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Roles of Environmental Knowledge in Promoting Agricultural Students' Pro-Environmental Behaviors

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ABSTRACT

Environmental crises are among the most important problems and concerns in the 21st century. Many researchers and experts believe that by encouraging the pro-environmental behavior, these problems can be reduced and it requires increasing the human-environmental knowledge. Therefore, this study aimed to analyze the effects of environmental knowledge on students' pro-environmental behavior. This research is a descriptive and correlational study. The statistical population consisted of all agricultural students studying at the University of Zanjan (N= 1,127). The sample size was calculated using Krejcie and Morgan's sampling table (n= 290), and the subjects were surveyed using a proportional stratified random sampling method. In the statistical process of data analysis, Structural Equation Modelling (SEM) with AMOS ver. 24.0 software was used to test the research hypotheses. The results indicated that students' systematic knowledge had a positive and significant effect on students' pro-environmental behavior. Also, the findings indicated that action-related and effective knowledge had no significant effect on students' environmental behavior. Therefore, the systematic knowledge is, directly and indirectly, a good determinant for the environmental behaviors that should be taken into consideration to improve the students' environmental behaviors.

Keywords: Action-related knowledge, Effective knowledge, Pro-environmental behavior, Systematic knowledge.

INTRODUCTION

Today, natural resource reduction, soil erosion, water deficiency, air pollution, global warming, deforestation, and loss of biodiversity are some of the current environmental issues that significantly threaten sustainability and make humankind vulnerable to disasters (Lange and Dewitte, 2019; Maleksaeidi and Keshavarz, 2019). Environmental quality strongly depends on the individuals behavior styles. Human behavior is commonly accepted as a major contributor to these environmental issues (Lange and Dewitte, 2019). Furthermore, politicians, environmental activists, and individuals who generally tend to promote a less polluted environment and support the sustainable use of natural resources consider human behavior as the main cause of many environmental degradations (Kaiser and Fuhrer, 2003). It can also be said that environmental attitudes and knowledge (among other characteristics) often determine environmental capability (Gifford and Sussman, 2012). Investment in the behavioral change programs is possible with knowing their requirements and determinants comprising intention, attitude knowledge, identity and moral norm (Valizadeh *et al*., 2020).

Knowledge is what people know about phenomena, philosophies, actions, theories, procedures, concepts and objects (Geiger *et al*., 2019). Environmental knowledge is an interdisciplinary concept and consists of the

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following arenas: nature, ecology of the natural environment, human ecology, as well as social science (Pérez- Belis *et al*., 2015; Kukkonen *et al*., 2018). Certainly, there is sufficient evidence that environmental knowledge is reasonably related to ecological behavior (Geiger *et al*., 2018). Given that the human and environment interact with an individual's personality traits (such as knowledge) (Liefländer and Bogner, 2018), and as mentioned, it is important to examine the effects of different types of environmental knowledge on environmental behavior.

Based on the UI (University of Indonesia) Green Metric World University Rankings (2020), in connection with indicators of Green Campus and Sustainability such as: setting and infrastructure, energy and global climate change, waste, water, transportation, education and research, the University of Zanjan was ranked 54th in the world, 14th in Asia, and, therefore, the first in Iran. This demonstrates the commitment of the people involved in this university in developing an 'environmentally friendly' infrastructure and behaviors. Furthermore, they give students the skills and abilities needed to integrate into the labor market (Puertas and Marti, 2019). University students as a part of the young people of the community endure the load of the former and common carelessness towards the environment. However, they are the important people who reach and use the technical knowledge necessary to encourage appropriate solutions to change environmental behavior (Shafiei and Maleksaeidi, 2020). Many universities commitment to encourage students' Pro-Environmental Behaviors (PEBs) (Janmaimool and Khajohnmanee, 2019; Kukkonen *et al*., 2018; Arnon *et al*., 2015). Thus, increasing knowledge on what motivates them to behave pro-environmentally is a substantial area of concern that has reasonable application for moving on the manner a sustainable future (Yu *et al*., 2017; de Leeuw *et al*., 2015). Given that agricultural students work on agricultural farms to spend some of their courses and their actions are directly and indirectly related to the environment, so, it is necessary to examine their environmental knowledge and its relationship to environmental behaviors. Therefore, the main purpose of this study was to investigate the effects of different types of environmental knowledge on the environmental behavior of agricultural students at University of Zanjan.

A review of the research literature showed that some researchers indicated that environmental knowledge had positive effect on environmental attitude of subjects (Gurbuz and Ozkan, 2019; Varoglu *et al*., 2018; Pe'er *et al*., 2007), but Erhabor and Don (2016) found a negative relationship between knowledge and the attitude towards the environment. Also, Paço and Lavrador (2017) showed no relationship between knowledge and attitude as well as knowledge and behavior, while the relationship between attitude and behavior was poor.

