

Full Length Research Paper

Opinions on genetic engineering studies of primary school students in Turkey

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In this research, what primary school 8th class students think about the genetic studies and what were their views and attitudes concerning these studies were examined. An information-oriented descriptive survey method was adopted as the research method. The research has been carried out in 12 primary schools which were chosen in 7 provinces of Turkey, from different regions. Schools and provinces were randomly selected for this research. In total, 860 8th class students, 418 girls and 442 boys, participated in our research. The data obtained were evaluated using the SPSS 14 package program. In order to examine the students' opinions in depth, semi-structured interviews were also conducted with 5 female students and 5 male students. The data collected for the research were obtained during the school year 2008 to 2009. As a result of the research, the viewpoints of the primary school 8th class students for the genetic studies were revealed. 59% of the students who participated in the survey said that genetic studies are necessary if used for the right purposes. Also, they stated that genetic studies should further focus on microorganisms.

Key words: Genetic engineering, science and technology education, ethics.

INTRODUCTION

Genes carry the chemical information to determine the characteristics of an organism. Genetic engineering is a technology that allows the scientists to take the genes from one organism and transfer them to another organism; the desired characteristics can be given to an organism by modifying the genes. Today, with the application of genetic engineering to plants and animals, better and healthier foods, safer and cleaner environments, and developments in the field of health have been available to people. Such an important subject in terms of society should be highly understood to take the best advantage. For this purpose, there are various studies that measures the general information of the students on the topic of genetics and biotechnology that provides many benefits for humanity (Lock and Miles, 1993; Chen and Raffan, 1999).

There is a strong relationship between information on genetic engineering and student attitudes. Wrong or imperfect information in this field causes students to have a poor attitude against genetics or biotechnology (Lamanauskas and Makarskaitė-Petkevičienė, 2008;

Jallinoja and Aro, 2000; Prokop et al., 2007). The difference between concerns of students and concerns of teachers concerning biotechnology affects this education (Kidman, 2009).

Therefore, the knowledge of the students about genetic engineering and relevant student attitudes, including the ethical aspect, are mentioned in recent studies. For example, knowledge levels and attitudes of 2003 Australian students (Dawson and Schibeci, 2003) on biotechnology and genetic engineering were examined, including their ethical aspects. Also, Bal et al. (2007) measured the information and attitudes of the university students in Turkey on genetic engineering. They found that students find biotechnology more interesting or beneficial as a result of the detailed introduction of this field (Dori et al., 2003).

In a study that measured the information and attitudes of the Lithuanian university students on biotechnology, it was noted that people nowadays should be knowledgeable, well-equipped and responsible enough to exercise critical thinking, so that they can keep up with

Table 1. Frequency distribution of student answers for completion: By modifying the genes of plants for more yield.

Response	Number	Frequency (%)
The country develops	54	6.3
We can eat any vegetable we want when we want	75	8.7
We can earn more money	47	5.5
Our health may be damaged in long term	325	37.8
The ecological balance is disturbed	359	41.7
Other	0	0
Total	860	100

biotechnological developments (Lamanauskas and Makarskaitė-Petkevičienė, 2008).

There are also various studies on this subject from different countries (Sterling et al., 1993; Macer et al., 2000).

Whilst genetic engineering contributes to medicine, nutrition, agriculture and environment, it has also harmful effects. Therefore, in addition to the introduction of genetics and genetic engineering, the ethical and social effects of this technique should also be mentioned in education (Bal et al., 2007). Educators agree that the ethical and social effects of science phenomena should be mentioned in the education in order that the students will be well-equipped in the future (Booth and Garrett, 2004). If biotechnology is better comprehended by the society, this may occur in the future (Edmonston, 2000). For this purpose, our research tried to reveal what the primary school 8th class students think about genetic studies, their views and attitudes on these studies.

MATERIALS AND METHODS

Design of the research

The model of the research is a descriptive survey that aims to show the present situation (Karasar, 2008). Also, within the scope of the method applied in the study, semi-structured interviews were carried out.

Sample

The research was performed in 12 primary schools in 7 provinces of Turkey, each province from a different region. Both schools and provinces were randomly selected for the study. In total, 860 primary school 8th class students, 418 girls and 442 boys, participated in our research. All students that participated in the survey had been taught the unit 'Cell Division and Heredity'.

