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Impact Assessment of Self-directness and Meta-cognitive Skills on Agricultural Students' Academic Achievement in Iran

Masoud Bijani [a,], Aliakbar Raeisi [b], Naser Valizadeh [c], Negin Fallah Haghighi [d] and Maryam Neisi [e]*

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Abstract

Students' academic achievement is one of main indicators in evaluating higher agricultural education. One of the most effective strategies in terms of academic achievement is to reinforce self-directness and meta-cognitive skills. The main objective of this study was to evaluate the effects of elf-directness and meta-cognitive skills on the academic achievement of agriculture students in Iran. This research was a descriptive-correlational study using a survey technique. The instrument adopted in this study was a questionnaire which validity was confirmed by a group of curriculum developers and educational planning specialists in the higher agricultural education system. Cronbach's alpha coefficients were used to determine the reliability of this scale. Cronbach's alpha values for different variables showed the acceptable reliability of this instrument ($0.74 \leq \alpha \leq 0.96$). The statistical population of the study consisted of the agriculture students in Iran (N=236973). The sample size was estimated to be 150 persons by using Cochran statistics and two-stage sampling method (cluster sampling and proportional stratified random sampling). The results showed that the variables self-directness, metacognitive skills, and social conditions had a positive and significant effect on the academic achievement among these students. In total, they could predict a significant percentage (68.1%) of variance for the variables academic achievement.

Keywords:
Academic achievement; agricultural students; meta-cognitive skills; self-directedness skills; social conditions

[a] *Associate Professor, Department of Agricultural Extension and Education, College of Agriculture, Tarbiat Modares University (TMU), Tehran, Iran*
[b] *Former M.Sc. Student, Department of Agricultural Extension and Education, College of Agriculture, Tarbiat Modares University (TMU), Tehran, Iran*
[c] *Former Ph.D. Student, Department of Agricultural Extension and Education, School of Agriculture, Shiraz University, Shiraz, Iran*
[d] *Assistant Professor, Department of Technology Development Studies (DTDS), Iranian Research Organization for Science and Technology (IROST), Tehran, Iran*
[e] *Ph.D. Student, Department of Agricultural Extension and Education, School of Agriculture, Shiraz University, Shiraz, Iran*

Corresponding author's email: mbijani@modares.ac.ir

INTRODUCTION

The growth and prosperity of each society depends upon its educational system (Ghadampour et al., 2016). Today, the educational system is of paramount importance in all countries all around the world and there have been some attempts to improve the qualitative and quantitative status of higher education through taking some effective measures (Zarei et al., 2014). Since the students' academic achievement is considered as one of the important criteria in determining the quality of the educational system, it is of particular importance to have a close examination of this effective factor. Therefore, the theoretical and research efforts of many theorists have increasingly contributed to the analysis and explanation of factors associated with the academic achievement (Tamanaifar & MansouriNik, 2014; Oliver et al., 2019). Students' academic achievement is one of the main indicators to assess higher education and predict the future status of the students in terms of obtaining academic qualifications along with practical and academic skills (Soares et al., 2009). There are many methods to assess this factor, some of which include the assessment of achievements in each training course, the annual grade point average, the grade point average obtained for a specific course, and specialized tests (Pitt et al., 2012). The identification of factors affecting the students' academic achievement provides an appropriate approach to planning and developing educational programs, thus providing the best possible results for both the educational institution and students (Halpenny et al., 2010).

Having a close look at the factors influencing academic achievement at universities, one can found that a large number of factors affect academic achievement (Ghomi et al., 2016), the most important of which is self-directed learning strategies (Bahar, 2010). Self-directness in learning is a process throughout which the learners take the responsibility of identifying their own learning requirements as well as planning, implementing, and evaluating their learning outcomes (Fisher & King, 2010).

Self-directed learners are active and self-motivated individuals who, instead of passively waiting for reactive learning, take initiatives in their own learning. Self-directedness is a psychological mode in which one assumes being personally responsible for oneself and one's learning (Long, 2000). This type of learning is underpinned by a principle clarifying how the learner organizes his learning behaviors according to his metacognitive and motivational beliefs (Linnenbrink & Pintrich, 2002). Self-directed learners are purposeful and meaningful and, given their high motivational level, their learning is sustainable and consistent (Saif, 2012). This type of learning consists of three components: Self-management (management of or by oneself; taking the responsibility of one's own behavior and well-being), Self-control (the ability to control oneself, in particular one's emotions and desires, especially in difficult situations), and willingness to learn (defined as a desire, wish or readiness to acquire new knowledge and develop) (Williamson, 2007).