Some studies have examined the relationship between knowledge and environmental behavior, and most have concluded that systematic knowledge focuses on understanding global environmental problems. Therefore, it is expected to be more closely related to environmental behaviors; and since the relevant forms of knowledge should work together in a converging way to enhance environmental professional behavior, system knowledge can play an important role and is more related to environmental behavior (Kyriakopoulos *et al*., 2020; Li *et al*., 2019; Díaz-Siefer *et al*., 2015; Kaiser and Fuhrer, 2003). In connection with this result, Frick *et al*. (2004) explained that three forms of knowledge had different effects on environmental protection behavior. Practical knowledge and effective knowledge had a direct effect on performance. In contrast, systematic knowledge did not affect behavior and it was only influenced by affecting the other two types of knowledge. Also, Li *et al*. (2019) indicated that the influence of subjective norms on the willingness of residents to purchase energy-efficient appliances is not significant. Environmental concern and environmental knowledge have a positive

impact on attitudes and indirectly affect residents' willingness to purchase energy-efficient appliances. Erdogan (2015) reported that environmental knowledge, environmental sensitivity, intentions, environmental attitudes, and environmental behaviors were significantly increased after intervention and training. Zsóka *et al*. (2013) showed a strong correlation between environmental training intensity and environmental knowledge of students. Table 1 summarizes the most important studies that have been conducted in this field, along with the variables that have been used. As can be seen, in most of the studies mentioned in Table 1, knowledge has been investigated in the form of a general variable or in the form of other dimensions, and less attention has been paid to its three dimensions (systematic, practical, and effective knowledge).

Therefore, this study seeks to fill the gap of studies that have tried to examine the relationship between the three dimensions of knowledge with other environmental variables.

Table 1. Pervious research on students' environmental knowledge and behavior.

Author, Year	Country	Environmental variables investigated
Kaiser and Fuhrer (2003)	Netherlands	Declarative; Procedural; Effectiveness; Social knowledge; Intention; Attitude and Behavior
Pe'er *et al.* (2007)	Israel	Students' Knowledge and Attitude
Kukkonen *et al*. (2012)	Finland	Information; Perceptions and Education
Esa (2010)	Malaysia	Knowledge; Attitudes; Practices; Education; Sustainable Development
He *et al.* (2011)	China	Knowledge; Attitudes; Education; Behavior
Vicente-Molina *et al.* (2013)	Spain; USA	Knowledge; Behavior; Attitudes
Zsóka *et al.* (2013)	Hungary	Environmental Education and Environmental Knowledge; Attitudes and Reported Actual Behavior
Erdogan (2015)	Turkey	Environmental Education Program (SEEP); Environmental Sensitivity; Intentions; Environmental Attitudes and Environmental Behaviors
Díaz-Siefer *et al*. (2015)	Chili	Human-Environment System Knowledge; Environmental Action Knowledge and Pro-Environmental Behavior
Erhabor and Don (2016)	Nigeria	Environmental Knowledge and Attitude
Ibanez *et al*. (2017)	Spain	Education; Knowledge; Behavior
Paço and Lavrador (2017)	Portugal	Knowledge; Attitude and Behavior
Kukkonen *et al*. (2018)	Finland	Behavior; Education
Varoglu *et al.* (2018)	Cyprus	Knowledge; Attitude and Behavior
Fu *et al.* (2018)	China	Behavior; Awareness; Cultural norms
Gurbuz and Ozkan (2019)	Turkey	Consumers' Knowledge; Attitude and Behavioral Patterns towards the Liquid Wastes
Janmaimool and Khajohnmanee (2019)	Thailand	Knowledge; Behaviors; Attitudes; Political ecology; Sustainable development
Ramezani and Tahsini (2019)	Iran	Knowledge; Attitude; Behavior
Valipour and Farrokhian (2019)		
Li *et al*. (2019)	China	Concern, Knowledge; Attitude; Subjective Norms; Perceived Behavior Control; Intention, Behavior
Kyriakopoulos et al. (2020)	Greece	Behavior; Education and Ecological Sensitivity
Shafiei and Maleksaeidi, (2020)	Iran	Attitude; Efficacy; Vulnerability; Severity; Behavior
Sousa *et al.* (2021)	Portugal	Knowledge; Attitude and Behavior

Source: Sousa *et al.* (2021); Research findings.

