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Full Length Research Paper

Agricultural awareness for prospective teachers

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Personal decision making, participation in civic and cultural affairs, and economic productivity are the end goals of education in different disciplines at the individual level. If knowledge and understanding of agriculturally-related scientific and technologically-based concepts are included in the processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity, it is called agricultural literacy. Agricultural awareness which requires understanding of basic concepts related to agriculture, and their impacts on social and economic life of the society, is the first step of agricultural literacy. This research study examined 310 prospective elementary teachers' understandings of basic concepts related to agriculture, including its definition. Therefore; participants' agricultural awareness as a prerequisite for literacy was examined. Research participants were chosen among three programs, mathematics, science and social studies, at the elementary education department. A questionnaire, prepared by the researchers, and interviews with selected participants was the two ways to collect data. Data from questionnaires were analyzed statistically, whereas data gathered through interviews were analyzed qualitatively. Therefore; it is a mixed method research where two techniques were used to analyze data. Quantitative data analysis corresponds mean values of participants with regard to programs they attend. The mean difference among prospective elementary teachers' from different programs was significant at the 0.05 level. Therefore, the sequence of means display that prospective mathematics teachers are more knowledgeable than social studies teachers and lastly, prospective science teachers have the least amount of agricultural knowledge among the others. Participants' agricultural knowledge which might be counted as the basic of agricultural awareness and literacy was at the moderate level. Qualitative data analysis of interviews displays participants' reasoning and resources of what they know about the issue. Details about qualitative analysis were given in the paper.

Key words: Agricultural awareness, agricultural literacy, misconceptions in agriculture.

INTRODUCTION AND THEORETICAL BACKGROUND

Rapid increase in population brings problems about nutrition. Nutrition with healthy, good and enough amount of food gained importance in our world today. The environmental issues discussed in our century also underline the importance of agriculture for future generations. Erosions, saltiness and misuse of lands limit the agriculture in these lands. For that reason, farmers aim to get the highest profit from every unit of their farms. This requires farmers and all individuals to know and understand agricultural issues. There needs to be a concern about public perceptions about agriculture, food and food production. In the United States, there has been also a growing concern about agriculture since 1990's. Agriculture is one of the important issues cited in science education. It is argued that agriculture is among the science content that a science teacher need to develop herself (American Association for the Advancement of Science, 1990). Consistently, based on the importance of the issue, Wright et al. (1994) related individuals' knowledge about agriculture to their agricultural literacy. They mentioned the effects of agricultural literacy on individuals' attitudes and actions to produce a public policy about the issue. People who have limited amount of knowledge in agriculture and how it relates to society would not be in decision making process. Frick et al. (1995) argued that every person

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should possess a minimum level of knowledge of the industry which produces and markets food needed for human to survive. Frick et al. (1995) pointed out that agricultural literacy is based on this premise.

Although agricultural literacy is not a new concept, there is no consensus on its definition. Wright et al. (1994) defined agricultural literacy linked with agricultural awareness. Based on the definition of literacy, which is an attitude toward the world, they defined agricultural awareness as having positive attitudes and association with agriculture. Frick et al (1995) identified agricultural literacy with individuals' knowledge and perceptions regarding agriculture, food and natural resources. They also identified seven agricultural literacy concept areas based on Frick's (1990) Delphi study. These concept areas were societal and global significance of agriculture, public policy in agriculture, agriculture's relationship with the environment and natural resources, plant science, animal science, processing of agricultural products and marketing and distribution of agricultural products. Powell et al. (2008) emphasized the reason of having no consensus on the definition of agricultural literacy as philosophical, political and epistemological differences among specialists. Based on the philosophical and epistemological differences, Powell et al. (2008) reported three approaches to agricultural literacy from Agricultural Literacy Special Interest group meetings in 2005 and 2006. These approaches were programmed agricultural literacy (deductive model), emergent agricultural literacy (inductive model) and agriculturally literate value judgment (evaluative model). First approach states agricultural literacy as a content area and view it as a driving force in the K-12 curriculum. Second approach defines agricultural literacy as an outgrowth of the simultaneous development of generalized academic skills and specific contextual learning inherent in the agricultural problem to be solved. Lastly, the third approach argues the ability to think critically and make value judgments about the impact of agriculture as an economic and environmental activity as the basics of agricultural literacy (Powell et al., 2008). The last approach to agricultural literacy reflects cognitive constructivist epistemology, which includes using knowledge in decision making, problem solving, and making judgments. The approach requires agriculturally literate individuals demonstrate their understanding of agriculture with the ability to enter the discourse about and make decisions.