Students from Hakkari (97, 9.1%), Erzurum (99, 9.3%), Trabzon (100, 9.4%), Adana (94, 8.8%), Ankara (266, 24.9%), Izmir (40, 3.8%), Istanbul (European Side, 145, 13.6%; Anatolian Side, 225, 21.1%) participated in our research.

Semi-structured interviews were carried out with 5 female students and 5 male students who were randomly selected from the sample.

Data collection tools

A survey form was prepared during the research in order to reveal the perceptions of primary education 8th class students about the studies carried out in the field of genetic engineering. The survey form was prepared through reviewing the literature, interviewing the students, taking the teachers' opinions and family opinions over 1 year. The survey form with 14 questions was finalized in line with opinions from five specialists, and was subsequently carried out in the school year 2008 to 2009 in order to collect data.

The semi-structured interviews were carried out in order to examine in depth the perceptions of the students. During the interviews, other questions were also in order to receive more detailed opinions. Since the semi-structured interviews have no specific format, no pilot study was carried out. The interviews lasted for 15 to 20 min, depending on the interviewees' situation, and were tape recorded for later analysis.

Data analysis

The data obtained from the survey form were analyzed using the SPSS 14 package. The opinions of the primary school 8th class students on genetic engineering are examined in the Findings' of the study.

The data obtained from the interviews are categorized and arranged by considering alternative opinions of the students. The opinions of the students who gave the same type of answers and the students who gave different types of answers are categorized. Also, some of the student statements that were different and interesting are included in italics in the 'Findings' of the study.

RESULTS

The results are separately examined in tables. 41.7% of those who participated in the survey think that the modification of plant genes for greater yield will disturb the ecological balance. 37.8% of the participants stated that our health will be damaged because of this situation in the long term (Table 1).

42.7% of those who participated in the survey stated that modification of animal genes will damage our health. 41% of the participants think that modification of animal genes will disturb the ecological balance (Table 2).

32.6% of those who participated in the survey stated that the first thing that comes to their mind when human cloning is said is that the balance of the World is

Table 2. Frequency distribution of student answers for completion: By modifying the genes of animals.

Response	Number	Frequency (%)
We can obtain bulkier animals	54	6.3
More people can eat meat	37	4.3
We make economic profit	49	5.7
The ecological balance is disturbed	353	41.0
When we consume, they may damage our health	367	42.7
Other	0	0
Total	860	100

Table 3. Frequency distribution of student answers for question: The first thing that comes to mind when human cloning is mentioned.

Response	Number	Frequency (%)
If there is another me, he/she does my duties	122	14.2
Impossible	98	11.4
The balance of the World is disturbed	280	32.6
We can heal using the organs of our clone when we become ill	142	16.5
It would be a positive development	68	7.9
It is not true	150	17.4
Other	0	.0
Total	860	100

Table 4. Frequency distribution of student answers for completion: Prenatal determination of a baby's characteristics.

Response	Number	Frequency (%)
We can have kids with the hair and eye color we want	114	13.3
The baby can be protected against possible diseases	337	39.2
Every one will be beautiful, and this disturbs the ecological balance	233	27.1
The World becomes more beautiful since there will be healthy and beautiful people	176	20.5
Other	0	.0
Total	860	100

disturbed. 7.9% of the participants think that the human cloning is a positive development (Table 3).

When Table 4 is examined, 39.2% of those who participated in the survey think that the prenatal determination of baby characteristics will have a protective effect on the diseases that may occur in the future. 20.5% stated that the World will be more beautiful.

36.7% of those who participated in the survey stated that the use of the genetically modified wheat seeds is not true, and agriculture is necessary for the national economy. And 35.5% of those who participated in the survey think that this will cause a biological war (Table 5).

72.4% of those who participated in the survey think that the genetically modified organisms will disturb the ecological balance. 8% of the participants think that genetically modified organisms are necessary for world development (Table 6).

When Table 7 is examined, 73.4% of those who participated in the survey think that the modification of tomato genes is unhealthy. 9% of the participants stated that it is good to find tomatoes in all seasons.