Relevant studies show that Iranian students are not well-ranked in terms of self-directedness skills (Amini & Fazli-nejad, 2010; Rezaei et al., 2013). A review of studies conducted during 1995-2007 also indicates that Iranian students are at a low level in terms of self-management, self-control, and willingness to learn, which are in fact the main components of self-directedness in learning (Heidari-Damani, 2010). Furthermore, given the effectiveness of self-directness development programs in different parts of the world, Iran's higher education system has also recently focused on the development of similar programs (Saadvandi et al., 2019; Saif, 2012; Taqipour et al., 2016). Due to the rapid and growing changes in the agricultural sciences, the higher education centers need to grow their students in such a way that they are equipped with lifelong learning abilities (Abbasi & Zamani-Miandashti, 2013). Educating such students in the higher agricultural edu-

cation system requires empowering learners with self-directed learning skills (Abbasi & Hedjazi, 2013). Acquiring such anability not only leads to academic achievement during the course of study at higher agricultural education centers but also makes them more responsive to the widespread changes in future knowledge and agricultural skills (Zamani & Azizi –Khalkheil, 2006). With regard to the practical nature of agricultural sciences, the need to concern and invest on training self-directed learners is more highlighted (Taqipour et al., 2016). Indeed, many of today's postgraduates in agriculture have practically no special skills; therefore, they after graduation are struggling with unemployment problems or engaging in unrelated fields of study. (Zamani & Azizi-Khalkheili, 2006). Although a part of the problems stems from shortcomings in our educational system and weaknesses in social, economic, and political structures, it is partly because they are lacking self-directedness and knowledge updating skills.

In the agriculture sector and its sub-sectors, the one's ability to direct one's learning process and experiences is considered as an important factor in achieving success. Hence, improving self-directed learning skills is assumed to be one of the main tasks of any responsible agricultural educator in higher agricultural education centers, given the fact that many agricultural students' knowledge becomes obsolete after graduation. Here, self-directed learning enables current graduates (previous students) to update their knowledge (Taqipour et al., 2016).

Unfortunately, agricultural higher education system in Iran is faced with many challenges. Increasing number of students who pursue careers in agriculture and unemployment rates among agricultural graduated students have caused an ongoing debate about whether agricultural higher educational strategies have been aligned with the needs of the labor market (Abbasi et al., 2015; Alizadeh et al., 2016). AHES is responsible for supplying the skilled man power required to improve the performance of the agricultural sector, but previous research results indicate that Iranian higher education system and especially in the agricultural sector had not been successful to manage talents (Abbasi, 2010; Alizadeh et al., 2016). One of the most effective strategies to improve this situation in order to increase the ability of agricultural students is to reinforce self-directness and meta-cognitive skills. Therefore, the purpose of this study was to evaluate the effects of elf-directness and meta-cognitive skills on the academic achievement of agriculture students in Iran.

THEORETICAL BACKGROUND

Meta-cognitive skills are another factor affecting the academic achievement and self-directedness skills (Ghomi et al., 2016). In other words, meta-cognition is an engine stimulating students' academic achievement and self-directedness (Reeve et al. 2003; VeisKarami et al., 2012). To put in simpler words, meta-cognition is "recognition of cognition" or "knowing about knowing". In other words, metacognition refers to an individual's knowledge of his own learning method (Saif, 2012). Meta-cognition allows learners to select and invent explicit learning strategies through understanding available cognitive resources and gaining experience from solving similar problems. It also plays a critical role in effective and profound learning since it empowers individuals to plan, monitor and control their cognitive function (Pennequin et al., 2010). Meta-cognition is known as a method that can be used to develop studying and learning skills and strategies (Saif, 2012; Veenman et al., 2006). The comparison between cognition and meta-cognition reveals that the former is engaged with act and action; however, the latter is associated with the selection and development of what one wants to do and the control of what is being done (Ghomi et al., 2016). Improving his meta-cognition skills, one can enhance his focus on a particular learning unit, recognize the necessity of information, and, if neces-

sary, use meta-cognitive strategies to keep information in short-term memory or to store them in long-term memory and retrieve them (Altindag & Senemoglu, 2013).

Similarly, meta-cognition consists of three components as follows: Meta-cognitive knowledge, meta-cognitive control, and meta-cognitive strategy. The first component (i.e., meta-cognitive knowledge) refers to the general required strategies to carry out different tasks, the situations in which these strategies can be adopted, and the learning units in which these strategies can play an effective role (Altindag & Senemoglu, 2013). In this study, meta-cognitive knowledge includes the sub-components of personal knowledge (an individual's general knowledge about how to learn and process information), knowledge of task (i.e., knowledge about the nature, type, quality, and procedure of a task in which a person is supposed to be involved), and strategic knowledge (i.e., an individual's knowledge about when and where which strategy should be used).

Another component (i.e., metacognitive strategies) refers to the tactics that individuals use to monitor and control their progress (Saif, 2012). The component of metacognitive strategies includes the following subcomponents: Regulation: (the fact of something like an organization regulating itself without interventions from external bodies), planning (the process of thinking about the activities required to achieve a desired goal) and monitoring (the regular observation and recording of activities taking place in a program).

Finally, the meta-cognitive control component includes follow-up and attention while reading, self-questioning about topics, and monitoring the speed and time needed to read a lesson (Salarifar & Pakdaman, 2012). Its meta-cognitive control also contains self-control, evaluation, and ordering. McClelland's aAchievement motivation theory is one of the most important theories in curriculum development. McClelland assumes the social conditions of the community to be effective in encompassing achievement motivation, some of which are listed below:

Education in the families: According to McClelland, the most significant education in the family is the one nurturing features such as autonomy, self-control, specific ambitions, and trust in childhood.

Social class: The social class influences the achievement motivation, and such motivation is higher in the middle class than in other classes.

Social mobility: The achievement motivation is mostly notices in individuals and groups that have a tendency for social mobility.

Ideology: From the perspective of McClelland, the change of ideology is another factor having some impacts on the achievement motivation.