In their detailed examination of agricultural literacy, Powell et al. (2008) mentioned the barriers to development of a shared vision for it. Perceived lack of utility outside the agriculture field, timing and opportunity, and a dichotomy of purpose regarding agricultural literacy within education are among these barriers. They emphasized the change in the efforts to define agricultural literacy from mostly technical aspects of production and distribution of agricultural goods to include sense of environmental and global social significance. They also argued the efforts to define it in terms of conversational knowledge, critical analysis, and value based judgment. Based on the review of literature cited earlier, for the research study presented in this paper agricultural literacy is defined as decision making, problem solving and making judgments about agricultural issues, whereas agricultural awareness is defined as understanding basic concepts related to agricultural issues and their societal impacts including the definition of agriculture.

There are several research studies which addressed the definition and benefits of agricultural awareness and literacy, as well as addressing the collaboration between science and agriculture teachers (Wright et al., 1994; Frick et al., 1995; Knobloch et al., 2007; Thompson and Warnick, 2007; Stephenson et al., 2008; Cannon et al., 2009). Research studies cited put forward that due to differences in individuals' philosophies and epistemologies there is no consensus on the definition of agricultural literacy. It is a known fact that philosophies and epistemologies of individuals influence their beliefs and mental images which reflect their attitudes and practice. Bellah and Dyer (2006) reported agricultural literacy studies in the agricultural education and divided these studies about their foci. Some research studies were focused on assessing teacher and student knowledge and attitudes (Connors and Elliot, 1995; Knobloch and Martin, 2000; Leising et al., 2001; Meischen and Trexler, 2003), some of them focused on teacher preparation and professional development (Elliot, 1999; Miller and Gliem, 1994; Portillo and Leising, 2003; Terry et al.,1992; Wilhelm et al.,1999), and some focused on identifying barriers to curriculum implementation (Balschweid and Thompson, 2002; Conroy, 1999) as cited in Bellah and Dyer (2006).

Knobloch and Martin (2002) emphasized the recommendations of several educators for many years that agriculture should be taught in elementary school curriculum. They cited Dewey's (1938) philosophy of experiential education which stated the necessity of ordinary life experiences to derive materials in studies like arithmetic, history, geography, or natural sciences. This would be the most direct method in understanding science, economic and industrial problems in present. A teacher's background and experience play significant role in teaching students about agriculture. Based on the analytical review of studies mentioned above, the purpose of this research study is to examine prospective elementary teachers' agricultural awareness limited to their conceptual understandings about agricultural and environmental issues related to agriculture.

METHOD

Although the purpose of this research study is to examine prospective elementary teachers' agricultural awareness limited to

Table1. Research participants' majors.

Program in elementary education department	No of prospective teachers
Teaching mathematics	101
Teaching social studies	102
Teaching science	107

Table 2. Descriptive statistics for questionnaire.

Program	N	Mean	Standard deviation	Standard error	95% Confidence interval for mean		Min	Max
					Lower bound	Upper bound		
6.00	101	62.4554	9.74836	.97000	60.5310	64.3799	40.00	88.00
7.00	102	59.9608	9.62661	.95318	58.0699	61.8516	28.00	92.00
8.00	107	56.0748	8.66973	.83813	54.4131	57.7364	36.00	72.00
Total	310	59.4323	9.68569	.55011	58.3498	60.5147	28.00	92.00

their conceptual understandings about agricultural and environmental issues related to agriculture, it is also aimed to find an explanation of where participants' knowledge about the issues cited come from. Based on this purposes, there needs to be both quantitative and qualitative techniques to collect and analyze data. Therefore this research study is a mixed method research in which both quantitative and qualitative techniques of collecting and analyzing data were used.

