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A Comparative Study of Turkish Elementary and Science Education Major Students' Knowledge Levels at the Popular Biotechnological Issues

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Abstract: The purpose of this study was to determine the knowledge levels of popular biotechnological issues of Turkish science and elementary teacher candidates. A questionnaire was administered during 2006-2007 school term to 336 students pursuing their education in the departments of science and elementary education in two Turkish universities. The questionnaire covers six biotechnological issues such as biotechnology, agrobiotechnology, human health and pharmacy, environment and biotechnology, and food production with biotechnology. Results revealed that whereas science and elementary teacher candidates had an approximate consistent knowledge of describing biotechnology and human health/pharmacy that almost all students had an inadequate knowledge about other biotechnological issues. The mean of the knowledge levels of science teacher candidates was significantly higher than that of elementary teacher candidates at the popular biotechnological issues. On the other hand, there was no significant mean difference between female and male science and elementary teacher candidates' knowledge levels related to biotechnology. In the result, the elementary and science education programs should be regulated to put extra effort to increase teacher candidates' awareness of biotechnological topics and issues in Turkey since one of the important future technologies seems to be biotechnology.

Key words: Biotechnology Education, Science and Elementary Education in Turkey.

INTRODUCTION

There is a proverb commonly mentioned in the Philosophy of Science that is "Before positive science, there was a positive technology" (TUSIAD, 2002, p.89). Before human beings establishing the real methods of positive science until 16th century, there were different technologies in human life from agriculture to different areas. Especially genetically inter and intra-breeding of some animals and plants by crossing different traits (hybridization) that plants and animals had economical importance (United Nations, 2002). Without knowing the real reason how milk can be converted to yogurt or the juice of grape turns to wine or wine gear (ancient brewing), human beings acquired those technologies some of which are currently called biotechnologies. On the other hand, to describe technology is not easy as it seems because of many different descriptions related to technology. However, one of the accepted definitions of technology is "developing natural things to use in daily life of human beings".

Historically, biological sciences showed the most important developments after 1940's, such as the discovery of the life saving antibiotics and green revolution by using pesticide and putting chemical compounds into soil (Doelle, 2001). Especially many unknowns in molecular biology area began to be known with the finding of molecular shape of DNA by Watson and Crick. These developments in molecular biology and DNA rapidly gave a way to many inventions, discoveries and applications, one of which later was called bio-technology. In fact, traditional biotechnological methods had been known by human beings as mentioned above but it was difficult to explain how those things happened. Currently modern biotechnological methods and their application areas have been spread out from medicine, food industry, and agriculture to pharmacy. On the other hand, public knowledge and interest as well as attitude toward biotechnology are not clear. From one point of view, biotechnology could save human beings from food shortages and find some solutions in medicine, pharmacy, ecological and environmental issues, etc. However, general public attitudes indicate some negative view points such as; genetically modified foods and stem cell researches. Pardo, Midden & Miller (2002) reported

that in the European Union, public attitudes toward biotechnology should be classified as negative by using Eurobarometer data but in their study the attitudes of general public showed some progress in positive direction. Additionally, another study mentioned the similar point that European consumers were not fully aware of biotechnology but public trust toward biotechnology decreased significantly (European Commission, 2000; Fritz et all., 2003). The reasons why people have some negative attitudes toward biotechnology mostly seem to be emanated from misuse of chemical compounds, pesticides, herbicides, and irrigations (Doelle, 2001). Despite of some negative view points related to biotechnology, the currents problems of worlds such as starvation, feeding human population, finding new reliable and sustainable energy resources, treating some diseases, putting new drugs and vaccines would be solved through biotechnological researches and innovations.

Under current conditions, it is important to know how people and students perceive and understand biotechnology and what are the misconceptions related to biotechnology. In this point, biotechnology education gains importance because the wrong information about biotechnology and negative attitudes toward biotechnology could only be changed through science, biology and biology education. Also it should not be forgotten that especially science teachers have an important responsibility to give the importance of biotechnology in our life and the right biotechnological information to their students (Harms, 2002).