Additionally, the family environment is another factor contributing to the academic achievement of children. In his studies on the process of family socialization, Anderson & Bourke (2000) concluded that the more number of variables are related to the family environment and thus, have more impacts on children's educational achievement. Some of these factors are family's insistence on achievements for children, educational guidance, family's endeavors, family's intellectual interests and their work habits as well as the parents' levels of education and family problems (Golabzadeh, 1980; Khayer, 1998; Sharifian, 2001). In general, this variable included three components of education in family, family environment and organization of the educational and social environment.

A review of studies on the effects of meta-cognitive and self-directedness skills on student's achievements shows that a majority of these studies have been conducted among students in medical, educational, and human sciences, even though, few studies have been carried out investigating such an effect among agriculture students. One of the few studies on the field of agriculture was conducted by Taqipour et al. (2016). The study aimed to examine self-directedness learning skills among Iranian agriculture students, and the results indicated that the agriculture

students' self-directedness skills are generally at a medium level.

In a research study aimed at investigating the applications of meta-cognitive strategies in the experiences of students at Department of Education and Psychology of Shiraz University and revealing its relationship with their academic achievement level, Safari & Mohammadjani (2011) claimed that 26 percent of these students properly used meta-cognitive skills in their studies and learning. Regarding meta-cognitive components, 35 percent of students used self-regulation skills. In general, a significant positive correlation was observed between students' meta-cognitive skills and their mean scores. In addition, there was a positive and significant correlation between meta-cognitive components and students' mean scores. Further, significant correlations existed between the study strategies and methods and a variety of meta-cognitive knowledge.

Baradaran et al., (2014) examined the relationship between meta-cognitive knowledge about study strategies and academic achievement among the students of Iran University of Medical Sciences, and the findings showed that their mean score obtained for the knowledge about the study strategies was favorable, and that there was a significant correlation between the medical students' knowledge about the study strategies (and its three components) and their academic achievements. Based on the findings of this research, knowledge about planning and goal-setting strategies, in comparison with other meta-cognitive strategies, can better explain the academic achievements among medical students.

Long (2007) also concluded that self-directed learning is a continuous process that is required by the individuals throughout their lives, and that each individual matures with the challenges he faces in the environment. At the State University of New York (SUNY) at Oswego, Corey (2007) assessed the undergraduate students' perceptions of involvement in online fields of study and possible facilities for self-directedness in students' learning. The findings showed that the students were able to self-select and self-direct some assignments, headline presentations and readings. Also, considering different comments, engaging students in the Socratic method, devoting much time to homework, self-reflecting, and creating pleasant assignments have also been useful in this regard.

In summary, it can be mentioned that since academic achievement is one of the most important factors for the development and progress of each country, the identification of the factors affecting the students' academic achievement is one of the most important approaches by which we can educate creative students having high compatibility with environmental and technological changes. Students trained in such a system would be able to move the development wheels in their own countries. In this context, self-directedness skills, meta-cognitive skills, and social conditions are important factors affecting academic achievement and preventing academic failure. It also seems that these factors are important tools to prepare individuals for the job market and entrepreneurship. Hence, the main objective of the present study was to examine the effect of cognitive and self-directedness skills on the academic achievement of agriculture students. Considering that meta-cognitive skills, in addition to affecting academic achievement, are also one of the facilitators of self-directedness skills, the meta-cognitive skills in the present study are both directly and indirectly (as self-directedness skills directly affect academic achievement) correlated with academic achievement. Moreover, given that various researchers have emphasized on the role of social factors in achieving academic achievement and improving self-directedness and meta-cognitive skills, the effect of this variable on academic achievement, self-directedness skills, and meta-cognitive skills was both indirectly and indirectly examined (Figure 1).

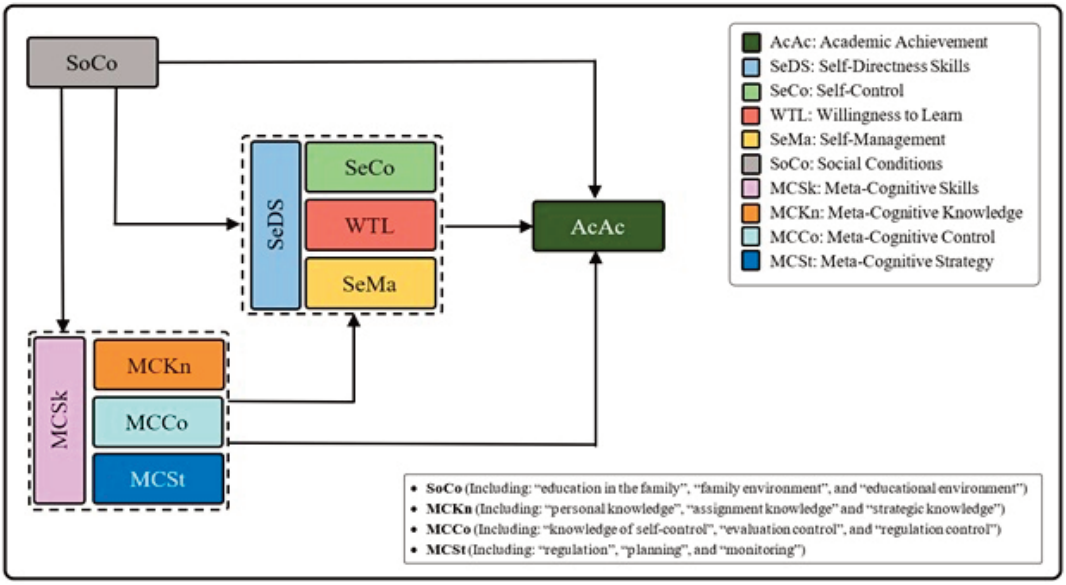

Figure 1. Theoretical Framework of the Study

METHODOLOGY

Research design

This research was quantitative in terms of the research nature and applied in terms of purpose since the findings would be used by planners and curriculum developers in higher agricultural education. With regard to the data collection method, the study was a survey. Regarding the type of data-processing, it was also descriptive-correlational.

