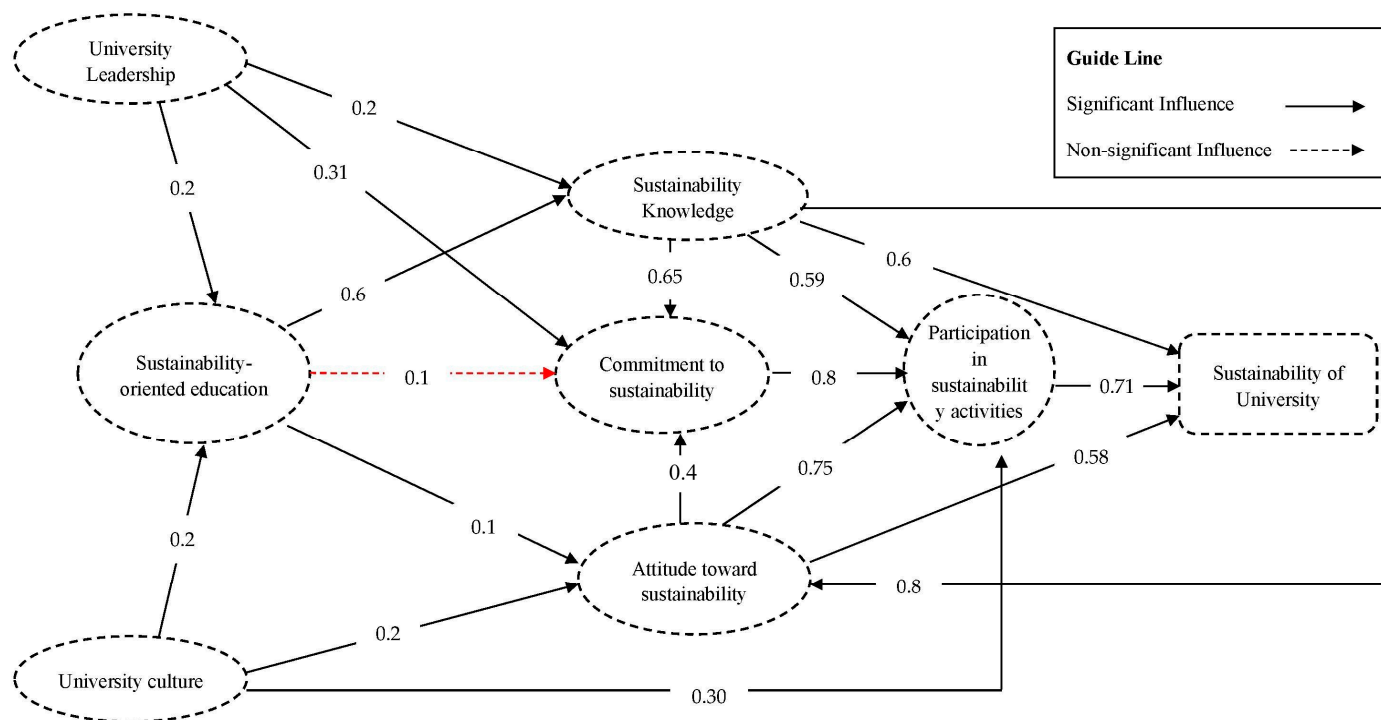

Figure 3. Structural Model Output of the Research.

On the other hand, the students' commitment to sustainable development issues (t = 6.02, β = 0.82) has the most direct impact on the students' participation in sustainability-oriented activities, and then on attitudes toward stability (t = 3.74, β = 0.75) and their sustainability knowledge (t = 2.69, β = 0.59), respectively. On the other hand, sustainability knowledge (t = 5.56, β = 0.65) and attitudes toward sustainability (t = 3.14, β = 0.48) had the most direct effects on commitment to sustainability, respectively. Based on these findings, it can be argued that the commitment to sustainability in the academic environment leads to preserving plant and animal species, collective planning and individuals' responsibility to their activities. Such activities are directly influenced by sustainability knowledge and attitudes. Thus, increasing sustainability knowledge and positive attitudes toward sustainability in the academic environment is of particular importance in creating a commitment to sustainability. Sustainability knowledge is strongly influenced by sustainability education, and organizational culture explains the attitude toward sustainability (Figure 2). These findings are consistent with the results of Læssøe et al. [90], James and Card [60], Kurland [43] and Wright and Wilton [44] showing the impact of sustainability knowledge and attitudes on people's commitment to sustainable development issues and Bamberg and Moser [93], Moore and Asay [94] and Alas et al. [95] indicating the impact of sustainability knowledge and the attitude of individuals on forming sustainable behaviors.