After reviewing the theoretical background, the research framework was developed; four key variables including dimensions of environmental knowledge, attitude, intentions, and behavior were considered by the researchers in this

framework. Therefore, this research attempted to answer the following question: Does three domains of students' environmental knowledge (systematic, action-related, and affective) affect their environmental behavior?.

MATERIALS AND METHODS

Description of Research Variables

The Pro-Environmental Behavior

The current community was identified by a strong awareness of the actual situation of the environmental degradation as a result of the human irresponsible actions over the past decades. The sharpness of the environmental problems has led to a developing consideration of peoples' environmental behavior (Sousa *et al*., 2021). The human pro-environmental behavior is currently considered as one of the most important environmental factors (Cascante *et al*., 2015) and is defined as a measure that helps protect the environment (Kaiser and Fuhrer, 2003). According to the influence, which may be positive or negative, individuals' environmental behavior may be identified as environmentally friendly or unfriendly. Any human behavior is obviously environmentally friendly such as riding a bicycle, or environmentally unfriendly such as traveling by plane (Krajhanzl, 2010).

The Environmental Attitude

Attitude refers to the sustainable mental tendency of an individual for a special behavior (Li *et al*., 2019; Ajzen, 1991). A set of emotions, desires, and judgments of a person's attitude toward an environmental phenomenon in life is called attitude (Naeimi *et al*., 2018). Attitudes refer to individual interests and differences of opinion, support or disagreements, positive and negative views, and are generally regarded as individual tendencies and evaluations that are used to evaluate a wide range of objects, issues, and so on. (Liefländer and Bogner, 2018). It can also be said that a person's attitude, positive or negative, is about a given subject or behavior (Fishbein and Ajzen, 1975; Pe'rez *et al*., 2002).

The Intentions of Pro-Environmental Behaviors

Okumah *et al*. (2020) described intention as an intent or resolve (not) to influence environmentally important behaviors. Cheng (2018) stated that intention means people will create a particular behavior. Therefore, the intention of pro-environmental behavior comes before the real behavior.

The Environmental Knowledge

The ecological knowledge is driving global concerns; hence, it should be supported through scientific education. Students are a significant entity in sustainability because they are the main users of resources including paper, water, and energy, with severe results for university budgets and the environment (Kukkonen *et al*., 2018). In this study, three types of knowledge were studied according to the study of Kaiser and Fuhrer (2003) as follows:

Systematic Knowledge: Systematic knowledge refers to natural processes in the ecosystem and human-nature interactions, including problems and consequences (Liefländer and Bogner, 2018). This knowledge reduces uncertainty and allows individuals to take action. However, having the right knowledge does not necessarily mean doing the right thing (Kaiser and Fuhrer, 2003).

Action-Related Knowledge: This knowledge refers to the existing behavioral options that are appropriate for addressing environmental problems (Lieflander and Bogner, 2018). The action-related knowledge, in a sense, refers to knowledge

about behavioral options and possible ways of behaving. Action-related knowledge is a good predictor of protective behavior (Frick *et al*., 2004). It also addresses the question of how specific protection goals can be achieved (Kaiser and Fuhrer, 2003).

Effective or Affective Knowledge: Effective knowledge includes the knowledge of a particular effect and the effect of a particular action and option compared to another (Lieflander and Bogner, 2018). Different behaviors have different protective potentials; and those that are energy-efficient are more powerful means of saving energy than any behavioral restriction (Kaiser and Fuhrer, 2003). Thus, eight hypotheses are considered according to the conceptual framework and research questions (Figure 1):

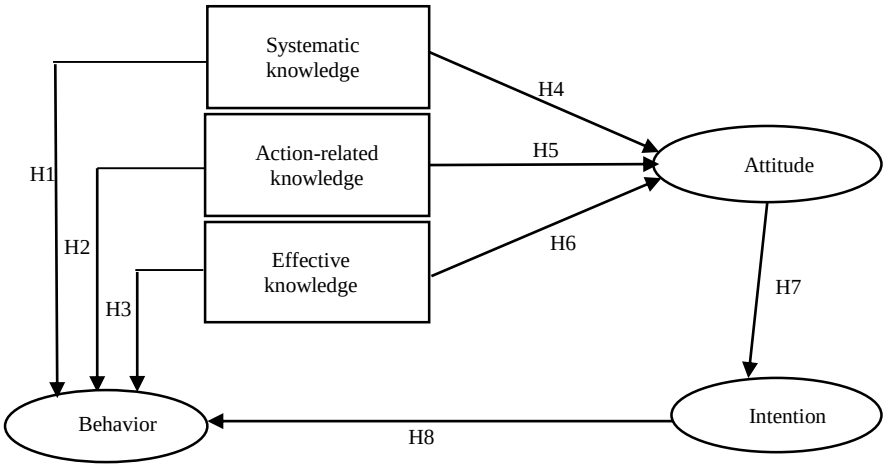

Figure 1. Conceptual framework of research.