Statistical population and sampling method

This research was conducted in agriculture department of Iran's universities. Due to the limited spatial and temporal scope and according to the statistics reported by the Ministry of Science, Research, and Technology (MSRT), Iran was divided into five domains/regions (MSRT-Deputy of Research, 2014) and one department was randomly selected from each pole. From the first, second, third, fourth, and fifth regions, the Colleges of Agriculture at Tarbiat Modares University (TMU), Sistan and Baluchestan University, Razi University of Kermanshah, Yazd University, and Shiraz University were selected respectively (Table 1).

Table 1
Stratification System Developed By the MSRT

Scientific center of five domains/regions	Province
Region 1	Tehran, Alborz, Golestan, Semnan, Mazandaran, Qom, Qazvin, Guilan, and Zanjan
Region 2	North Khorasan, Razavi Khorasan, South Khorasan, Kerman, and Sistan and Baluchestan
Region 3	West Azarbaijan, East Azarbaijan, Ardabil, Kurdistan, Kermanshah, and Hamadan
Region 4	Isfahan, Yazd, Chaharmahal and Bakhtiari, Lorestan, Khuzestan, and Ilam
Region 5	Kohgiluyeh and Boyer-Ahmad, Bushehr, Fars, and Hormozgan

The statistical population consisted of all Iranian agriculture students (N=236973), and the sample size was estimated to be 150 persons according to Cochran formula and two-stage sampling method (cluster sampling in the first stage (Table 1) and proportional stratified random sampling in the second stage). In the second stage, the strata included different fields of agriculture. Using Cochran formula, the probable desired precision (d) was calculated to be 0.43; however, it was set at 0.19 compared with some previous works in order to increase the sample size and make the findings of the research more reliable.

$$d = t.\frac{s}{\sqrt{n}} \Longrightarrow d = 1.96 * \frac{1.22}{\sqrt{30}} \Longrightarrow d = 0.43$$

$$n = \frac{N.(t.s)^2}{Nd^2 + (t.s)^2} \Longrightarrow n = \frac{236973 * (1.96 * 1.22)^2}{236973 * (0.19)^2 + (1.96 * 1.22)^2} \Longrightarrow n = 150$$

Survey instrument

In the present study, the "documentary" and "field study" methods were used to collect data. The documentary method includes a study of reliable sources, books, the Internet, journals, articles, reports, dissertations and theses, though, the instrument used in the field study method is a questionnaire. In this study, the developed questionnaire- in both electronic and written versions, contained closed and open responses. To confirm its face and content validity, the questionnaire was submitted to a group of curriculum and educational planning specialists in the higher agricultural education system. Considering the comments provided by these specialists and making the required revisions, the validity of the questionnaire was confirmed. In this research, Cronbach's Alpha was used to assess the reliability of the questionnaire. To conduct a pilot study, 30 questionnaires were completed at one of the agriculture departments (i.e., University of Tehran) not included in the population. Based on the obtained results, the questionnaire consists of three sections: The first section was devoted to the title and explanations on purpose of the research, and the second section contained the demographic information of the respondents. Finally, the third section consisted of the main variables included in the theoretical framework and the relevant items to be measured (Table 2).

The operational definitions and procedures for each variable are presented below. The items of variables were measured using a five-point Likert scale (very low= 1, low= 2, medium= 3, high= 4, and very high= 5). The items are listed in Table 2.

Academic achievement: This term refers to the extent in which the students achieve predetermined educational goals that are expected to be achieved in their learning efforts. In order to measure this variable, the students' grade point average was used (Saif, 2012).

Meta-cognition: Meta-cognition refers to each individual's knowledge of his or her own cognitive processes or anything related to these processes, such as the information or data learning features. In other words, meta-cognition is an individual's knowledge of his own learning (Flavell, 1979). Meta-cognition consists of three components: Meta-cognitive knowledge (Altindag & Senemoglu, 2013), Meta-cognitive control (Salarifar & Pakdaman, 2012), and Meta-cognitive strategy (Saif, 2012). The conceptual definitions of each component and sub-component are presented in the Introduction Section. Meta-cognitive skills were measured in the form of 68 items.