Surprisingly, it was observed that sustainability-based education did not have a significant impact on a commitment to sustainability in the university. These findings are in stark contrast to those of Bürgener and Barth [64] and Figueiró and Raufflet [43]. Various factors might have caused this issue including the lack of appropriate technologies in the field of integrated pest management, the priority of economic issues over environmental protection and the lack of an institutionalized collective decision-making culture in the university and top-down decision-making in the higher education system of Iran. In

fact, since Iranian universities are funded by government sources, they have to follow the rules and guidelines issued by the Ministry of Science, Research and Technology and are only able to take measures within the specified framework. On the other hand, the university budget is limited, and most of it is spent on the running costs of the university including maintenance, energy, student nutrition, research and education and there will be insufficient financial resources to be allocated to sustainability-oriented issues (such as environmental issues).

University leadership and academic culture are among the most important factors influencing the implementation of sustainability at Bu Ali Sina University, and act as pioneers of all other factors. The positive attitude of the university management towards sustainability issues and the implementation of sustainability principles directly impacts on the budget allocation of the university, the integration of sustainability-oriented education into the university structure, the support of sustainability-oriented activities as well as embedding sustainability-related issues into the university's principles, structure and perspectives. As long as the management of a university does not have a positive attitude towards sustainability and the implementation of its principles, the expectation of integrating the principles of sustainability into the university structure is in vain and, if implemented, will remain incomplete. Therefore, it is necessary for the university management to have a positive attitude toward sustainability issues in the university and to guide university culture and education in this regard. These findings confirm the results of Lukman and Glavič [4], who demonstrated the role of university leadership in achieving sustainability through conservation rather than destructive activities, natural systems and education in a way that drives the university and graduate activities toward sustainable society; Beringer and Adomßent [5] highlighted the prominent role of university leadership in integrating sustainability-oriented activities into campus strategies, operations and day-to-day activities; Blake and Sterling [13] highlighted the role of a university's high-ranking officials' attitudes toward sustainability, which can broadly influence the dynamics of the institution in using new structures and channels to achieve sustainability; Hoover and Harder [49] highlighted the significant impact of the academic environmental culture on the engagement of universities in sustainability processes.

It is worth noting that the research variables totally explained 48% of the variance of sustainability at the Bu-Ali Sina University of Hamadan (Table 5). The indirect and total effects of research variables on university sustainability-oriented activities are presented in Table 6.

Table 5. Direct effects, t-value and explained variance of latent variables.

Parameters	Estimation	t-Value	Sig	R^2	Hypotheses	Result
UL → SE	0.26	2.60	0.004	0.28	H3	confirmed
UC → SE	0.25	2.64	0.007		H6	confirmed
UL → KS	0.20	2.92	0.003	0.47	H1	confirmed
SE → KS	0.61	6.36	0.000		H9	confirmed
UC → AS	0.21	2.98	0.001		H5	confirmed
SE → AS	0.14	2.01	0.014	0.69	H11	confirmed
KS → AS	0.85	6.27	0.000		H12	confirmed
SE → CS	0.11	1.93	0.053		H10	Rejected
KS → CS	0.65	5.56	0.000	0.53	H13	confirmed
AS → CS	0.48	3.14	0.000		H16	confirmed
UL → CS	0.31	3.99	0.000		H2	confirmed

Table 5. *Cont.*

Parameters	Estimation	t-Value	Sig	R^2	Hypotheses	Result
KS → PS	0.59	2.69	0.000		H14	confirmed
AS → PS	0.75	3.74	0.000		H17	confirmed
CS → PS	0.82	6.02	0.000	0.66	H8	confirmed
UC → PS	0.30	3.89	0.000		H4	confirmed
KS → US	0.67	4.03	0.000		H15	confirmed
AS → US	0.58	3.81	0.000	0.48	H18	confirmed
PS → US	0.71	4.73	0.000		H7	confirmed

Note: UC (university culture), UL (university leadership), PS (participation in sustainability activities), CS (commitment to sustainability), KS (knowledge of sustainability), AS (attitude toward sustainability), SE (sustainability education), US (university sustainability).

Table 6. Indirect and total effects of research variables on university sustainability-oriented activities.