Lately, many studies mostly in developed countries have put extra efforts the awareness of public, students, teachers toward biotechnology (Olsher & Dreyfus, 1999; Chan & Lui, 2000; France, 2000; Dunham et al., 2002; Dibartolomeis & Moné, 2003; Lewis et al., 2003; Rota & Izquierdo, 2003). By means of these studies, it would be possible that a new disciple could be called biotechnology education area covering the attitudes and awareness of general public, teachers and students and also promoting biotechnological products with the all ways, such as giving education, seminars in order to change the attitudes positively toward biotechnology and misconceptions related to biotechnology. On the other hand, making some comparisons between developed and developing countries what are the attitudes, awareness, and misconceptions in general public, students and teachers shows importance so that to conduct a research covering biotechnological studies pertained to the knowledge levels of teacher candidates and teachers who are responsible for teaching biotechnological concepts, topics and issues in the firs hand seems to be necessary in the developing countries such as Turkey.

The purpose of this study was to determine the knowledge levels of Turkish university students in relation to popular biotechnological items, such as agricultural biotechnology, human health and pharmacy. There are two major questions of this study which are at the following;

1. What are the Turkish elementary and science teacher candidates' knowledge levels at the popular biotechnological issues and topics, such as agricultural biotechnology, human health and pharmacy?

2. Are any differences between the Turkish elementary and science teacher candidates' knowledge levels at the popular biotechnological issues and topics as well as between genders?

Theoretical Framework

Especially as mentioned above, to give information the awareness and attitudes as well as knowledge levels of general public, students and teachers toward biotechnology, biotechnology products and applications is important for the future of biotechnological research. Even old style biotechnological applications are so common in our daily life but new applications coming from biotechnology somehow create some suspicions among general public. By forgetting useful and necessary parts of biotechnology, mostly media (tv, news papers and radio broadcastings) coverage puts extra efforts to the negative sides of biotechnological applications and researches.

For example, one of the most important studies conducted by European Commission (2006) revealed not only public attitudes among European Countries toward biotechnology but also toward other scientific and technological applications. In contrast to the Eurobarometer report in 2000 by European Commission, the acceptance of biotechnology among European seems to rise but they still keep some suspicions related to the GM foods. The reason for rising is not very clear but the newly entered countries to the European Unions might have changed the perceptions of European public. Another study concerns the same point investigating attitudes toward biotechnology in European Union that in early studies (European Union, 2000) public opinion indicated negative attitudes but in this study public attitudes were going to be shaped positively (Pardo, Midden & Miller, 2002). On the other hand, there is still a concern for GM foods. In the other side of Atlantic, a study by Fritz and others (2003) showed that American awareness of students and public was not as high as in Europe despite

of much of genetically modified food produced in the US.

The questions what are the most important tools to influence public awareness and attitudes toward biotechnology tried to be answered by the study of Schoell and Guiltinan (1995, cited in Frits and others, 2003, p.179). In this study, it was found that the consumers' attitudes were influenced by the family members, and friends. Additionally, National Science Foundation (2004) study indicated that scientific information related to global warming and biotechnology mostly was learned through television and printed media as well as internet., However, the adequate knowledge can be only found in the reliable journals while mostly the knowledge covering biotechnology comes from media in which it was difficult to find a real experts in the subjects of biotechnology among journalists (Vestal & Briers, 2000).

Biotechnology education in school curriculum goes back to elementary school years. In this sense, not only science teachers and science education major students but also elementary school teachers and elementary education major students should have sufficient knowledge level in the biotechnology area. In elementary school years, it would be explained how some micro organisms could help the food production and decompose the organic waste. During middle school years, the cycles of nutrients necessary for the food web, pathogenic micro-organisms that can cause some infections in humans, breeding and hybridizing in plants and animals could be a part of science curriculum dealing with the some aspects of biotechnology. On high school level, the students can understand the importance of enzymes in the living systems. With the following high school years, other topics of biotechnology could be taught to the students, such as GM foods, and stem cell technology (Harms, 2002). With the biotechnology education in school years from elementary school to college level, students fully conceive the importance of biotechnology in our daily life from the simple forms and varieties to the complex biotechnological applications and how biotechnology can help to solve some of the important problems of the world, such food and energy shortages as well as environmental issues. Additionally biotechnology education especially in biology courses can give an opinion in their future carries selections to work and pursue their educations in biotechnology areas such as genetic engineering.