Table 2

The List of Variables, Items and Cronbach's Alpha for Studied Scales

Variable			Items
Meta-cognitive skills (MCSk) (Items= 70, α= 0.97)	Meta-cognitive knowledge (MCKn) (Items= 25, α= 0.86)	Personal knowledge	(Items= 9, α= 0.74)
			I know timing to have better learning.
			When teaching is finished, I know how much I have learned.
			I am aware of my activities to have better learning.
			I know the important points of the textbooks (books, pamphlet, and others).
			I know the extent of achieving the study goals.
			I know how to divide different parts of a textbook to study.
			I know teaching and learning methods.
			I know the title of the lesson before it is taught by the instructor.
			I know the content of the lesson before the teacher starts teaching.
		Assignment knowledge	(Items= 8, α= 0.89)
			I know about the amount of time to be spent on learning different lessons.
			I know how to ask questions to have better learning.
			I know the ideal learning environment for more effective learning.
			I know how to solve the lesson problems.
			I know how to set up the assignments that help me reaching my goal.
			I know the strategies nurturing self-reflection to improve my studies.
			Sometimes the people are mentioned in the article as the authors who have not played any role in conducting the article.
			I know how to properly set up and schedule my homework.
		Strategic knowledge	(Items= 8, α= 0.96)
			I know my reasons for the study type and method of my choice.
			I know how to answer questions.
			I know the process of my thinking to study.
			I know how academic achievement is assessed.
			I know how to take notes to learn better.
			I know how to plan for my learning.
			I know how to ask for help from teachers.
			I appreciate the opportunities for further learning.
	Meta-cognitive control (MCCo) (Items= 25, α= 0.84)	Knowledge of self-control	(Items= 9, α= 0.82)
			I know that thinking about a topic for a long time enhances learning.
			I do not know how to control the fear of the exam.
			I know the strengths and weaknesses of my learning.
			I know about the healthy competitive methods to proceed my classmates.
			I know how to be successful with the perseverance and effort to learn the lesson.
			I know about the impact of difficult assignments on learning a lesson.
			I know how to control my anxiety when I have the lesson seminar or conference presentation.
			I can correctly guess my score from a test.
			I know when to do my assignments.
		Evaluation control	(Items= 11, α= 0.94)
			I know that summarizing makes my assessment easier to learn.
			I know asking myself questions after reading the content is very effective in improving my learning.
			I know how to answer the questions at the exam session.
			I know how to assess myself to learn more about the study speed and about how to answer questions.
			During the study, I continuously know how to evaluate my learning.
			I know about how to evaluate planning for further learning.
			I know how to evaluate the study methods to have better learning.
			I know the pre-, while- and post- evaluation methods in learning.
			I know how to evaluate and manage my learning activities.
			I get aware of my learning by comparing previous tasks and textbooks with the recent ones.
			I know how to evaluate planning to have better learning.
		Regulation control	(Items= 5, α= 0.76)
			I know how to assign time to any subject.
			I know how to set my learning speed proportional to the degree of difficulty.
			I am aware of the self-organizing practices, including prioritizing and postponing what I know.
			I know how to improve my study methods.
			I know how to rewrite my classroom pamphlets.

Table 2
Continued

Variable			Items
Meta-cognitive skills (MCSk) (Items= 70, α= 0.97)	Meta-cognitive strategy (MCSt) (Items= 20, α= 0.81)	Regulation	(Items= 5, α= 0.78)
			According to the needs of a course, I change my study method.
			I organize content to have more effective learning.
			To fully understand the content, I study courses with close content at the same time.
			To fully understand the content, I study courses with close content at the same time.
			I set timing to have better learning.
		Planning	(Items= 8, α= 0.81)
			I try to think before answering questions.
			I try to determine what is necessary for the test.
			I underline the hints.
			I specify how to use the study methods.
			There not approved rules to accept articles in journals.
			During the study, I raise some questions.
			Before the class, I set the objective of learning a lesson for myself.
			Before class, I preview the lesson.
		Monitoring	(Items= 7, α= 0.84)
			At the end of the test, I almost always rate my success.
			I modify the writing errors.
			After answering the questions, I review them once more.
			I compare the recently acquired content with similar content.
			I track my progress and, if necessary, I decide to continue or stop the task.
			I evaluate the study methods.
			During doing my assignments, I evaluate my learning.
Social conditions (SoCo) (Items= 13, α= 0.86)		Family environment	(Items= 4, α= 0.88)
			My family has enhanced my self-confident in learning.
			My family has taught me to be independent when learning.
			My family has strengthened my specific ambitions for academic achievement.
			My family encourages me to study during my free time.
		Education in the family	(Items= 4, α= 0.78)
			My family has compensated for my financial shortages to pursue education.
			My family has played an important role in enhancing my intellectual interests.
			My family encourages me to attend training classes.
			My family's guidance had an effective role in selecting my major.
		Educational environment	(Items= 5, α= 0.88)
			My educational environment has a good social organization and structure.
			The educational environment has had a good interaction with me in terms of effective learning.
			The educational environment has provided me with good educational facilities.
			The educational environment has played an important role in my out-of-school learning.
			The educational environment encompasses my learning and my employment at the same time.

Table 2
Continued

Variable		Items
Self-directness skills (SeDS) (Items= 36, α= 0.95)	Self-control	(Items= 13, α= 0.91)
		I am a responsible person.
		I can find the information I need.
		I would like to personally make decisions for myself.
		I am logical.
		I have high self-expectations.
		I have high standards and benchmarks.
		I prefer to set my own goals by myself.
		I can solve problems.
		I evaluate my performance.
		I prefer to determine my learning goals by myself.
		I know my weaknesses.
		I prefer to set my performance assessment criteria by myself.
		I have no control over my personal life.
	Willingness to learn	(Items= 12, α= 0.87)
		I want to learn new information.
		I enjoy learning new information.
		I am interested in evaluating my own work.
		I look at the reasons of happenings around me.
		Learning is a necessity to me.
		I critically evaluate new ideas.
		I learn from my mistakes.
		I enjoy the challenge (conflict of ideas).
		I am open (welcoming) to new ideas.
		When there is a problem that I cannot solve, I ask for the help from others.
		I learn regularly.
		I do not like studying.
	Self-management	(Items= 11, α= 0.91)
		I prioritize my works.
		I have set my own discipline and punishments for me.
		I prefer to personally plan my own learning.
		I can find the information I need.
		I have a timely schedule.
		I can trust myself to further my learning.
		I solve my problems through planning.
		I have good managerial skills.
		I act systematically.
		I assign certain times to personal studies.
		I am disordered.