Variables	1	2	3	4	5	6	7
UL (1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SE (2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
UC (3)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KS (4)	0.258	0.000	0.152	0.000	0.000	0.000	0.000
AS (5)	0.248	0.518	0.164	0.000	0.000	0.000	0.000
CS (6)	0.166	0.645	0.306	0.000	0.000	0.000	0.000
PS (7)	0.917	1.528	0.628	0.533	0.393	0.000	0.000
US (8)	0.777	1.786	0.974	1.980	0.811	0.582	0.000
Total Effect	0.777	1.786	0.974	2.650	1.391	0.582	0.710

6. Discussion

The failure by universities to implement the slogans of UN declarations and legal instruments and to prioritize policies to gain benefits sends messages to the community that sustainability is not important for universities and they are not able to apply the principles of sustainable development. They raise the issue of how sustainability can be taught before applying it in action. It has been argued that just having a positive attitude toward sustainability is not enough to create a lively and engaging working commitment that creates university-oriented sustainability activities over many years. In fact, sustainability should be institutionalized in the organizational culture, and managers who are in charge of university administration should put aside their traditional thinking and formulate innovative and sustainable policies in order to incorporate sustainability in all university affairs from research and education to university management and leadership. Therefore, it can be acknowledged that to integrate sustainability activities into universities, various components are involved, from the management system of the organization to the knowledge, attitudes and behavior of students, which must first be known and then the logical connection between them must be determined; the main goal of this study was to fill this research gap.

We have used the term sustainable development process at the university here. This means that sustainable development has at least four characteristics: (1) directional and progressive; (2) purposeful; (3) multi-stage; and (4) upward return. Accordingly, we have presented an empirical model (Figure 4) that has four interrelated stages: the first stage is about management inputs and it includes university leadership, university culture and sustainability education; the second is about students' inputs to sustainability, which includes sustainability knowledge, attitudes toward sustainability and commitment to sustainability; the third stage is about the process of engaging in sustainability behavior and activities and the fourth stage demonstrates the output of the process, which is university sustainability. These steps demonstrate that sustainability-oriented leadership and the dominant culture of the university act as catalysts for moving the university toward sustainability. In fact, the direction of university leadership and the culture towards

achieving sustainability provide a development path for sustainability-based educational activities at the university, which plays an important role in increasing the sustainability knowledge and attitudes of students. As, Hoover and Harder [49] state, the transition to sustainability has faced challenges due to the unsustainable performance of current managers and the limitations of the organizational culture and may require institutions to adopt new-generation governance approaches with a long-term orientation. Also, it is believed that organizations will not achieve sustainability until sustainability becomes embedded within the culture of the organization [105].
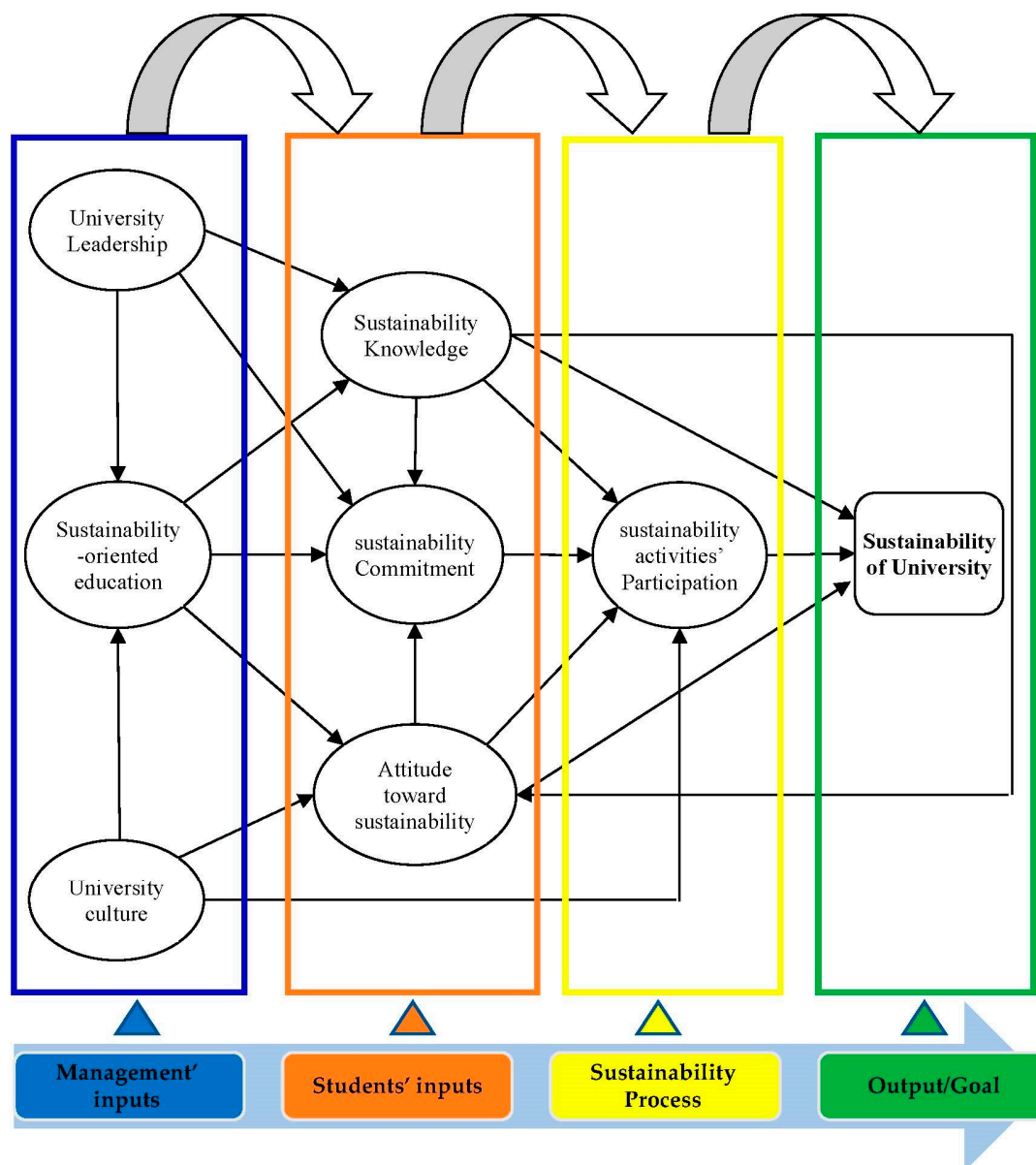
Figure 4. Final research model to facilitate university transition towards sustainability.