Most studies covering attitudes and public awareness and knowledge level of general public, students, and teachers belong to developed countries but the number of studies from developing countries is not as many as in developed countries. On the other hand, not only developed countries but also developing countries are confronted with some serious environmental problems, for example: severe salinity, misuses of pesticide and herbicide, degradation of natural resources (Doelle, 2001). Turkey as a developing country put extra effort to her education. Like other developing countries, Turkey is already face to face some major problems related to environmental and energy areas. In near future, many of these problems could be solved through biotechnological applications. In this sense, it should be necessary to give active biotechnology education in schools. To give biotechnology education, teacher education programs could cover those subjects especially in science and elementary education programs.

Methods

Data in this study were collected from 173 female and 163 male sophomore university students enrolled in teacher education programs of the two midsize universities in Turkey. The sample consisted of the students of Pamukkale University Education Faculty Department of Science Education, Usak University Education Faculty Department of Primary Education. The sample included 199 pre-service science teachers and 137 pre-service primary teachers.

The questionnaire contains 20 questions relating to knowledge of popular biotechnological issues. The questionnaire was first time developed by Darcin & Turkmen (2006) for a study conducted in a Turkish university in order to measure the knowledge levels of science teacher candidates at biotechnological issues and topics. The responses of students for each item in the questionnaire correspond that if the meaning of a statement is correct, it is expected to be checked the true box, if the meaning of a statement is not correct, the answer is to be the false box. Finally, if they have any idea about a statement, they chose the neutral box. The students had 20 minutes to complete the survey. Data obtained were analyzed by SPSS (Statistical Package for the Social Sciences) program. Two-way ANOVA test was run to compare students' biotechnological knowledge levels based on science education and elementary education departments as well as gender differences. Additionally, frequency, percent analysis and quantitative information were evaluated to reveal the knowledge level of Turkish elementary and science teacher candidates.

Results

Expression asked to students about popular biotechnological issues were divided into five different areas covering the mean of biotechnology, agricultural biotechnology and its benefits, human health and pharmacy, environment and biotechnology, using biotechnology for food production. In order to give the answer of the first research questions, the responses of students (science and elementary school teacher

Table 1. Students' responses to the questions related to the knowledge of describing biotechnology

Questions	True		Neutral		False		Total	
	f	%	f	%	f	%	f	%
1. A number of one-cellular microorganisms could be used in biotechnology, such as, bacteria, algae, protozoa, and viruses.	273	81,3	53	15,8	10	3,0	336	100
2. The biotechnological products produced by transgenic microbes have no harmful effects at al	55	16,4	102	30,4	179	53,3	336	100
13. Biotechnological methods merely based on transferring genes from one organism to another.	76	22,6	125	37,2	134	39,9	336	100
17. Cytogenetics is field that focuses on fast production and improvement, changing of organisms	69	20,5	243	72,3	24	7,1	336	100

Table 2. Students' responses to the agricultural biotechnology and its benefits

Questions	True		Neutral		False		Total	
	f	%	f	%	f	%	f	%
4. Biotechnological methods show 100% certain successful results in agricultural fight for weeds and vermin.	134	39,9	80	23,8	122	36,3	336	100
7. It could be possible that the plants produced by means of the tissue culture method could provide the same amount of plant products.	114	33,9	139	41,4	82	24,4	336	100
14. Until now, all plants are produced with plant tissue culture techniques	131	39,0	153	45,5	52	15,5	336	100

Table 3. Questions related to the knowledge of human health and pharmacy

Questions	True		Neutral		False		Total	
	f	%	f	%	f	%	f	%
3. Only the embryonic stem cells are potentially able to differentiate into all cell types	176	52,4	88	26,2	72	21,4	336	100
5. Producing antibiotics is mainly related to the field of pharmacy but potentially biotechnological methods should be used to produce antibiotics	175	52,1	75	22,3	86	25,6	336	100
11. The number of organ transplantations could be decreased in the future because of potentially using stem cells.	238	70,8	59	17,6	39	11,6	336	100
12. Stem cells could be obtained with the recombinant DNA technology	172	51,2	143	42,6	21	6,3	336	

candidates) were analyzed to show the frequencies and percentages. In the table 1, summarizes the frequencies and percentages of students whose knowledge of describing biotechnology were reported as the first area.