Self-directedness: Self-directed learning is a process in which learners are responsible for planning, implementing, and assessing their own learning and are expected to work independently from others in order to achieve their predetermined learning goals (Saif, 2012). The variable was measured in the form of 36 items.

Social conditions: This variable includes three components of education in family, family environment, and organization of the educational and social environment. The variable was measured in the form of 13 items.

Data collection and analysis

The research data were collected using an electronic and a written questionnaire. The electronic questionnaire was submitted to the students by email, as well as the social networks, such as WhatsApp and Telegram. The written questionnaire was submitted directly. The respondents were interviewed and their information was recorded. Finally, 150 questionnaires were returned back and analyzed. The $SPSS_{24}$ was used to analyze the data.

RESULTS AND DISCUSSION

Descriptive analysis of the data showed that the mean age of the participants was 25.18, with a minimum of 20 and a maximum of 38 years (SD=2.73). There were 106 (70.7%) male and 44 (29.3%) female respondents. Regarding their residence, 23 (15.3%) participants were rural and 127 (84.7%) participants were urban. The participants' mean monthly family income was 18631400.86 IRR (about US $ 450) [SD=1084981, Min= 2000000 IRR (about US $ 48(, and Max=80000000 IRR (about US $ 1900(]. The average number of the respondents' family members was about 5 persons (SD=1.42, Min=2, and Max=10). In terms of level of education, there were 29 (19.3%) undergraduates, 96 (60%) MA students and 25 (16.7%) PhD students. The mean of the participants' grade point averages was 15.72 (out of 20) (Min=12 and Max=19.87) (SD = 1.85) (Table 3).

Table 3
Respondents' Descriptive Statistics

Variable	Level	Frequency	Percentage	Cumulative percentage
Age (Years)(Mean = 25.21, SD = 1.73)(Min = 20, Max = 38)	$X_i \leq 26$	128	85.3	85.3
	$26 < X_i \leq 32$	16	10.7	96
	$32 < X_i$	6	4	100
Gender	Male	106	70.7	—-
	Female	44	29.3	
Residence	Urban	127	84.7	—-
	Rural	23	15.3	
Family income (Per each month, US $)*(Mean= 450, SD= 258.08)(Min= 48, Max= 1900)	Xi≤300	42	28	28
	$300 < X_i \leq 500$	87	52	80
	500< Xi	30	20	100
Family size(Median= 5, SD= 1.42)(Min= 2, Max= 10)	Xi≤4	54	36	36
	4<Xi≤7	82	54.7	90.7
	Xi≤7	14	9.3	100
Level of education	B.Sc.	29	19.3	
	M.Sc.	96	54	
	Ph.D.	25	16.7	
Grade point average (GPA) (From 20)(Mean = 15.72, SD= 1.85)(Min = 12, Max = 19.87)	Xi≤14	34	22.7	22.7
	$14 < X_i \leq 17$	75	50	72.7
	$17 < X_i$	41	27.3	100

*. Each US Dollar has been equivalent to 42,000 Iranian Rials.

Relationships between variables

Pearson correlation coefficient was used to determine the correlation between the variables (Table 4). Considering the theoretical framework of the study, there was a direct relationship between academic achievement and meta-cognitive skills, self-directedness skills, and social conditions (Figure 1). The correlation test revealed that there is a direct and significant correlation between meta-cognitive skills and academic achievement (r=0.774, p <0.01). This is in line with the findings in other studies (Baradaran et al., 2014; Abdellah, 2015; Kummin & Rahman, 2010; Safari & Mohammadjani, 2011). It can also indicate that the more the students' meta-cognitive skills are, the more the student's academic failure can be prevented. On the other hand, the correlational findings suggested a direct and significant relationship between the self-directedness skills and the academic achievement (r=0.746, p<0.01). This finding is in a similar vein with the findings of other researchers (Anderson & Bourke, 2000; Avdal, 2013; Shokar et al., 2002). That is, the higher the students' self-directedness skills are, the higher their academic achievement will be in the long run. Also, the correlation test showed that there is a positive and significant correlation between social conditions and academic achievement (r = 0.668; p <0.01). This result is consistent with the results in some other reseach (Barrett et al., 2013; Duran-Narucki, 2008; Maxwell, 2016). The correlation between meta-cognitive and self-directedness skills was also positive and significant (r=0.766, p <0.01). Furthermore, the correlations between social conditions with self-directedness skills (r=0.590, p<0.01) and metacognitive skills (r=0.648, p <0.01) were positive and significant (Table 4).

