

Prospective Elementary Science Teachers' GDO Awareness

Hasan Celal AKGÜL* Özlem AFACAN** Hatice MERTOĞLU***

Abstract

This is a research study designed to describe the Turkish prospective elementary science teachers' understandings about genetically differentiated organisms (GDO) as part of their perceptions about biotechnology. Therefore, it is a description of a current situation with a large sample. It is a quantitative survey in which individuals' understandings of GDO and the effects that were investigated. Research participants were 246 prospective elementary science teachers from three large-scaled universities located in three different cities in Turkey. Namely, Sakarya University in Sakarya, Marmara University in Istanbul and Ahi Evran University in Kırşehir. The "GDO Awareness Scale" was used as a data collection tool. It was developed by the researchers who were science educator, biology teacher and agricultural engineer. The original scale consisted of twenty- nine likert type items which were chosen from the item list generated by a team of specialists. Item analysis of the scale required to leave eleven of the items. Therefore data collected with the remaining eighteen item scale. Data display that research participants do not have adequate understanding and knowledge about the issues stated concerning most of the items.

Key words: GDO awareness, agricultural literacy, prospective science teachers, biotechnology.

İlköğretim Fen Bilgisi Öğretmen Adaylarının GDO Farkındalıkları

Bu araştırma, Türkiye'deki ilköğretim fen bilgisi öğretmen adaylarının biyoteknoloji algısının bir bölümü olan genetiği değiştirilmiş organizmalar (GDO) hakkındaki farkındalıklarını açıklamak üzere düzenlenmiştir. Bu nedenle durum geniş bir örnekleme yapılarak tanımlanmıştır. GDO farkındalıkları ve bunun etkileri konusunda ayrı ayrı nicel analizler yapılmıştır. Araştırmadaki katılımcılar Türkiye'deki üç farklı şehirde yer alan üç büyük üniversitedeki İlköğretim Fen Bilgisi Öğretmen adaylarından oluşmaktadır. Bunlar; Sakarya'da Sakarya Üniversitesi, İstanbul'da Marmara Üniversitesi ve Kırşehir'de Ahi Evran Üniversiteleridir. "GDO Farkındalık Ölçeği" veri toplama aracı olarak kullanılmıştır. Bu ölçek ziraat mühendisi, biyoloji öğretmeni ve fen bilgisi eğitimcisi araştırmacılar tarafından geliştirilmiştir. Yirmi dokuz Likert tipi madde içeren orijinal ölçek uzman bir ekip tarafından oluşturulmuştur. Ölçeğin maddelerinin analizi on bir maddenin geçersiz sayılmasını gerektirmiştir. Bu nedenle veriler ölçekte kalan on sekiz madde üzerinden değerlendirilmiştir. Veriler araştırmaya katılanların ölçeğin birçok maddesi hakkında bilgi ve farkındalıklarının olmadığını göstermiştir.

Anahtar kelimeler: GDO farkındalığı, tarımsal okuryazarlık, fen bilgisi öğretmen adayları, biyoteknoloji

* Yrd. Doç. Dr. - Sakarya Üniversitesi Eğitim Fakültesi Fen Bilgisi Eğitimi ABD- hakgul@sakarya.edu.tr

** Yrd. Doç. Dr. - Ahi Evran Üniversitesi Eğitim Fakültesi Fen Bilgisi Eğitimi ABD - ozlemafacan2005@gmail.com

*** Öğr. Gör. Dr.-Marmara Üniversitesi Eğitim Fakültesi Fen Bilgisi Eğitimi ABD- hatice.mertoglu@marmara.edu.tr

Introduction

Nowadays, the Science Technology Engineering and Mathematics (STEM) approach and STEM literacy are the two major reform efforts in science education which are more frequently mentioned. Although the STEM approach to education is very popular today, it is not a new approach. Bybee (2010) reported its origin as a generic label used by NSF in the 1990's. The STEM approach to education requires an increased emphasis on technology and engineering in school programs. Bybee also has emphasized that increased emphasis on engineering in school science will make students directly involved in problem-solving and new innovations.