H1: Systematic knowledge has a significant and positive effect on environmental behavior;
H2: Action-related knowledge has a significant and positive effect on environmental behavior;
H3: Effective knowledge has a significant and positive effect on environmental behavior;
H4: Systematic knowledge has a significant and positive effect on environmental attitude;
H5: Action-related knowledge has a significant and positive effect on environmental attitude;
H6: Effective knowledge has a significant and positive effect on environmental attitude;
H7: Environmental Attitude has a significant and positive effect on environmental intention,
H8: Environmental intention has a significant and positive effect on environmental behavior.

Methodology

This was an applied research with a descriptive-correlational approach. The study population consisted of agricultural students studying at the University of Zanjan in 2019 (N= 1,127). The sample size was calculated using Krejcie and Morgan Table (n= 290) and the subjects were studied using proportionate stratified random sampling method. For this purpose, in the first stage, students involved in any field of study were placed in eight separate strata (Agricultural Extension and Education; Horticulture; Agronomy and Plant Breeding; Animal Science; Water engineering; Plant science; soil science; Food Science and Technology). In the second stage, the samples in each strata were randomly selected based on the academic levels (Bachelor, Master, and Ph.D.) in proportion to their frequency. Data collection instrument was a researcher-made

questionnaire, which was developed according to the researches by Kaiser and Fuhrer (2003) and Diaz-Siefer *et al*. (2015). The questionnaire consisted of five parts: the demographic and educational characteristics of the respondents, and questions related to measuring variables of environmental knowledge (Effective, Action related, and Systematic knowledge), environmental behavior, attitudes, and environmental intentions. The face and content validity of the questionnaire was confirmed by the subject specialists. To determine the reliability of the research tool, a pilot test was conducted where the Cronbach's Alpha value was appropriate for the main scale of the questionnaire (Table 2). Cronbach's Alpha has been described as "one of the most important and pervasive statistics in research involving test construction and use" (Cortina, 1993) "to the extent that its use in research with multiple-item measurements is considered routine" (Schmitt, 1996). "Alpha is commonly reported for the development of scales intended to measure attitudes and other affective constructs" (Taber, 2018). Data were collected by face-to-face (in-person) interviews in accordance with the above-mentioned questionnaire. The collected data was analyzed by software SPSS and AMOS. Also, it should be noted that in the descriptive statistics section, Interval of Standard Deviation from the Mean (ISDM) method was used to describe the frequency of the respondents' responses to each of the research variables (Gangadharappa *et al*., 2007). According to this formula, individuals' responses were categorized as low, moderate, and high according to Likert type scale used:

A: Low= A≤ Mean-1/2 Sd
B: Moderate= Mean–1.2 Sd≤ B≤ Mean+1.2 Sd
C: High= Mean+1/2 Sd≤ C (Gangadharappa et al., 2007).

In the statistical process of data analysis, Structural Equation Modelling (SEM) with AMOS ver. 24.0 software was used to test the research hypotheses. To evaluate the structural model, the following fitting indices were used: (1) The relative Chi-square value ($\chi 2$/df) which, according to Schreiber *et al*., (2006) must be less than 3; (2) Comparative Fit Index (CFI), Goodness of Fit Index (GFI) and Incremental Fit Index (IFI), which according to Bagozzi and Yi (1988) should be equal or more than 0.90, (3) Root-Mean Square Error of Approximation (RMSEA), for which Meyers *et al*. (2006) suggested values between 0.05-0.10 as acceptable.

RESULTS

Description of Demographic Information of Respondents

According to the study results, the mean age of the respondents was less than 25 years. In terms of gender, just less than three quarters (131 students) were female and 27.2% (49 students) were male. Regarding the degree levels of the students, results showed that 55.6% of respondents were Bachelor, 27.8% were Master, and 16.7% were Ph.D. students. Also, 91.1% of the respondents lived in the city and 8.9% lived in rural areas. More than three quarters of the students (78.3%) were interested in participating in environmental activities.

Description of the Studied Environmental Variables Based on ISDM Index

The results of students grouping based on the index of Interval Standard Deviation from the mean at high, moderate, and low levels regarding the variables studied are shown in Table 2. According to the results, systematic knowledge of more than half of students (54.4%) was at an intermediate level and less than a quarter were at low (22.2%) or high (23.3%) levels. In relation to action-related knowledge, results showed that less than half of the respondents (40%) had a low level of action-related knowledge, more than a third of them had intermediate level of knowledge(33.9%), and more than a quarter

(26.1%) had high action-related knowledge.