The leadership style of the university, which somehow refers to the management of the organization, plays a key role in transitioning the university toward sustainability through the integration of sustainability in university performance, goals, policies and education [4–8,18,45–47].

The results of this study showed that there is a relationship between organizational management components and individual components such as students' knowledge, attitudes and commitment toward sustainability. In scientific texts, organizational culture and

leadership style have been introduced as a change agent of knowledge and attitudes in organizations. For example, Linnenluecke and Griffiths [104] argued that if universities and higher education institutions are to play their potential role as sustainable organizations, they must experience an important cultural shift towards sustainability, which implies a change in attitude and the development of a new set of values and behaviors within the organization's people.

According to the proposed framework (Figure 4), sustainability knowledge and attitudes affect students' commitment to sustainability and participation in sustainability-oriented activities. This process will result in the promotion of the sustainability level at the university. We believe that increasing the sustainability level at the university can lead to new sustainability-oriented activities at the university that enable the achievement of higher levels of sustainability. Zsóka et al. [92] argued that environmental knowledge can lead to environmental behaviors within the university by influencing students' commitment. In fact, universities with high levels of sustainability have a high organizational culture of sustainable development, sustainability-oriented leadership, a positive knowledge and attitude towards sustainability and a strong commitment to sustainable development issues and, consequently, more engagement in sustainable activities.

The findings of the structural model indicated that the students' participation in sustainability-oriented activities had a significant effect on the level of university sustainability. This means that the level of integrating sustainable development principles into the university structure increases after increasing the level of students' participation. As the university management benefits from the students' participation in planning and decision-making related to sustainable development issues, an opportunity is created for exchanging experiences. This dialogue gives students a strong sense of their ideas and viewpoints being considered by the university management and a greater trust in the university's operational plans. The output of this process is the coordination and synergy between university management activities and students, as one of the most important human resources of the university and decreasing the friction between their activities toward sustainable development.

Sustainability knowledge and attitudes toward sustainability were other factors that influenced the implementation of sustainability principles in the university, both directly and indirectly, through the mediating factors of participation and commitment to sustainability. In this process, sustainability knowledge is more important in implementing sustainability principles at the university because it acts as a pioneer for the other three factors: commitment to sustainability, attitudes toward sustainability and participation in sustainability-oriented activities. To explain this issue, increasing the students' levels of awareness to the sustainability-oriented issues improves their attitudes toward sustainability-oriented activities, which in turn affects commitment and participation in sustainability. Therefore, university managers must integrate sustainability-oriented programs into their curriculum content as the main factor influencing the students' knowledge to incorporate sustainable development into their structures.