STEM needs an "integrated" curriculum approach. One might connect it with agriculture as an engineering discipline for using STEM. Natural resources and environmental quality are among the components of STEM education where agricultural issues directly take place. Scientific literacy, agricultural literacy and STEM literacy are the century's literacies that will have personal, social and global impact on K-12 education. Although each one of the literacies cited above have their own definitions, they are very interrelated in terms of knowledge and skills required for problem-solving and decision making processes that they demand.

Biotechnology is a good example of a commonly required knowledge for the literacies listed above. Harms (2002) emphasized that biotechnology needs to be taught in school science education. Students need to understand basic methods, achievements and the effects of biotechnology. Harms (2002) also reported on an empirical research study reported by Todt and Gotz in 1998 about the student interests and attitudes towards biotechnology and more specifically gene technology. They found that student interest in genetic engineering or gene technology developed around age 16. But, boys

and girls were interested in different aspects of the topic. Girls were interested in social and ethical aspects whereas boys were interested in economical and technical aspects. Interestingly, results indicated that reports in the media seemed to have more impact and interest in biotechnology than typical science education in schools. Since 1998, several research studies have been conducted to understand individual attitudes towards biotechnology. In one of these research studies Simon (2010) examined the gender differences in knowledge and attitude towards biotechnology. Simon's findings supported by Harms's (2002) report that women place less value on social dominance, more value on social intimacy over financial success, and less value on scientific inquiry than male counterparts.

Individuals' understanding and attitudes towards biotechnology, including its basic methods and effects might very well be considered among the competencies to determine their so called literacies.

This paper reports a research study in which prospective Turkish elementary science teachers' understandings about genetically differentiated organisms (GDO) and their effects to be part of their perceptions about biotechnology were investigated.

Methods

This is a research study designed to describe the Turkish prospective elementary science teachers' understanding about genetically differentiated organisms (GDO) as part of their perceptions about biotechnology. Therefore, it is a quantitative survey in which individuals' understandings of GDO was investigated. The following research questions were addressed in this study.

- ⊙ Do research participants have adequate basic information about biotechnology and GDO?
- ⊙ Do research participants have an adequate knowledge about the global results and effects of the use of biotechnology and GDO?
- ⊙ Do research participants have an adequate understanding of the effects of GDO on living organisms?
- ⊙ Are research participants aware of the ethical issues related to use of biotechnology and GDO?

Research participants

Research participants were 246 prospective elementary science teachers from three large-scaled universities located in three different cities in Turkey. The universities in which participants attend were the ones in which the researchers work as a faculty. Cities and numbers of participants from each university are presented in Table 1 below.

Table 1. Research participants

University-City	Number of participants
AhiEvrans University-Kirsehir	105
Marmara University-Istanbul	56
Sakarya University-Sakarya	85
Total	246

The research participants were sophomore level students from the universities where the researchers were the instructors.

Data Collection

The "GDO Awareness Scale" was used as a data collection tool. It was developed by the researchers. The scale consisted of twenty-nine likert type items which were chosen from the item list generated by a team of specialists. The team included five specialists, namely, one biology education major, two science education majors, one agricultural engineer, and one biology major.

Research participants were asked to reflect on 29-item scale and data were used for item analysis. Tekin (1996) reported that in any research study, 27% of the research participants need to be taken into account in determining the num-

ber of participants in the upper and lower groups of the study. Based on this information, in this research study, upper and lower groups consisted of sixty-six out of two hundred and forty participants. The data gathered through the application of the GDO Awareness Scale for participants. They belonged to upper and lower groups of the study and were statistically analyzed. Items having the item differentiation index below .20 were discarded. Therefore, item differentiation index of the remaining items in the scale was either .20 or above. After discarding eleven items from the analysis indicated above, the final version of the data collection tool consisted of eighteen items. Table 2 displays p (item difficulty) and d (item differentiation index) of the remaining items in the scale.