Table 2. Variables, measurements and Cronbach's Alpha coefficients.

Constructs	Measurement items/Dimension (Symbols)	No of items	Scale	Cronbach's Alpha	CR
Knowledge	Systematic K (SK) Action-related K (AK) Effective K (EK)	14 9 9	Ratio (Score:0-100)	Ratio scale (Not required)	
Behavior	I use public transportation to do my job. (B1) Dropped I turn off the extra lamps at home, the workplace, etc. (B2) Dropped I throw empty bottles into the recycling bin. (B3) If anyone does environmental harmful behavior, I will warn him/her (B4) I help environmental organizations (B5) I'm talking with my friends about environmental issues (B6)	6	Ordinal (1: Never, 2: Rarely, 3: Sometimes 4: Usually, 5: Always)	0.77	0.79
Attitude	One of the worst cases of population growth is that many natural areas are destroyed for development (Eco1) Sometimes I get upset when I see that the forests are destroyed for agriculture (Eco2) Sometimes when I get upset I go to nature to feel comfortable (Eco3) It saddens me to see that the environment has been destroyed (Eco4) One of the most important reasons for protecting the environment is wildlife care (Eco5) Dropped Humans, like other animals, are part of the ecosystem (Eco6)	7	Ordinal (1: Strongly disagree, 2: Disagree, 3: No opinion, 4: Agree, 5: Strongly agree)	0.79	0.85
Intention	I intend to do environmentally friendly behaviors in the near future (In1) I intend to try more to protect the environment (In2) I'm going to change my lifestyle to be an environmentalist (In3) I intend to separate the waste at home and at work (In4) Dropped I intend to use less disposable containers that pollute the environment. (In5) Dropped I want to persuade those around me to practice environmental conservation behavior (In6) I intend to use less disposable containers that pollute the environment (In8)	8	Ordinal (1: Strongly disagree, 2: Disagree, 3: No opinion, 4: Agree, 5: Strongly agree)	0.83	0.86

Regarding behavior as deducted from respondents results, it was seen that less than half of the respondents (42.8%) were at a moderate level, less than a third of them (30%) were at a low level, and more than a quarter (27.2%) of respondents were at a high level. Results of ISDM for environmental attitudes showed that about three-quarters of the students (72.8%) had a moderate to high attitude, and the attitude of more than a quarter (27.2%) of the respondents was low. Related results of environmental intention of students showed that the intention of less than half of them (46.7%) was medium, less than a quarter (24.4%) had low, and more than a quarter of them (28.9%) had high level of intention (Table 3 and Figure 2).

Table 3. Frequency, percentage and mean of research variables.

Variables	Dimension	Low		Moderate		High		Mean	Standard deviation
		F	%	F	%	F	%		
Environmental knowledge	Systematic K	40	22.2	98	54.5	42	23.3	49.55	15.98
	Action related K	72	40	61	33.9	47	26.1	41.72	16.04
	Effective K	38	21.1	98	54.4	44	24.5	29.81	17.07
Behavior	-	54	30	77	42.8	49	27.2	3.31	0.52
Attitude	-	49	27.2	64	35.6	67	37.2	4.05	0.62
Intention	-	44	24.4	84	46.7	52	28.9	3.97	0.57

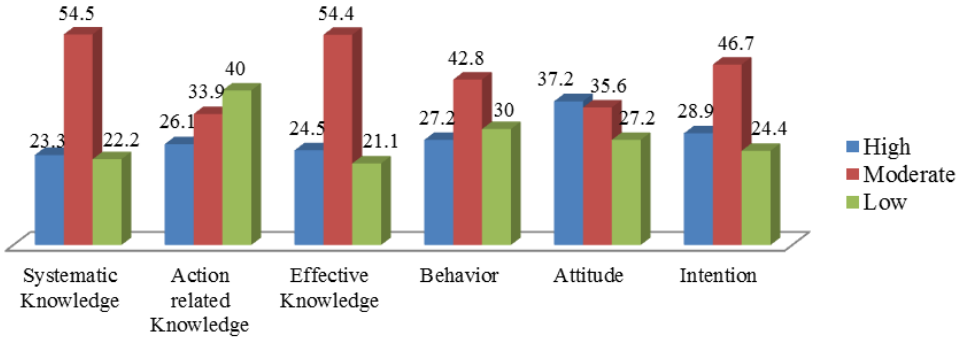

Figure 2. Percentage distribution of research variables.