It was shown that most of students (81,3%) answered first question correctly (using one-cellular microorganisms). It was observed that 53,3% of students did not know side effects of biotechnological products. 71,1% of students did not recognize if or not biotechnological methods only transfer genes from one organism to another organism. Most of students (72,3%) answered 17th question (biotechnology was described as cytogenetics) as neutral. It was seen that most of students (92,8%) have misconception between cytogenetics and biotechnology. In the table 2, responses to agricultural biotechnology and its benefits are summarized.

36,3% of students recognized that biotechnological methods do not show 100% certain successful results in agricultural fight for weeds and vermin. A minority of students answered 7th and 14th questions correctly (33,9% and 15,5%). The responses point out that the knowledge level of majority of students was below 36,3% in the statements covering agricultural biotechnology and its benefits. Students responses the questions related to human health and pharmacy are shown in the table 3.

Table 4. Questions referring to environment and biotechnology

Questions	True		Neutral		False		Total	
	f	%	f	%	f	%	f	%
8. With the biotechnological ways, it is not possible to change organic garbage to the energy	42	12,5	102	30,4	191	56,8	336	100
16. Genetically modified plants could have side effects on the biological diversity in worldwide.	98	29,2	153	45,5	85	25,3	336	100
19. The most common genetically modified plants, such as corn, soybeans could threat the biodiversity of Turkey.	115	34,2	128	38,1	93	27,7	336	100

Table 5. Statements using biotechnology for food production

Questions	True		Neutral		False		Total	
	f	%	f	%	f	%	f	%
6. Organic acids, such as citric acid and lactic acid could not be obtained with the way of biotechnological methods.	52	15,5	162	48,2	122	36,3	336	100
9. Yoghurt, wine, and vinegar could be the samples of biotechnological products.	207	61,6	74	22,0	55	16,4	336	100
10. Primer products such as, carbohydrates, amino acids, and alcohols could be produced by means of the biotechnological methods used genetic engineering techniques.	118	35,1	162	48,2	55	16,4	336	100
15. The producing ethyl alcohol with fermentation could be a kind of biotechnological procedure.	159	47,3	116	34,5	61	18,2	336	100
18. Commercially obtained enzymes could be only produced from plants.	70	20,8	147	43,8	119	35,4	336	100
20. The yeast is not used in biotechnological methods.	58	17,3	129	38,4	149	44,3	336	100

Table 6. Descriptive statistics of science and elementary school teacher candidates' responses based on the gender.

Gender	Department	Mean	Std. Deviation	N
Female	Science	8,96	3,03	101
	Elementary	7,53	2,90	72
	Total	8,36	3,05	173
Male	Science	9,31	3,73	98
	Elementary	7,32	3,73	65
	Total	8,52	3,85	163
Total	Science	9,13	3,39	199
	Elementary	7,43	3,31	137
	Total	8,44	3,46	336

It was suggested that most of students answered correctly 3rd, 5th and 11th questions (52,4%; 52,1%; 70,8%). It was said that generally, the students had enough knowledge about human health and pharmacy. On the other hand, 12th question elicited a neutral response (51,2%) indicating that students had unstable knowledge of how stem cells were obtained by using biotechnology. Statements about environment and biotechnology were 8, 16, 19th questions and results could be seen in the Table 4.

56,8% of students answered correctly to use organic waste for being fuel with biotechnological processes. A minority of students (29,2%) were aware of genetically modified plant's side effects on the biodiversity in the world wide. Additionally, a majority of students did not recognize adverse effects of genetically modified plants in Turkey. Students' responses using biotechnology for food production are summarized in the Table 5.

It was shown that a minority of students know using biotechnology for production of organic acids and primer products (36,3% and 35,1%) in the statements of 6 and 10. 44,3 % of students gave true responses to use of the yeast in biotechnological methods. On the other hands, majority of students answered questions of traditional biotechnology correctly (9th and 15th). The

Table 7. The results of two-way ANOVA based on departments and genders of teacher candidates

Source	Sum of Squares	df	Mean Square	F	Sig.
Gender	,403	1	,403	,036	,851
Department	236,272	1	236,272	20,869	,000*
Gender*Department	6,136	1	6,136	,542	,462
Error	3758,818	332	11,322		
Total	4000,688	335			

*P<.05

results of the difference between female and male teacher candidates' knowledge levels related to biotechnology is given in the following tables 6 and 7.