Table 2. Item analysis of the GDO awareness scale

Item number	<i>p</i>	<i>d</i>
1	.53	.39
2	.25	.38
3	.50	.42
4	.21	.36
5	.50	.60
6	.19	.29
7	.20	.36
8	.46	.65
9	.42	.56
10	.23	.40
11	.45	.71
12	.21	.27
13	.37	.53
14	.17	.30
15	.30	.39
16	.38	.45
17	.10	.20
18	.34	.47

Table 2 indicates that item differentiation index *d* changes between .20-.71, and item difficulty *p* changes between .10-.53. The analysis of 18-item scale also revealed that 0.78 as KR-20

value for validity. The 18-item revised scale was called the GDO Awareness test and the items in the test were grouped as those in Table 3.

Table 3. Item groupings of the GDO awareness test

Group names	Item numbers
Global results and effects of biotechnology and GDO	1, 9, 12, 14, 17
Effects of GDO on living organisms	2, 8, 11, 15, 16, 17
Basic information on biotechnology and GDO	3, 4, 5, 6, 10, 12, 13, 18
GDO and ethics	7

Item groupings displayed in Table 3 indicates that the components of GDO awareness have a basic information about biotechnology and GDO, knowing the global results and effects of using biotechnology and GDO, understanding the effects of GDO on living organisms, and finally ethics. Some of the items appeared twice in the table because of their nature.

Therefore they may belong to two different groups related to biotechnology and GDO.

Data Analysis

Data collected with the administration of GDO awareness test were transferred to SPSS 15.0 program. Then, the Kolmogorov-Smirnov test was applied to data to determine distribution type of data and the test results which implied

normal distribution (.93, $p>.05$). Once the normal distribution was determined, mean values (X), standard deviations (sd), frequency and percent values were also determined and used in the data analysis. Additionally, t tests and one way ANOVA analyses were also reported for two or more variables and used to understand the statistical meaningfulness of differences between groups. For statistically meaningful group differences, an impact factor was used; it was interpreted with Cohen d

index consistently with Buyukozturk's (2002) interpretations of small, medium, and large impact as .01, .06 and .14 respectively.

Results and Discussion

Research findings are discussed in terms of the research questions listed above at the beginning of the methods section. Participant reflections on the 18-item GDO awareness test were indicated in Figure 1, regardless of the universities they attend.