Research participants

Three hundred and ten prospective elementary teachers, majored in different programs of the elementary education department of a big scaled university located in Marmara Region of Turkey, participated in this research study. Table 1 displays the majors of participants.

Data collection and analysis

Data, to examine research participants' conceptual understandings about agriculture and related concepts, were collected with two instruments. First, a questionnaire which consisted of 25 true-false type items developed by the researchers is used to collect data from 310 participants. Then, three of the participants were interviewed to get detailed knowledge about the items in questionnaire. Items in questionnaire included definition of agriculture as well as including some popular concepts like organic farming, genetically differentiated organisms, global warming and so on. Data from questionnaire were transformed into computer file then statistically analyzed by using SPSS program. Some descriptive and comparative analyses were presented in findings. At the second step of data collection, 3 volunteer participants were chosen among all to interview. Interview is in structured form and included the items present in questionnaire with the additional why and how questions. Data from interviews were open-coded to get some categories and form assertions to explain where research participants get their knowledge about agriculture and related concepts. Quantitative and qualitative analyses of data were presented together in the findings and discussion.

FINDINGS AND DISCUSSION

Research findings were presented in three parts: descriptive statistics for questionnaire, ANOVA results for comparison of means and at last, qualitative analysis of interviews. Table 2 show descriptives for participants according to the program they attended.

Programs were represented with numbers as follows in Table 2: 6-Teaching Mathematics, 7-Teaching Social Studies, and 8-Teaching Science. Table 2 displays that mean value of the prospective math teachers is higher than prospective social studies teachers' mean and mean value of prospective social science teachers is higher than prospective science teachers' mean. This result contradicts with the results of the research study done by Harris and Birkenholz in 1996. They worked with language art teachers, science teachers, social science teachers and mathematics teachers and found math teachers as the group of teachers who had the least amount of knowledge about agriculture. The contradiction can be tried to be explain with the level of education at which prospective teachers were prepared to teach, but, in fact this needs not to be the case. Regardless of the level, all prospective and in-service teachers need to be well informed to teach agricultural issues. Although agricultural and environmental issues presented in the questionnaire seem to be more likely in the content of science courses, prospective science teachers have the minimum mean value among others. Humphrey et al. (1994) discussed the priority of content in teacher preparation and stated that if a teacher was uninformed or ignorant, he or she could do much harm. Therefore, prospective science teachers' content knowledge related to agricultural issues need to be re-examined. In their research study, where pre-service elementary education majors' level of knowledge about

Table 3. Test of homogeneity of variances.

Levene statistic	df1	df2	Significance
1.223	2	307	0.296

Table 4. ANOVA for comparison of means.

	Sum of Squares	df	Mean Square	F	Significance
Between groups	2157.783	2	1078.891	12.345	0.000
Within groups	26830.295	307	87.395		
Total	28988.077	309			

Table 5. Multiple comparisons of means.

	(I)abd	(J)abd	Mean difference (I-J)	Standard error	Significance	95% confidence interval	
						Lower bound	Upper bound
Scheffe	6.00	7.00	2.49466	1.31229	0.166	-0.7332	5.7226
		8.00	6.38068	1.29695	0.000	3.1905	9.5708
	7.00	6.00	-2.49466	1.31229	0.166	-5.7226	0.7332
		8.00	3.88602	1.29367	0.012	0.7039	7.0681
	8.00	6.00	-6.38068	1.29695	0.000	-9.5708	-3.1905
		7.00	3.88602	1.29367	0.012	-7.0681	-0.7039
Dunnette C	6.00	7.00	2.49466	1.35994		-0.7406	5.7299
		8.00	6.38068	1.28194		3.3319	9.4294
	7.00	6.00	-2.49466	1.35994		-5.7299	0.7406
		8.00	3.88602	1.26926		0.8677	6.9043
	8.00	6.00	-6.38068	1.28194		-9.4294	-3.3319
		7.00	-3.88602	1.26926		-6.9043	-0.8677

agriculture was examined, they found that participants' level of knowledge was high but varied widely (Humphrey et al., 1994). This is in contrast with what Table 2 displays. Table 2 show mean values not very high but also not vary widely.