Despite of a mathematical difference between female and male science and elementary education major students' responses toward biotechnological issues and topic, the difference seems to be not very high. On the other hand, the mean of science education major students' responses indicates a higher difference than those of elementary education major students' responses. In order to check the significance level of the difference between genders as well as departments, generally an independent t-tests should been run because of two different independent groups. However, to show any interaction between genders and departments in which students follow their educations to become a science and elementary teacher is necessary to run a two-way analysis of variance (ANOVA) test, in addition to simple main effect tests. The following table reveals the results of two-way ANOVA test.

No significant interaction between genders and departments was observed that the responses of male and female science and elementary teachers' candidates seem to be a similar direction. The mean of the knowledge levels of science education major students at the biotechnological issues and topics indicates a significantly higher difference than those of elementary education major students. However, the means of female and male teacher candidates showed no statistically difference despite of a slight higher difference of male teacher candidates than female teacher candidates at the popular biotechnological issues and topics.

Discussion and Conclusions

Darcin & Turkmen (2006) reported science teacher candidates' knowledge level on the popular biotechnological issues but the data for that study was taken from the undergraduate university students pursing their education in a science education department in Turkey. In that study, prospective science teacher candidates from a Turkish university revealed some misconceptions regarding on some popular biotechnological topics. Also, this study revealed almost similar results with the previous study conducted by Darcin &Turkmen (2006) that science and elementary school teacher candidates gave correct and expected responses which were not higher than the half of questions covering popular biotechnological issues and topics (Table 6). It could be inferred that science and elementary teacher candidates still keep some level misconceptions. Science teaching department as their nature generally offers more science related courses than elementary teaching programs in Turkey so that the average correct answers of science teacher candidates at biotechnological issues and topics was significantly higher than those of elementary school teacher candidates (Table 7).

There are 20 statements (questions) in the scale measuring the knowledge level of elementary and science teacher candidates at biotechnology area. Only some of the questions were correctly responded more than 50%. The correctly response rate of the remaining of part of questionnaire is low than 50%. Science education and elementary education students are mostly aware of some of one-cellular microorganisms used in biotechnology over 80%, and biotechnological methods employed in health and pharmacy areas over 51% (Table 1 and 3). In food technology, only making yoghurt, vine and vinegar were accepted by the students over 61% as biotechnological products but producing ethyl alcohol as a biotechnological procedure did not reach the 50% acceptance rate based on the science and elementary education students' response percentage (Table 5). It could be easily inferred from these results that Turkish science and elementary school teacher candidates have simple level biotechnological knowledge and only they know common applications of biotechnology. Darcin and Turkmen (2006) found the almost similar results that Turkish science and elementary education major students' viewpoints in the certain areas of biotechnological issues and topics seem to be the same. Additionally, Australian Biotechnology (Cormick, 2006) revealed some similar results that Australian seems to have common biotechnological applications in our daily life.

Biology and biotechnology related courses should have considerable effect to increase science and elementary teacher candidates' awareness of biotechnological issues in science teacher preparation programs of Turkish Universities because of significant mean difference between science and elementary teacher candidates' knowledge levels at biotechnological issues and topics. Even though the biotechnological knowledge levels of male science and elementary teacher candidates did not show any significant mean difference, the mean of male teacher candidates had slightly higher difference than female teacher candidates (Table 6 and 7). There is a general believe that male students and teachers are better than their female counterparts in science related areas. However, it should be early to say the same thing for biotechnological areas. Perhaps the

future studies could fill this knowledge gab in biotechnology education.

This current research only deals with science and elementary school teacher candidates' knowledge level at biotechnological issues and topics. In addition to students' opinions related to biotechnology, many researches focus on the public opinions covering biotechnological issues and some problematic areas such as GM foods, and stem cell researches interesting general public widely (Macer et all, 2000).