Structural Models

Structural equation modelling technique was used to test the relationship between research variables. In this study, three types of effects (direct, indirect, and total) on behavior were investigated, which are summarized as follows:

The results of the direct effects analysis showed that systematic knowledge and intention of students has a positive and significant effect on students' environmental behavior. Also, findings showed that action related and effective knowledge had no significant, direct effect on students' environmental behavior. Therefore, systematic knowledge and intention accounted for 27% of the pro-environmental behavior variance (Figure 3). Other results are shown in Figure 3 and Table 4, which show that systematic and action related to knowledge had a significant effect on students' environmental attitudes, as these two variables account for 17% of the variance in attitude (Figure 3). Action related to knowledge (Beta= 0.27) had a greater contribution to explaining the variance of students' environmental attitudes than systematic knowledge (Beta= 0.23). Results of Table 4 show that students' attitudes had a significant and positive effect on their intentions. Therefore, this variable could explain 39% of the changes in the environmental intention of students. According to the conceptual framework of the research, the indirect effects of different types of knowledge and attitude on behavior were calculated. As shown in Table 4, only systematic knowledge and attitude had a direct and significant effect on students' pro-environmental behavior. According to the findings, the indirect effect of attitude on behavior through intention was 0.29 and for systematic knowledge through attitudes and intentions was 0.067.

Finally, the total effect of systematic knowledge and attitude on students' pro-environmental behavior was calculated through the algebraic sum of direct and indirect effects. According to findings in Table 4, the total effect of systematic knowledge and attitude on students' pro-environmental behavior was calculated as 0.250 and 0.915, respectively.

Table 4. Direct, indirect and total effects of variables on students' pro-environmental behavior.

Effects	Path	Standardized estimates	Std error	CR	Sig
Direct effects	Systematic K.→ Behavior	0.183	0.003	2.054	0.040
	Action related K. → Behavior	-0.168	0.003	-1.835	0.066
	Effective K. → Behavior	0.061	0.003	0.711	0.477
	SK → attitude	0.237	0.003	2.836	0.005
	Ak → attitude	0.274	0.003	3.100	0.002
	EK → attitude	0.018	0.002	0.227	0.821
	Attitude→Intention	0.625	0.149	5.667	***
	Intention→Behavior	0.464	0.087	3.80	***
Indirect effects	Attitude→Intention→Behavior	0.29			
	Sk→Attitude→Intention→Behavior	0.067			
Total effect	Direct effect + Attitude	0.915			
	Indirect effect Sk	0.250			

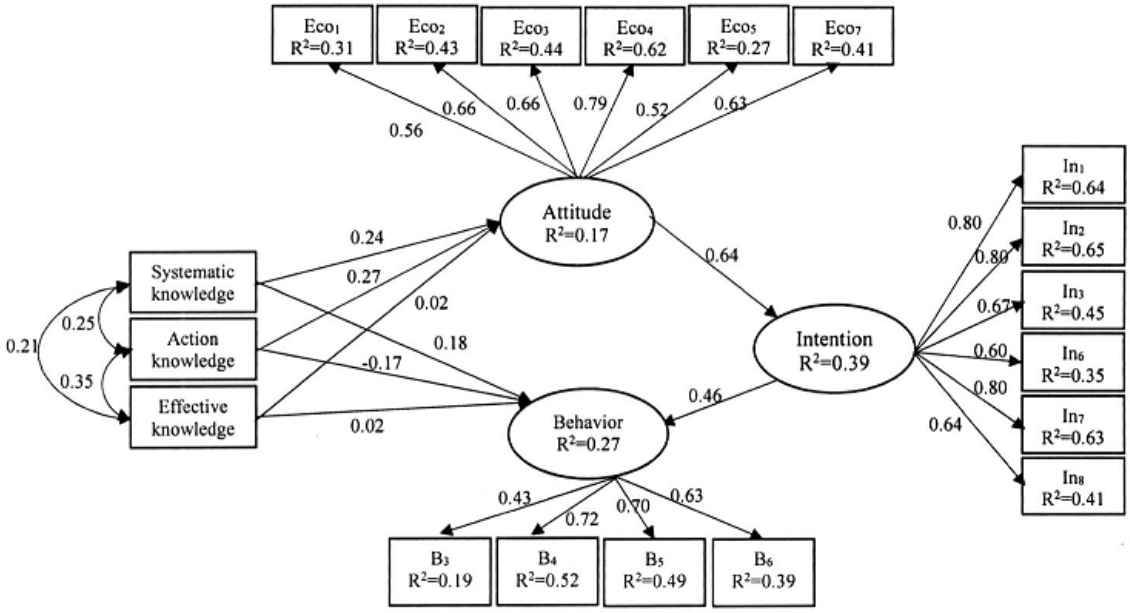

Figure 3. Structural model of research.