The analysis of causal relationships among variables

In this study, the path analysis was used to examine the relationship among the variables affecting the agriculture students' academic achievement. To this end, the direct effect of each variable on the dependent variable (academic achievement) was assessed. According to the findings, meta-cognitive skills and social conditions had the highest and lowest direct impacts, respectively. The results of the causal analysis were summarized in three steps, as discussed below.

In the first step, the academic achievement as the dependent variable and other variables as independent variables were included in the analysis. The results showed that self-directedness skills (β=0.317, p<0.01), meta-cognitive skills (β=0.379, p <0.01), and social conditions (β=0.235, p <0.010) could explain 68.1% of variance in academic achievement.

Table 4
Correlations Among Study Variables

	Academic achievement (AcAc)	Meta-cognitive skills (MCSk)	Self-directedness skills (SeDS)	Social conditions (SoCo)
Academic achievement (AcAc)	1			
Meta-cognitive skills (MCSk)	0.774**	1		
Self-directedness skills (SeDS)	0.746**	0.766**	1	
Social conditions (SoCo)	0.668**	0.648**	0.590**	1

**p<0.01

These results imply that the higher and the better the students' levels of metacognitive skills, self-directedness skills, and social conditions are, the netter their academic achievement will be.

In the second step, self-directedness skills as a dependent variable and meta-cognitive skills and social conditions as independent variables were also introduced into the analysis. The findings in this step showed that metacognitive skills (β=0.661, p <0.01) and social conditions (β=0.161, p <0.01) could explain 59% of the variance in student's self-directedness skills.

In the third step, the variable meta-cognitive skills as the dependent variable was included in the analysis, and the effect of the social conditions on this variable was assessed. The findings showed that the variable social conditions β=0.648, p<0.01) could predict and explain 41.6 percent of variance in meta-cognitive skills; that is, the better students' social conditions is, the more their meta-cognitive skills will be (Table 5 and Figure 2).

Table 5
Direct Effects on Academic Achievement (AcAc), Self-directedness Skills (SeDS), and Meta-cognitive Skills (MCSk)

	Independent variables	B	Beta (β)	t	*p*-value
Direct effects on the AcAc	Constant	6.450	—-	12.17	0.000
	SeDS	0.025	0.317	3.79	0.000
	MCSk	0.016	0.379	4.87	0.000
	SoCo	0.048	0.235	6.02	0.000
	Sig. F = 0.000	F= 116.819	R^2_{Adj} = 0.681	R^2 = 0.678	R= 0.829
Direct effects on the SeDS	Constant	33.720	—-	4.78	0.000
	MCSk	0.361	0.661	9.66	0.000
	SoCo	0.416	0.161	2.35	0.000
	Sig. F = 0.000	F= 110.837	R^2_{Adj} = 0.596	R^2 = 0.601	R= 0.775
Direct effects on the MCSk	Constant	98.883	—-	7.49	0.000
	SoCo	3.062	0.648	10.35	0.000
	Sig. F = 0.000	F=107.240	R^2_{Adj} = 0.416	R^2 = 0.420	R= 0.648

Table 6
Direct, Indirect and Total Effects of Dependent Variables on AcAc

No.	Variables	Direct effects	Indirect effects	Total effects	Correlation coefficient	Non-causal effects	Model compliance with the theoretical framework
1	MCSk	0.379	0.209	0.588	0.774	0.186	√
2	SoCo	0.235	0.431	0.666	0.668	0.002	√
3	SeDS	0.317	———-	0.317	0.746	0.429	√

√ Compliance with the theoretical framework, ×Non-compliance with the theoretical framework