This study is limited to science and elementary education major students in two separate Turkish universities. The opinion and knowledge levels of in-service science and elementary teachers could be revealed by using the scale in which the authors employed in this research. Future studies dealing with biotechnological issues as well as public concerns and attitudes toward biotechnology should be conducted in Turkey. In addition to current studies, the results coming from the future biotechnological research referring attitudes and public concerns should give crucial information how biotechnology education would be integrated to current science and biology curriculums from K to 12 and college level teacher preparations in science and elementary education areas in Turkey. 1

REFERENCES

Chan, S. L. and Lui, K. (2000). To Promote Biotechnology Education. Asia-Pacific Forum on Science Learning and Teaching. 1(1), http://www.ied.edu.hk/apslt/v7_issue2

Cormick, C. (2006). Australian attitudes to GM food and crops, Australian Biotechnology. Available at:http://www.biotechnology.gov.au/

Darcin, S. E. and Turkmen, L. (2006). A Study of prospective Turkish science teachers' knowledge at the popular biotechnological issues, Asia-Pacific Forum on Science Learning and Teaching, 7(2), http://www.ied.edu.hk/apslt/v7_issue2

Dibartolomeis, S. M. & Moné, J. P. (2003). Apoptosis: A Four-week laboratory investigation for advanced molecular and cellular biology students. Cell Biology Education Article, 2, 275-295.

Doelle, H. W. (2001). Biotechnology and human development in developing countries, Electronic Journal of Biotechnology, 4(3).

Dunham, J., Wells, J., & White, K. (2002). Photobioreactor: Biotechnology for the technology Education classroom. The Technology Teacher, p. 7-12.

European Commission (2000). Questions and expectations on biosciences: Commission to promote debate, Eurobarometer 2000 Summary Report. Available at: http://ec.europa.eu/research/press/2000/pr2704en-ann2.html

European Commission (2006). Europeans and Biotechnology in 2005: Patterns and Trends.

France, B. (2000). The Role of models in biotechnology education: An analysis teaching models. Developing Models in Science Education. (Ed: Gilbertt, J. and Boulter, C.). p.271-288, Kluwer Academic Publishers, London, UK.

Fritz, S., Husmann, D., Wingenbach, G., Rutherford, T., Egger, V., & Wadhwa, P. (2003). Awareness and acceptance of biotechnology issues among youth, undergraduates, and adults, AgibioForum, 6(4), 178-184, http://www.agbioforum.org

Harms, U. (2002). Biotechnology Education in Schools, Electronic Journal of Biotechnology, 5(3).

Lewis, J. R., Kotur ,M. S., Butt, O., Kulcarni, S., Riley,A. A., Ferrell, N., Sullivan, K. D., & Ferrari, M. (2003). Biotechnology apprenticeship for secondary-level students: Teaching advanced cell culture techniques for research. Cell Biology Education, 1, 26-42.

National Science Foundation (2004). Science and Technology: Public Attitudes and Understanding, Science and Engineering Indicators. Available at: http://www.nsf.gov/statistics/seind04/c7/c7h.htm

Macer, D., Azariah, J. & Srinives, P. (2000). Attitudes to biotechnology in Asia. International Journal of Biotechnololgy, 2(4), 313-332.

Olsher, G. and Dreyfus, A. (1999). The "ostension-teaching" approach as means to develop junior-high student attitudes towards biotechnologies. Journal of Biological Education, 34(1), 25-31.

Pardo, R., Midden, C. & Miller, J. D. (2002). Attitudes toward biotechnology in the European Union. Journal of Biotechnology, 98(1), 9-24.

Rota, G. & Izquierdo, J. (2003). "Comics" as tool for teaching biotechnology in primary schools. Electronic Journal of Biotechnology 6(2), 85-89. (cited 11.November 2005) Available at: http://www.ejbiotechnology.info/

TUSIAD (2002). Felsefe 2002, Lebib Yalkım Yayınları ve Basım İşleri, İstanbul. Electronically available at: http://www.tusiad.org.tr (The Association of Turkish Businessmen and Enterprenuers)

United Nations (2002). Key Issues in Biotechnology, United Nations Conference on Trade and Development (UNCTAD X, Bangkok 2000), Newyork and Ceneva.

Vestal, T. A & Briers, G. E. (2000). Exploring knowledge, attitudes and perceptions of newspaper journalists in metropolitan markets in the United States regarding food biotechnology, Journal of Agricultural Education, 41(4). 134-144.

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