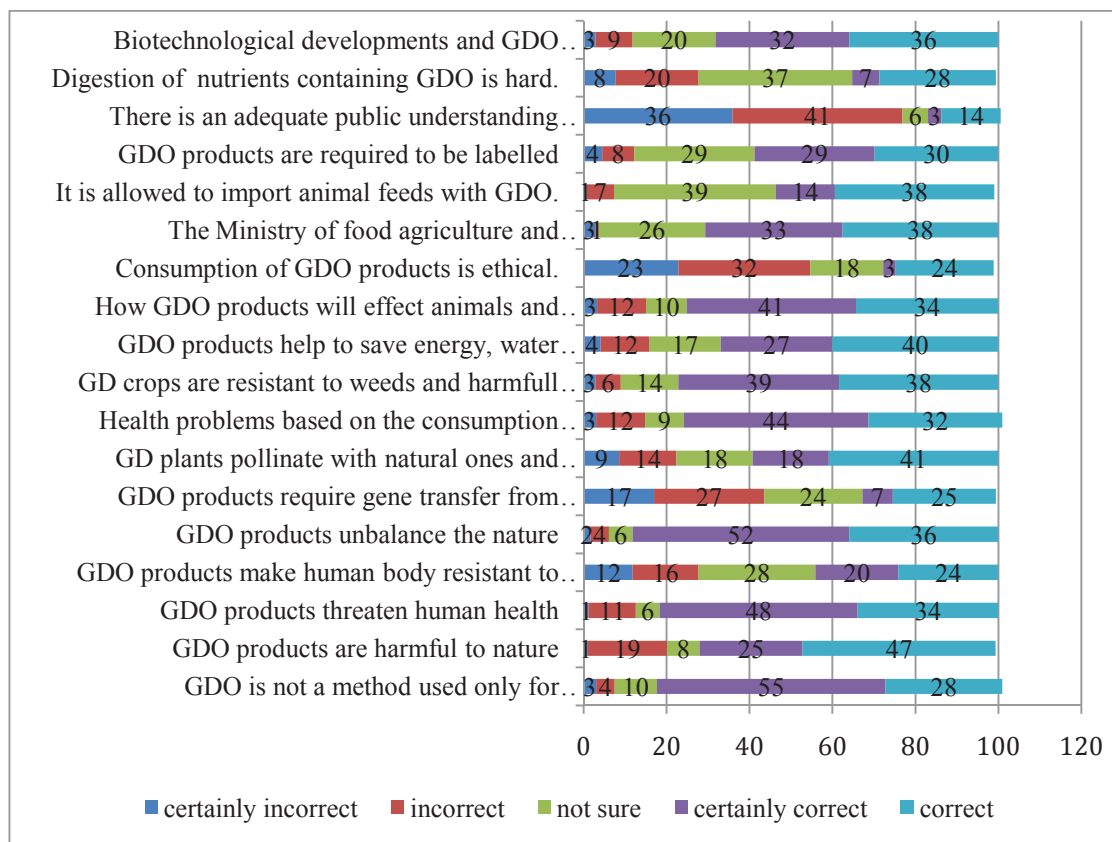


Figure 1. Participants reflections on the GDO awareness test-percent values

The scale used in data collection was 5-point likert scale. Colours used in the Figure 1 represent these 5 points. Participants' reflections for every item and for every point in the item was as described at the below of the figure. The numbers on the color is the number of participants chosen the related point. Figure 1 displays that research participants do

not have adequate understanding and knowledge about the issues stated concerning most of the items. There are only two items in which almost half of the participants show relatively high awareness. These are the fourteenth and eighteenth items and they represent the basic information about the nature and the effects of biotechnology and

GDO. Details related to Figure 1 will be presented under different headings below.

- Research participant knowledge about the global results and the effects of the use of biotechnology and GDO

Participants' reflections to 1, 9,12,14,17 numbered items are listed in Figure 1. Only 32% of the participants reported the correct answer for item 1 which stresses the dependency status of the countries which were the technologically developed ones. GDO products require gene transfer mostly of soil born bacteria. DNA structures with the desired characteristics are transferred to these bacteria and to bacteria which are penetrated by plants which will be genetically differentiated. This requires a certain technological background and only countries that have this technological background can have GDO products. Other countries may only become the importers. Therefore, countries not being able to use biotechnology will be dependent on the technologically developed ones. About one-third of the research participants are aware of the fact that biotechnology is an important factor to produce and consume GDO and this is consistent with the findings of Lui, 2008.

The analysis of participant reflections to other items implies that prospective elementary science teachers who participated in this research study do not have an adequate knowledge about the global results and effects of the use of biotechnology and GDO.

Only 27% of the research participants are aware of its positive effects whereas 52% know GDO products that unbalance in nature. The purpose of generating genetically differentiated plants is to have plants that can be grown in dry fields that are resistant to dehydration. These plants need less energy and water. It is also possible to have efficient amounts of genetically differentiated plants in small fields. In other words, genetically differentiated plants

require less energy, water, and fields to grow which makes the process attractive. This is something that almost one-third of research participants know as the positive side of GDO products (Mattoo, 2000). On the other hand, genetically differentiated plants are produced with the differentiation of the same kind of plants by changing their genetic structures. During the pollination process, GD plants pollinate with undifferentiated ones and produce seeds. These seeds are genetically new and they may not have desired characteristics. By the time they may get dominant and spread very rapidly and even may cause undifferentiated "same type" plants to disappear. This means a decrease in biodiversity. These undesired and new plants may be sensitive to plant diseases and pests. This may cause an increase in diseases. As explained above, GDO products may have some harmful effects as well as positive sides (Ellstrand, 2006).

Figure 1 indicates that research participants have very inadequate understandings and knowledge about either the harms on the negative effects of positive sides of GDO products. Half of the participants knew the negative effects of GDO products on natural balance; only few of them (25% and below) were aware of the reasons. Media mostly underline and stress the negative effects and harms of GDO products. It is usual that participants have a lower level of awareness about the positive effects than negative sides concerning the issue.