Fit Indices of Structural Model

The results of model fit statistics showed that the relative Chi-square value was 1.652, which is an acceptable value. GFI value was 0.874, which, according to Meyers *et al*. (2006), values of 0.80 and more for this index indicate the model fits well. Also, values of CFI (0.914) and IFI (0.916) were greater than 0.9 that is acceptable. Ultimately, the RMSEA value was 0.06, which indicates a desirable fit between model and data (Table 5).

DISCUSSION

Students are in a period of life that can be convinced about the environment being in a critical condition. Furthermore, the university environment can offer a condition for them to study and argue environmental problems, and from this way foster favorable environmental behaviors in the community (Yu *et al*., 2017; Shafiei and Maleksaeidi, 2020; de- Leeuw *et al*., 2015). Hence, this study was conducted to investigate the effects of different types of environmental knowledge on pro-environmental behaviors among agricultural students in the University of Zanjan.

Table 5. Summaries of fit indices of structural model.

Fit indices	Value	Acceptable value	References
Relative Chi Square	1.652	≤ 5	MacCallum*et al*. (1996) Byrne (2001)
Good Fit Index(GFI)	0.874	≥ 0.9	Schreiber *et al*. (2006)
Comparative Fit Index (CFI)	0.914	≥ 0.9	Meyers *et al*. (2006)
Incremental Fit Index (IFI)	0.916	≥ 0.9	Hair *et al*. (2010)
Root-mean square error of approximation (RMSEA)	0.060	≥ 0.08	Barrett (2007) Hooper, Coughlan and Mullen (2008)

Results of this study showed that although most of the students were interested in participating in environmental activities, their overall score of pro-environmental knowledge was not desirable. However, in some studies, students' knowledge about environmental issues was desirable (Sousa *et al*. 2021; Ntanos *et al*. 2018), and in a case study, Sousa *et al*. (2021) revealed that most students were aware of the importance of protecting the environment and considered themselves well informed about the main environmental issues. Also, Ntanos *et al*. (2018) concluded that students' had widespread knowledge on several environmental problems and energy sources. Therefore, it is suggested that students' pro-environmental knowledge should be increased with the right curriculum planning to be able to properly take steps to encourage pro-environmental behaviors. It is clear that with the increase in students' environmental knowledge, the level of their attitude towards environmental issues and, consequently, their behavioral intentions also improves, which can also strengthen the indirect effect of pro-environmental knowledge on behavior.

According to the results of the structural model, it was found that systematic knowledge had a positive and significant direct and indirect effect on environmental behavior. Overall, systemic knowledge explained 27% of the pro-environmental behavioral changes of agricultural students. This finding is consistent with the study results of Varoglu *et al*. (2018), Erdogan (2015), and Diaz-siefer *et al*. (2015). According to the literature (Diaz-Siefer *et al*., 2015), systemic knowledge can play a key role and is more related to pro-environmental behavior. The findings show that a better knowledge and a better understanding of environmental issues have an encouraging effect on pro-environmental behavior. Diaz-Siefer *et al*. (2015) stated that environmental system knowledge encourages the feeling of responsibility for the environment, thereby improving pro-environmental behavior. Blackley and Sheffield (2016) believed that fostering environmental education enables individuals and communities to reflect on ways of engaging with the environment, preserving the environment, and designing a more ecologically and socially just world through knowledgeable action. The research results of Li *et al*. (2019) indicated that environmental concern, environmental knowledge, attitude, and perceived behavioral control were significantly positively correlated with residents' willingness to purchase energy-efficient appliances.

According to the study's findings, practical and effective knowledge had no significant effect on the environmental behavior. In this regard, Paço and Lavrador (2017) stated that there was no relationship between knowledge and attitude as well as knowledge and behavior. Some studies (Salehi and Ghaemi Asl, 2013) also indicated the lack of impact of environmental knowledge on environmental behavior. Frick *et al*. (2004) stated that systematic knowledge had no effect on behavior and only affected behavior through affective and action-related knowledge. Kyriakopoulos *et al*. (2020) concluded that active and practical learning was positively related to environmental behavior of students. Therefore, scholars should reconsider how they can improve their teaching method in several disciplines to reach the higher order learning results such as

analyzing, evaluating and creating. In fact, Frick *et al*. (2004) believe that the focus of practical knowledge expands from simply knowing how to protect the environment to knowing how to get the highest environmental benefits. In short, it can be said that systematic knowledge is considered as the basis of practical and effective knowledge. It can be said that the as systematic knowledge increases, environmental uncertainty among students decreases, which leads to an increase in practical knowledge and, ultimately, effective knowledge is strengthened among students.