Tables 3 and 4 display test of homogeneity of variances and comparisons of means with one way ANOVA respectively. Table 3 shows a non-significant result ($p>0.05$ and 0.01). This is a desirable result because it shows that the homogeneity of variance assumption was not violated.

Table 4 shows that the value of "sig" is smaller than 0.01 ($p<0.01$). Therefore, the table shows that the result is statistically significant. The means for participants at different programs are statistically different from each other. This case is also analyzed with multiple comparisons given in Table 5.

Multiple comparisons of means displayed in Table 5 imply that the mean difference is statistically significant at the 0.05 level. Therefore, it can be concluded that mean values of participants' total points from the questionnaire differ according to the program they attend. Mean difference for participants of different programs of elementary education department is significant.

At the last part of data analysis, 5 of the volunteered participants were interviewed. Frequencies of participants' responses to selected questions are displayed in Table 6. The findings and supporting excerpts from interviews are presented in Table 6.

Although agriculture is a general concept which includes horticulture, field crops and animal husbandry, research participants do not have adequate

Table 6. Participants' responses to selected questions.

Items selected from questionnaire	Frequency	
	True	False
Agriculture is farming with horticulture and field crops.	22	288
Agriculture is different from and independent of animal husbandry.	222	88
Agriculture is a general concept which also includes animal husbandry.	173	137
Organic products consist of edible vegetables and fruits.	70	240
Genetically modified organisms are with hormones.	100	210
Genetically modified organisms are different than the one with hormones.	163	147
Genetically modified organisms are harmful.	277	33
Genetically modified organisms are not harmful.	280	30

understandings about agriculture. Therefore; their definitions of agriculture consists only horticulture and agronomy. Participants' definitions of agriculture do not include animal husbandry. Most of the participants (92.9%) believe that animal husbandry is not included in agriculture. Data from interview were transcribed and excerpts were analyzed to support findings presented here. Following excerpt supports why research participants' have not adequate definitions of agriculture:

"…in geography books, we always read as "agriculture and animal husbandry". As this is the title of the chapter we think and understand that agriculture is something different than animal husbandry..." (Adam).

Inconsistent with participants' definitions of agriculture, 71.6% of the participants believe that agriculture and animal husbandry are not independent concepts. Following excerpts display their reasoning:

"…they are not completely independent, because they are both economical activity.. (Suzan).

"…they are not independent because they need similar fields… (Can).

Inconsistency between the answers to first and second items can be explained with the excerpts presented earlier. For the definition of agriculture, the language, specifically the terms used to explain the concepts in high school books might be the cause of misconception. Then, for independency of agriculture and husbandry, participants can make a meaningful argument by using their reasoning abilities. This inconsistency shows itself in the responses to third item. Table 6 shows that 55.8% of the participants agree on the fact that agriculture is a general concept which includes animal husbandry. When these 3 items and related participants' responses were analyzed together, one might conclude that prospective elementary teachers do not have adequate understanding about agriculture. They have a misconception about the definition of agriculture which excludes husbandry. In fact; agriculture is defined as the science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products (Oxford Dictionaries, 2010).

The inadequacy of participants' knowledge is consistent with the research study of Terry et al. (1992). They worked with fourth grade elementary teachers and determined their knowledge of agriculture as unacceptably low.

Table 6 displays that research participants' definitions of organic products are limited to edible vegetables and fruits. 22.6% of the participants mentioned that organic products are not only edible vegetables and fruits. There might be several other organic things around the world. Following quotes from the interview display data about other organic products:

"…there are some clothes made up fibers from woods.. and also we, as human being, we are also organic…." (Can).

"…there needs to be other things…if something is in natural state, and if there is no intervention, it is organic I think…"(Suzan).