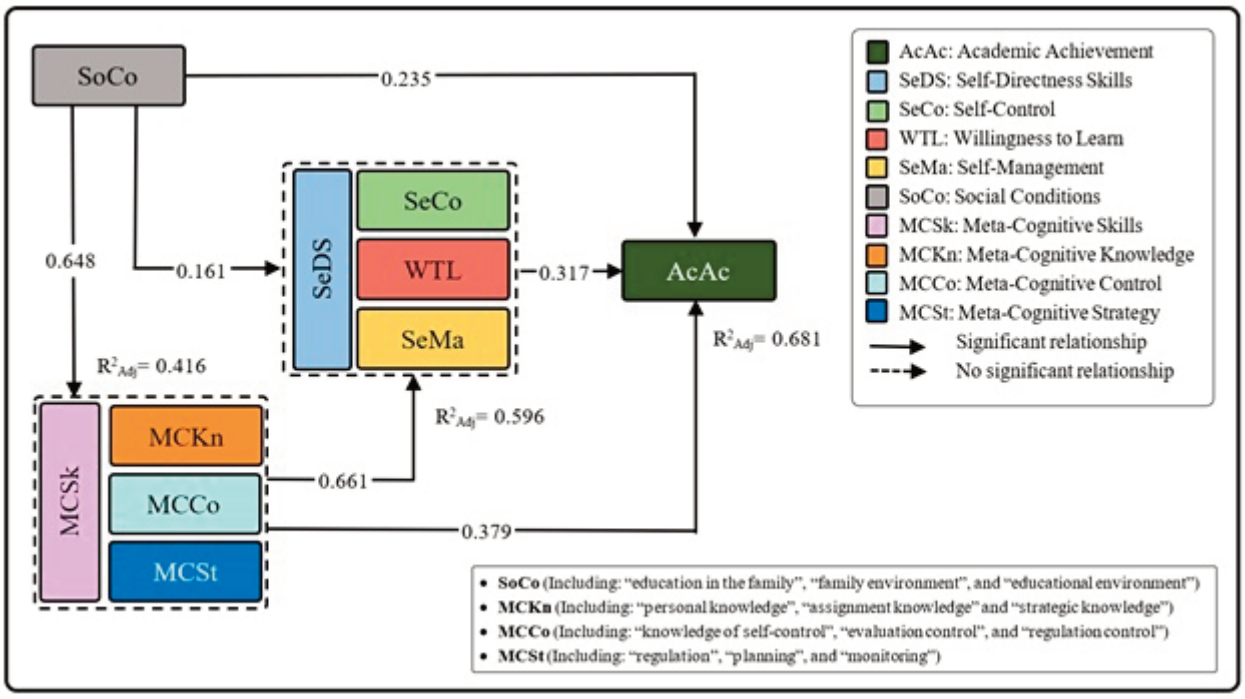

Figure 2. Causal Analysis Model

Correlation decomposition among research variables

In order to improve our understanding of the causal relationships and mechanisms among the main variables of the research, the correlation values (r) and the standardized effect coefficients (β) were used (Table 6). Thus it should be noted that meta-cognitive skills, self-directedness skills, and social conditions were the factors having a direct effect on academic achievement. Besides directs effects, the variables social conditions (0.648 × 0.379 + 0.648 × 0.661 × 0.317 + 0.161 × 0.317=0.431) and meta-cognitive skills (0.661 × 0.317=0.209) had indirect effect on academic achievement as well; however, no indirect effect was observed for the variable self-directedness skills.

An investigation of the direct causal effects also indicated that the meta-cognitive skills (β=0.379), self-directedness skills (β=0.317), and social conditions (β=0.235) had the greatest direct impact on the academic achievement, respectively. This suggests that the focus should be on enhancing meta-cognitive skills in order to achieve academic achievement among the agriculture students.

Also, the study of causal effects indicated that the variables social conditions (0.666), meta-cognitive skills (0.588), and self-directedness skills (0.317) had a significant causal effect on the academic achievement. Thus it can be claimed that although the improvements in social conditions have a great effect on the enhancement and promotion of academic achievement, this effect becomes much more pronounced with increasing students' meta-cognitive and self-directedness skills.

CONCLUSION

The main objective of this study was to assess the effects of meta-cognitive and self-directedness skills on the academic achievement of Iranian agriculture students. The results of the research confirm that the reinforcement of the students' meta-cognitive and self-directedness skills has a great impact on their academic achievement, and these two variables, together with the variable social conditions, could predict a significant percent of variance in students' academic achievement. According to the findings, it seems that a paradigm shift is of essence in Iran's higher agricultural educa-

tion system and its teaching and learning processes since no attention is being paid to the meta-cognitive and self-directedness skills in Iran's current higher agricultural education system. In other words, instead of banking education, parrot learning, and information bombardment, this system should move towards the use of meaningful teaching and learning processes and nurturing self-reflective and self-directed students. In this way, the agriculture students become aware of their own learning processes and know how and when learn what. This process would lead to the students' academic progress during studies and prepare them for self-directing and updating knowledge after graduation from the university.

A deeper look at the findings on the indirect and total effects of independent variables on the dependent variable academic achievement reveals that social conditions (consisting of education in family, family environment and the organization of educational and social environment) has the greatest indirect and total effect on this dependent variable. Some components of the social environment (i.e., education in family and family environment) cannot be controlled by the higher agricultural education institutions, despite their impact on the academic achievement of students, or if they are to be controlled, they require widespread and long-term coordination and planning among different organizations. Accordingly, it is suggested that the higher education institutions mostly focus on organizing the educational and social environment in agriculture departments in order to achieve faster results in terms of students' academic achievement. For example, agricultural educators can use collaborative methods in classroom environments to strengthen autonomy, achievement motivation, self-regulation, and other-regulation. Moreover, in order to improve the trainings and family environments in in line with the students' academic achievement, the Ministry of Science, Research and Technology (MSRT) authorities are also recommended to coordinate their goals with the objectives of institutions that are more involved with families and family education.

Based on the findings, the metacognitive and self-directedness skills are the most important predictors of academic achievement among students. In addition to having direct effects on the academic achievement, the meta-cognitive skills also indirectly influence this variable through reinforcing self-directed skills. Accordingly, the curriculum developers in the Higher Agricultural Education System are recommended to revise the curricula and programs related to agricultural courses with a focus on the aforementioned goal: "Students need to know (when) and (how) learn (what)." In order to operationalize this goal in the curriculum, the planners can teach students self-regulation, self-monitoring and self-evaluation of learning and teaching activities. If curriculum planning is underpinned by this objective, the students' meta-cognitive skills will be reinforced, and their self-directedness ability will be improved. Students' academic achievements will also be improved consequently.

To sum up, it can be concluded that self-directed learning abilities and meta-cognitive skills are of essence factor for all agriculture students, which should be considered in accordance with different fields of study in educational programs. These factors, if taken into consideration, can be extremely effective means to have academic achievement and lifelong learning among students. Finally, the study also suffered from some limitations. As the first limitation, this research was a self-reported study; therefore, there should be more caution in analyzing the results. The second limitation is the relatively small sample size in this study, which restricts the generalizability of the research findings to other agriculture students and agriculture departments at other universities.

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