It can generally be concluded that systemic knowledge is defined as knowledge of human-nature interactions. Higher-education students will also behave well in an environmentally friendly manner. In this regard, it is suggested that increasing students' knowledge should be considered due to its positive role and its effect on environmental behaviors. Therefore, the responsibilities of universities and higher education centers, especially for groups and departments in the field of environment, are highlighted and environmental education must be a top priority of the program to achieve this goal and increase students' environmental knowledge. If the interaction between the three types of students' knowledge is strengthened, then environmental behaviors among them will be encouraged.

Findings of this study provide some useful implications: firstly, for heads, managers, staffs, faculty members and students involved in University of Zanjan. Secondly, for other Iranian universities, especially those that want to take a step towards green management and improve environmentally friendly behaviors. Thirdly, for managers and planners of the higher education system in order to compile the curriculum. Fourthly, for governmental and non-governmental organizations and, finally, for all researchers and people who are environmentally friendly about the environment.

Therefore, some implications are presented in this section to facilitate the application of research results in executive areas (pro-environmental behavior studies).

This study presented new and important visions in line with a widespread insight to multipurpose issues, such as pro-environmental knowledge. These insights can be approved to develop conceptual framework in the universities of Iran and other countries with similar higher education structures and rules. In fact, each study cannot extensively cover all the variables that affect pro-environmental behaviors, but adding environmental knowledge by considering its dimensions in frameworks and models that have several variables can explain pro-environmental behaviors to make a significant contribution. As mentioned before, systematic knowledge is the basis of practical and effective knowledge. Therefore, it is suggested that in future researches, the effect of systematic knowledge on environmental behavior be investigated through practical and effective knowledge. Perhaps, the results of future research will show a significant effect of these two types of knowledge on pro-environmental knowledge.

One of the important issues that can be considered in future studies is paying attention to the culture in the relationship between knowledge and behavior. Since students from different regions are attending university, this issue can show the role of different cultures in promoting environmental knowledge and, consequently, the emergence of environmental behaviors. Also, this problem is one of the restrictions of this research that can be considered in future studies. Another limitation of this study was the non-cooperation of some students in the data collection phase. Unfortunately, some of them stated that they did not believe in the effectiveness of such studies, and some declared that they did not have enough time to participate in the interview. According to the conditions of the study, one of the limitations of this research was the study of agricultural students. It is suggested that in future studies, all people at the university including students, staff, and faculty

members, be studied.

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نقش دانش زیست محیطی در ارتقاء رفتارهای زیست‌محیطی دانشجویان کشاورزان

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چکیده

بحران‌های زیست‌محیطی از مهمترین مشکلات و نگرانی‌های قرن ۲۱ است. بسیاری از محققان و کارشناسان معتقدند که با ارتقاء رفتارهای حامی محیط‌زیست، می توان این مشکلات را کاهش داد و مستلزم افزایش دانش انسان و محیط زیست است. بنابراین، این مطالعه با هدف تجزیه و تحلیل اثرات دانش زیست‌محیطی بر رفتارهای دوستدار محیط زیست دانشجویان انجام شد. این پژوهش از نوع توصیفی - همبستگی است. جامعه آماری شامل کلیه دانشجویان کشاورزی مشغول به تحصیل در دانشگاه زنجان بود (N=۱۱۲۷). حجم نمونه با استفاده از جدول نمونه گیری کرجسی و مورگان (۲۹۰ نفر) محاسبه شد (n= ۲۹۰). افراد با استفاده از روش نمونه گیری تصادفی طبقه‌ای تناسبی مورد بررسی قرار گرفتند. در مرحله تجزیه و تحلیل داده‌ها، برای سنجش فرضیه‌های تحقیق، مدل سازی معادلات ساختاری (SEM) با استفاده از نرم‌افزار AMOS نسخه ۲۴ در دستورکار قرار گرفت. نتایج نشان داد که دانش سیستماتیک دانشجویان بر رفتارهای زیست‌محیطی آنها تأثیر مثبت و معناداری دارد. همچنین، یافته‌ها نشان داد که دانش عملی و اثربخشی بر رفتار محیطی دانشجویان تأثیر معنی‌داری ندارد. بنابراین، دانش سیستماتیک به طور مستقیم و غیر مستقیم تعیین کننده خوبی برای رفتارهای زیست‌محیطی است که باید برای بهبود رفتارهای زیست‌محیطی دانشجویان مورد توجه قرار گیرد.