- Research participants' understanding on the effects of GDO on living organisms

Items 2, 8, 11, 15, 16, and 17 were written to scale to understand participant understandings about the effects of GDO products on living organisms. Figure 1 indicates that 41% and 44% of the participants were aware that the effects of GDO products on animals and human beings were not known for sure as well

as health problems respectively. Only 7% of the participants know that digestion of GDO products is difficult. Although 48% of the sample accept GDO as a threat for human health; only about one- fifth of the participants even know now of it. Additionally one- fourth of the participants know that GDO products destroy nature. This is consistent with their knowledge about the global results and the effects of GDO products. It is obvious that prospective elementary science teachers do not have an adequate understanding on the effects of GDO products on living organisms. Consistent to what participants think, there are not enough research studies to explain the kinds of health problems which might be caused by GDO products. There needs to be more research studies focused on the health issues.

- Research participants' basic knowledge about biotechnology and GDO

Items 3,4,5,6,10,12,13,18 in Figure 1 indicates the related information about this research question. How participants reflected to these items show that 33% of the participants know that the Ministry of Food Agriculture and Livestock in Turkey is responsible for GDO products. (Don't start a sentence with a number) 29% of them know about the labeling requirement where only 14% know that animal feeds with GDO are allowed to import. These two items were related to laws and regulations; therefore, it is very usual that they have a low level regarding awareness at these items. Figure 1 implies that more than half of the

research participants (55%) know that GDO is not a method used only for agricultural products. They are used in medical science and textiles. Consistent with their low level of awareness, 36% of the participants think that most of the individuals do not have any information about GDO products and knowledge of their effects in Turkey. This analysis of data indicates that there needs to be more media programs and seminars for developing and improving GDO awareness among public.

- Research participants' awareness of the ethical issues related to use of biotechnology and GDO

GDO awareness test consists only one item, Item7, addresses the ethical issue. (Here again do not start a sentence with a number) 23% of the research participants think Item 7 is certainly incorrect and 32% of the participants label the item as incorrect. Therefore, 55% of the participants do not count consumption of GDO products as ethical. This can be explained by indicating religious beliefs. Sometimes individuals confuse ethics with religious belief. People might think that GDO products are similar to cloned ones. For example, some people may think that gene transfer for GD plants might be from an animal that they were religiously prohibited to eat its meat and that this GD plant will also be prohibited for them. It must be very important to understand that GDO products have nothing to do with ethics other than destroying and unbalancing nature.

References

- Bybee, R.W. (2010). Advancing Stem Education: A 2020. Vision. *Technology and Engineering Teacher*, 70(1). 30-35.
- Buyukozturk, S. (2002). *Sosyal Bilimler İçin Veri Analizi El Kitabı*: Pegem Yayıncılık Tic. Ltd. Şti. Adakale Sokak 4/B Yenışehir Ankara.179 s.
- Harms (2002). *Biotechnology Education in Schools*. *Issues in Biotechnology Teaching*, 5(3), 205-209.

- Harms, U. (2002). Biotechnology Education in Schools. *Issues in Biotechnology Teaching*. 5(3), 205-209.
- Simon, R. (2010). Gender differences in knowledge and attitude towards biotechnology. *Public Understand. Sci.* 19(6), 642-653.
- Tekin, H. (1996). *Measurement and evaluation in education*. Ankara: Yargi Publications.
- Lui, Z. (2008). An environment-friendly, multi-gene silencing event-based & genetic-stable approach for preventing spread of transgene & invasive species. *Annual Report, Innovative Fruit Production, Improvement and Protection*. Project Number: 1931-21000-017-10.
- Ellstrand, N.C. (2006). Scientists Evaluate Potential Environmental Risks of Transgenic Crops. *California Agriculture*. 60(3), 119-120.
- Mattoo, K. (2000). Transgenics for a Better Tomato (September 2000). *Agricultural Research magazine*.