7. Conclusions and Future Work

As the sustainable university makes sustainability a central priority in its teaching and research, it is important to understand how universities are transitioning towards sustainability. This study showed that the process of university sustainability is the result of the interaction between the university management system and students' behavior. The method of leading and guiding the university along with the organizational culture of the university determines to what extent the university is ready to move towards sustainability and this readiness shows itself by providing infrastructure and services as well as providing sustainability education at the university level. Sustainability education leads students to become familiar with the concepts and importance of sustainability and to find a positive attitude towards it, which in turn increases their commitment to sustainability issues. By increasing knowledge, improving attitudes and making a commitment towards sustain-

ability, students' participation in university sustainability-oriented activities increases and facilitates the process of transitioning the university towards sustainability. As a result, the sustainability wheel of universities starts moving through the management system and is oiled by the participation of students in sustainability activities.

From a theoretical point of view, this research contributes to developing a rich literature on the sustainable university, developing behavioral theories to achieve sustainability, explaining the important role of university leadership in achieving sustainability, demonstrating the prominent role of university-dominated culture in moving towards sustainability, developing a process model of sustainable development at universities and explaining the important role of collaboration and participation in achieving sustainable development goals.

Another important contribution of this work is that as there are no frameworks to support interaction between the university management system and student behavior in order to integrate sustainability into universities, a new framework to cover this research gap has been developed based on the results of this systematic literature review.

From a practical point of view, transitioning to the sustainable university will make the entire campus greener and healthier, setting an example for other universities in Iran and other countries. Therefore, university managers, policymakers and students must focus on the future, not just on their own short-term interests, and work to implement this transition now. Also, university managers are able to facilitate the integration of sustainable development into the structure of the university under their management through following the model presented in this study step by step.

Finally, based on the findings of the study, the following practices can accelerate the process of moving universities towards sustainability:

Considering students' opinions and desires in university decision-making;

Having open days at the university where local communities can engage with the university (university culture);

Reducing administrative bureaucracy;

Holding workshops for students and faculty members to familiarize them with environmental crises;

Improving the university's capacity to teach and conduct research related to sustainability.

For future work, considering the results of this research and the importance of the role of organizational management in changing the attitudes and commitments of students towards sustainability and encouraging them to participate in sustainability activities at the university, it is suggested that new studies be conducted on the impact of different management styles on the adoption of sustainability activities within the university.

8. Limitations

The findings of this study have to be seen in the light of some limitations. Firstly, participants were not able to explain or give reasons for their responses to the questionnaire. Secondly, a lack of probability sampling was an important issue that should be mentioned. Third, all of the students that participated in our research were from the same university, which restricts the generalization of our results to a greater number of participants.

It is suggested that in future research, to overcome these limitations, conditions for probability sampling should be provided as much as possible, and secondly, students from different universities should be selected in order to increase the generalizability of the results.

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Institutional Review Board Statement: Not applicable.

Appendix A

Dear respondent,
Please rate the implementation of each of the following items at the university from 1 (minimum) to 10 (maximum).

Item	Indicator	Rate from 10
Environmental	Separating drinking water from other uses (such as water for bathing)	
	Use of public transport services for commuting students	
	Use of office automation for student affairs	
	Use of double-glazed windows to prevent energy wasting	
	Use of pressurized irrigation systems in the university environment	
Social	Holding seminars	
	Holding sports competitions aimed at student health	
	The naming of some days as open days at the university where the local communities can go and see how agricultural products are scientifically produced.	
	Transferring some university affairs to students	
	Holding a tree planting ceremony at the university	
	Establishing environmental forums at the university	
	Including marine meals (such as fish and shrimp) in the diet of students	
Economic	Paying attention to relations with industry	
	The processing and selling of agricultural products	
	Holding exhibitions at the university for the sale of agricultural products	
	Establishing knowledge enterprises	
	The assignment of facilities to students to commercialize their scientific products	
	The construction of greenhouses, a dairy, fish farming ponds and…	

Item	Indicator	Rate from 10
Educational	The compatibility of educational content with existing job opportunities	
	Compatibility of educational content with local community issues and problems, and helping solve them	
	Attempts to attract elite students to the university	
	Creating a flexible educational structure for teaching sustainable development subjects at the university	
	Use of creative teaching approaches	
	Enabling students to make informed decisions	
	Creating environmental responsibility through educational programs	
	The facilitation of social learning	
Research	Devoting some part of the university's budget to research related to sustainable development	
	Holding scientific conferences on Sustainable Development	
	Funding for theses and dissertations related to university sustainability	

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