24.5% of those who participated in the survey stated that the genetic studies are necessary for the human health. 21.9% of the participants stated that public peace will be disturbed and genetic studies are unnecessary (Table 8).

43.6% of those who participated in the survey consider that the immortalization of people by the genetic studies is impossible (Table 9).

29.2% of those who participated in the survey stated that having a baby same as a relative of us who is dead is impossible. 28.8% of the participants think that this is a negative development (Table 10).

45.7% of those who participated in the survey think that

Table 5. Frequency distribution of student answers for completion: 'We obtain more crops with genetically modified wheat, but these wheats are barren, do not seed and do not grow next year. We need to buy new seeds again.'

Response	Number	Frequency (%)
I prefer it nevertheless. I buy new seeds for next year	54	6.3
More yield means that we earn more money	59	6.9
There may no seed in our possession and in our country in time. This can cause biological war	305	35.5
Agriculture is necessary for the national economy and it's best if we use normal wheat	316	36.7
Such wheat may be hazardous to our health	126	14.7
Other	0	.0
Total	860	100

Table 6. Frequency distribution of student answers for completion: The genetically modified organisms.

Response	Number	Frequency (%)
Are necessary for world development	69	8.0
May be used in a biological war	168	19.5
Disturb the ecological balance	623	72.5
Other	0	.0
Total	860	100

Table 7. Frequency distribution of student answers for completion: By modifying the genes of tomatoes.

Response	Number	Frequency (%)
It will be good for me to find tomatoes whenever I want	77	9.0
It is unhealthy since it will not be in its season	631	73.4
It is good to eat bulky and beautiful-colored tomatoes	65	7.6
It is possible to obtain square or different shaped tomatoes and we can earn more money selling them	86	10.0
Other	1	0.1
Total	860	100

Table 8. Frequency distribution of student answers for completion: The genetic studies are in terms of human health.

Response	Number	Frequency (%)
Necessary	211	24.5
We can replace cancerous tissues	145	16.9
We can protect against diseases	152	17.7
People can live for a longer time	52	6.0
Extending human lifetime may disturb the ecological balance	112	13.0
The public peace is disturbed unnecessarily	188	21.9
Other	0	0
Total	860	100

the modification of animal genes is important in terms of the endangered animals. 38.4% of the participants think that this is cruelty to the animals (Table 11).

26.6% of those who participated in the survey stated that genetic studies should be performed on all plants, animals, human and microorganisms. 19.5% of

participants think that no genetic study should be carried out on any organism (Table 12).

When the Table 13 is examined, it is seen that 73.4% of those who participated in the survey stated that the genetic studies are necessary if used for the right purpose. 3.5% of the participants think that the genetic

Table 9. Frequency distribution of student answers for completion: 'People can be immortalized.' According to Me'.

Response	Number	Frequency (%)
It disturbs the balance	231	26.9
World population increases and a war can break out	212	24.7
It will be a positive development	42	4.9
Impossible	375	43.6
Other	0	.0
Total	860	100

Table 10. Frequency distribution of student answers for completion: You can have a child who is same as a relative of you who is dead with the genetic studies.

Response	Number	Frequency (%)
We fulfill our longing	104	12.1
It disturbs the balance	173	20.1
It is a positive development	84	9.8
It is a negative development	248	28.8
Impossible	251	29.2
Other	0	.0
Total	860	100

Table 11. Frequency distribution of student answers for completion: Modification of animal genes at first is.

Response	Number	Frequency (%)
Cruelty to animals	330	38.4
Necessary since they will be used for humanity	81	9.4
We can obtain more beautiful animals	53	6.2
We can generate the endangered animals	393	45.7
Other	3	.3
Total	860	100

Table 12. Frequency distribution of student answers on what genetic studies should further focus on.

Response	Number	Frequency (%)
Plants	120	14.0
Animals	102	11.9
Humans	87	10.1
Microorganisms	154	17.9
All	229	26.6
None	168	19.5
Total	860	100

studies lead to new studies.

96.5% of those who participated in the survey stated that the consumer should be informed when the genetically modified plants or meats of genetically modified animals are sold. 3.5% of the participants do not

consider it necessary (Table 14).