Geniştirilmiş özet

Son günlerde, Fen Teknoloji Mühendislik ve Matematik (FTMM) yaklaşımı ve FTMM okuryazarlığı fen eğitimi alanında büyük bir önem taşımaktadır. Her ne kadar FTMM yaklaşımı eğitim alanında yeni bir yaklaşım gibi görünse de Bybee'ın (2010) belirttiğine göre bu yaklaşımın temeli 1990'lı yıllara dayanmakta ve FTMM öğretisi "entegre" müfredat yaklaşımına ihtiyaç duymaktadır. Fen okuryazarlığı, tarımsal okuryazarlık ve FTMM okuryazarlığı K-12 sınıflarındaki eğitimi kişisel, sosyal ve küresel olarak etkileyen yüzyılın okuryazarlıklarıdır. Her bir okuryazarlığın kendi tanımları olsa da, üçü de karar verme ve problem çözme süreçleri için gerekli olan bilgi ve beceriler açısından birbirleriyle bağlantılıdır. Biyoteknoloji, bu bağlantıları destekleyen ve söz konusu okuryazarlıkların hepsinde var olan iyi bir örnek olarak ele alınabilir. Harms (2002) okullardaki fen eğitiminde biyoteknolojinin öğretilmesinin gerekli olduğunu belirtmiş ve öğrencilerin yöntem, başarı ve biyoteknolojinin etkilerini anlamalarına yönelik çalışmaların yapılageldiğinden bahsetmiştir. Nitekim Todt ve Gotz 1998 yılında yaptıkları deneysel çalışmalarında öğrencilerin genetik mühendisliği ve gen teknolojileri ile ilgilendiklerini tespit etmişlerdir. Kız öğrenciler konuyla sosyal ve etik yönden ilgilenmelerine karşın, erkekler ise konunun ekonomik ve teknik boyutuyla ilgilenmişlerdir. Bireylerin, biyoteknolojiye yönelik temel yöntem ve etkilerini de içeren algı ve tutumlarını belirlemek onların okuryazarlıklarını belirlemeye yardımcı olabilir. Dolayısıyla bu araştırma Türk fen bilgisi öğretmen adaylarının genetiği değiştirilmiş organizmalar (GDO) ve biyoteknoloji hakkındaki düşüncelerini tespit etmek amacıyla yapılmıştır.

Araştırma Modeli

Bu araştırma Türkiyedeki fen bilgisi öğretmen adaylarının genetiği değiştirilmiş organizmalar (GDO) ve biyoteknoloji hakkındaki düşüncelerini tespit etmek amacıyla geniş bir örneklem grubuyla yapılmıştır. Örneklem grubu İstanbul, Sakarya ve Kırşehir illerinde bulunan Marmara, Sakarya ve Ahi Evran Üniversitelerinden seçilen ilköğretim fen bilgisi öğretmen adaylarından oluşmuştur. Bu çalışma fen bilgisi öğretmen adaylarının GDO ve etkileri hakkındaki düşüncelerinin ve dolaylı olarak biyoteknoloji hakkındaki bilgilerinin incelendiği bir nicel araştırmadır. Araştırmada aşağıdaki araştırma sorularına cevap aranmıştır.

1. Fen bilgisi öğretmen adaylarının biyoteknoloji ve GDO hakkında yeterli düzeyde temel bilgileri var mıdır?
2. Fen bilgisi öğretmen adaylarının biyoteknoloji ve GDO'lu ürünleri kullanmanın küresel etkileri ve sonuçları hakkında yeterli düzeyde bilgileri var mıdır?
3. Fen bilgisi öğretmen adaylarının GDO'lu ürünlerin yaşayan organizmalar üzerindeki etkilerine yönelik yeterli bilgileri var mıdır?
4. Fen bilgisi öğretmen adayları biyoteknoloji ve GDO'lu ürünlerin kullanımı ile ilgili etik konuların farkında mıdır?

Araştırma Grubu

Araştırma grubunu Türkiye'nin farklı şehirlerinde bulunan Sakarya, Marmara ve Ahi Evran Üniversitesi'nin Eğitim Fakültesi Fen Bilgisi Öğretmenliği Ana Bilim Dalı'nda öğrenim gören toplam 246 öğretmen adayı oluşturmaktadır. Öğretmen adaylarının üniversitelere göre dağılımı yukarıdaki sırayla 85, 56 ve 105 tir.