Prospective elementary teachers have very limited understandings and definition about "organic products". Whereas the earlier quotes imply some of the research participants define organic as being in its natural state without any intervention. Briz and Ward's (2008) research study had consistent results with this research. They reported the consumers' lack of awareness in knowing and using organic products in their research study with people in Spain. Despite the increasing availability, most consumers did not know the organic alternatives they could use.

Last four items in the table were related to genetically modified organisms. Participants to this research study were able to differentiate genetically modified organisms

from organisms with hormones. Table 6 shows that 66.7% of prospective teachers can make this differentiation. The following quote from interview support their explanations:

"…hormone…that is something different I think…genetic modification is not the same by giving hormones…hormones cannot make genetic differentiation I think….."(Adam).

Based on their differentiation, prospective teachers also identify the negative effects of genetic modification. Almost 90% of the research participants state these negative effects. Hallman and Hebden (2005) reported inconsistent results for American people they worked with. They cited that American people are generally uninformed about genetically modified foods and their presence in food system, as well as, in their diet. They also reported that the majority of Americans have never had a discussion about it, although the United States is the largest producer of food biotechnology products. This situation can be explained with some research studies reported by Hubert et al. (2000). They underlined the fact that as countries develop and move to more urbanized societies, individuals' basic knowledge and understanding of the natural environment and its interrelated systems appears to have declined.

In a later study, Laux et al. (2010) report some contradicting results for Americans. Laux et al. (2010) argued that nationality of students play an important role in their acceptance and safety perceptions. American students felt more positively about genetic modification technology in food and agriculture than international students. In another research study, Kimenju et al. (2005) reported a positive correlation between socioeconomic status and awareness about genetically modified foods. This implies that people in higher socioeconomic status are more aware of genetically modified crops and biotechnology. In the same research study, it is also argued that awareness of people about genetically modified crops clearly increase with the level of education. The higher level of it means higher awareness (Kimenju et al., 2005).

A research study from China implied that people's awareness about genetically modified foods were not at an adequate level (Zhong et al., 2002). It was reported that 56.67% of the participants have not heard about GM foods. Even among those who had heard of genetically modified foods, about 74% only "have heard the words" but "have no idea" of the benefits and risks associated with it. Consumers who had heard of genetically modified foods, only 26% of those thought that they knew something about it. A relatively larger percentage of men participated in the survey had heard about genetically modified foods (53.4%) compared to women (32.3%). This result is consistent with the findings of Kimenju et al. (2005).

Conclusion

This research study primarily examines prospective elementary teachers' agricultural awareness limited to their conceptual understandings about agricultural and environmental issues related to agriculture. Some of the issues discussed in the paper were participants' definition of agriculture, organic products, and genetically modified organisms. In this research study, how prospective teachers' knowledge about agriculture and related issues can differ according to their area of study is also examined. Findings discussed in the findings imply that prospective elementary teachers participated in this research do not have adequate agricultural awareness. Following summary of findings explain the fact.

Overall findings:

(i) Research participants' have not adequate definitions of agriculture.
(ii) 71.6% of the participants believe that agriculture and animal husbandry are not independent concepts.
(iii) Research participants' definitions of organic products are limited to edible vegetables and fruits. (iv) 22.6% of the participants mentioned that organic products are not only edible vegetables and fruits.
(v) Participants to this research study were able to differentiate genetically modified organisms from organisms with hormones and also identify the negative effects of genetic modification.

Findings for participants' area of study:

(i) Mean values of participants' total points from the questionnaire differ according to the program they attend. Mean difference for participants of different programs of elementary education department is statistically significant ($p<0.05$).

Environmental issues and rapid increase in population underline the importance of agriculture for future generations. Individuals need to understand what agriculture is and how it is processed for a better life. This is basic for agricultural awareness. Agricultural awareness and literacy need to be the focus of education at all levels. Specifically, for elementary school students, it is important to understand and practice agricultural issues. In order to teach elementary school students for conceptual understanding, teachers need to be well informed and aware of the fact. This research study implies that prospective elementary teachers may not be considered as well informed. Agriculture needs to be integrated into other courses they attend. Thematic teaching of agriculture by integrating with other subject areas will help prospective teachers develop an adequate understanding about the issue.

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