In the semi-structured interviews, the students answered such questions as 'What are the positive and negative aspects of the modification of genes of organisms? How does modification of genes of organisms disturb the ecological balance? In this case, how can it be of damaged to our health? What is your opinion about human cloning? Should the consumers be informed when consuming a genetically modified organism and why? It was observed that five male students and three female students had the negative judgment that the consumption of genetically modified foods may cause different unknown diseases when they get old. It was found that they are of the opinion that these diseases will disturb the world's order. Two female students thought that consumption of genetically modified foods will not cause diseases in the future and necessary measures must be already taken. All students that participated in the interviews lean towards a positive view of

Table 13. Frequency distribution of student answers on genetic studies.

Responses to genetic studies	Number	Frequency (%)
Simplify human life	75	8.7
Are unnecessary	89	10.3
Are necessary if used for the right purpose	507	59.0
Disturb the ecological balance	96	11.2
We can recover from many diseases such as cancer	63	7.3
Lead to new studies	30	3.5
Other	0	.0
Total	860	100

Table 14. Frequency distribution of student answers on consumer information at the sale of genetically modified plants or meats.

Response	Number	Frequency (%)
Yes	830	96.5
No	30	3.5
Undecided	0	.0
Total	860	100

genetic studies since they can be used in the treatment of such diseases as cancer. They are of the opinion that genetic studies will be beneficial if used for the right purpose. Four male students and four female students take a dim view of human cloning. It was seen that the students who lean towards genetic studies disapprove of human cloning, and it was revealed that they think the human cloning will cause a disturbance in the World order. Five male students and three female students think that consumers should be informed of the genetically modified plants and animal meat before offering them to the consumers. These students stated that genetically modified products are harmful for the human health and they will not use them if they know they are there. We found that two female students who did not consider the information necessary have this idea since they thought that the consumption of the genetically modified organisms would not damage health in the long term. Some student opinions are exactly as follows:

'If human cloning will be realized, some people will not do what they should do. They will send their clones instead. And we can not know which one is the real or the clone. Everything will be confused.'

'The World has an order. If we intervene in it, this order will be disturbed. There will be something like the doomsday
'Genetic studies may be used for the treatment of disease. We can overcome such diseases as cancer. But we should not modify the genes of the plants and animals. If we eat modified plants or animals, our health may deteriorate.'

DISCUSSION

In our research, 59% of the students who participated in the survey emphasized that the genetic studies are necessary when used for the right purpose. Bal et al. (2007), in their studies on the university students, showed that most of the students think that genetic engineering will simplify human life, which aligns with our research result. Furthermore, they revealed that the students are of the opinion that this field will enable new studies.

96.5% of the students participated in the survey stated that the consumers should be informed when selling genetically modified plants or meat of genetically modified animals. In contrast to our findings, Bal et al. (2007) revealed in their study that the university students thought meat of genetically modified animals may be sold to the consumers without informing them. This result can be explained by the fact that the dates of studies are different, and the students now have more information about the subject as the subject is considered more and more.

Chen and Raffan (1999), and Lock and Miles (1993) found in their studies that perceptions of the students about genetic studies may vary according to the species of organism applied. Similar to these results, in our study, it was seen that students think that genetic studies other than human cloning are important for humanity (from the semi-structured interviews). Bal et al. (2007) found in their study that students consider that genetic studies may be performed on animals provided that it will be for the benefit of humanity. However, they do not disapprove of the examples given (use of the sheep and mice in the medicine). Furthermore, students are of the opinion that plants may be used in genetic engineering if they know there are medical benefits. Most students that participated in this study think that bacteria could be used in the genetic studies. When comparing animals, plants and microorganisms with each other, they think that the use of animals in genetic studies, even if it is for medical purposes is less acceptable. In our study, similarly, 26.6% of the participants noted that genetic studies may be performed on all animals, plants and microorganisms. However, it was also found that they state that genetic

studies should be performed mostly on microorganisms when the results of animals, plants and microorganisms are compared with each other.

IMPLICATIONS

When students learn biotechnology, information should be given not only at school level but also with its social dimension (Moses, 2003). Therefore, the individuals who are well-equipped in the new studies and who know how to act when encountered can grow.

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