Veri Toplama Aracı

Alanyazında incelenen arařtırmalarda kullanılan veri toplama araları temel alınarak ve Trk kltr gz nne alınarak hazırlanan ‘‘GDO Farkındalık leęi’’ veri toplama aracı olarak kullanılmıřtır. lek maddeleri fen eęitimi, ziraat ve biyoloji alanında uzman ve arařtırmayı yapan ęretim yeleri tarafından hazırlanmıřtır. Bu maddelerin yer aldıęı madde havuzundan 29 madde seilerek aday lek hazırlanmıřtır. Daha sonra yapılan madde analizi ile lek 18 madde haline gelmiřtir. Onsekiz maddeli lekte maddeler, biyoteknoloji ve GDO lu rn kullanımının kresel etkileri ve sonuları, GDO lu rnlerin canlı organizmalar zerindeki etkileri, GDO ve biyoteknoloji hakkında genel bilgi, GDO ve etik bařlıkları altında toplanmıřtır. Verilerin zmlenmesinde de bu bařlıklar altında gruplamalar yapılmıř ve sonular yorumlanmıřtır.

Bulgular ve Yorumlar

Verilerin analizi sonucunda arařtırmaya katılan ęretmen adaylarının byk bir oęunluęu GDO ve biyoteknoloji hakkında yeterli bilgi ve anlayıřa sahip olmadıkları bulunmuřtur. ęretmen adaylarının yarısından fazlası biyoteknoloji ve GDO’nun doęası ve etkileri hakkında bilgi veren sadece iki maddeye duyarlılık gstermiřlerdir. ęretmen adaylarının %32’si birinci soruya doęru cevap vermiřtir. GDO’lu rnler oęunlukla topraktaki bakterilerin gen transferi ile ortaya ıkmaktadır. Karakterleri deęiřtirmek iin gerekli DNA yapısı bu bakteriler tarafından bitkiye aktarılmaktadır. Bu olay sadece belirli teknolojik alt yapıya sahip lkeler tarafından yapılabilmektedir. ęretmen adaylarının %52’si doęanın dengenin bozulacaęını dřnmekte ve GDO’lu rnlere karřı ıkmakta bununla birlikte sadece %27’si genetięi farklılařtırılmıř bitki retme amacının kuru alanlara dayanıklı olan bitki tr yetiřtirmek iin nemli olacaęı zerine durmaktadırlar. ęretmen adayların %33’ Trkiye’de Gıda Tarım ve Hayvancılık Bakanlıęı’nın GDO’lu rnlerden sorumlu olduęunu bilmektedirler. %29’u GDO’lu rnlerin etiketlenmesi gerektięini biliyorken bunlar arasından sadece %14’ GDO’lu hayvan yemlerinin ithaline izin verildięini bilmektedir. ęretmen adaylarının %55’i GDO’lu rnlerin sadece tarım alanında deęil aynı zamanda tekstil ve tıp alanında kullanıldığını da bilmektedirler. Bu bulguların yanı sıra arařtırmaya katılan ęretmen adaylarının biyoteknoloji ve GDO lu rnlerin kullanımı ve sonuları hakkındaki bilgi ve algıları da yeterli deęildir. Arařtırmaya katılanların GDO ve etik konusundaki bilgileri de yeterli dzeyde deęildir. GDO’ lu rnlerin sadece doęal dengeyi bozma tehlikesi yarattıkları fakat etik herhangi bir yanlarının olmadığı da ęretmen adaylarının farkındalıkları olan bir konu deęildir. Bu alıřma GDO ve biyoteknoloji gibi fen okuryazarlıęı, tarımsal okuryazarlık ve FTMM okuryazarlıęı iin nem tařıyan konuların ęretmen adaylarıyla daha ok alıřılması gereęini ortaya koymuřtur. ęretmen adaylarının konuyla ilgili farkındalıklarının artması ve dolayısıyla yzyılın okuryazarlıkları konusunda daha iyi seviyelere gelmeleri yetiřecek nesillerin de okuryazarlık dzeylerini doęrudan etkileyecektir. Dolayısıyla bilimsel okuryazarlık seviyesi yksek, problem zebilen ve karar verme srecine katılabilen retken bireyler yetiřmesine olanak saęlayacaktır. O halde yapılması gereken, GDO lu rnler ve biyoteknoloji uygulaması ve etkileri gibi kresel nem tařıyan bařka konular da seilerek farkındalık belirleme ve geliřtirme alıřmalarının dzenlenmesidir.