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Articles on biotechnology teaching: Thematic content analysis study

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Abstract

This thematic content analysis done about teaching biotechnology which is researched in Turkey is conducted with 64 articles, from a total of 45 magazines published in Turkey from 2003 to 2018. An analysis of the research trends of Turkish researchers based on teaching biotechnology. In this research, it has been tried to guide the researchers by determining the trends in the field and research methods frequently used(changes according to publication years and languages, what kind of research problems on qualitative research subjects are emphasised, what research methods are used, data collection tools, sample or working group, data analysis methods). In studies conducted to investigate the biotechnology education in Turkey, it shows that there is not adequate studies to address the issue of biotechnology education. Biotechnology and its sub-rules, cloning, genetically modified organisms, biotechnological vaccines, genetic engineering and microbiology may require more space in curricula at early learning levels.

Keywords: Biotechnology, teaching biotechnology, thematic content analysis, analysis of articles, academic achievement.

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1. Introduction

People have not been aware that they have taken the first step in the field of biotechnology, which is among the most important technologies of today while producing the first cheese, yoghurt and vinegar while making efficient seeds separation. In the 19th century, scientists such as Mendel and Pasteur contributed to biotechnology with their studies in the field of genetics and microbiology and helped to reach the present level (Yilmaz & Ogretmen, 2014). However, the use of microorganisms in the industry (such as yeasts and lactic ferments) has been extended until then. Genetics, an important basis of biotechnology, came to an important stage in the 1940s with the work of Delbruck (Ustun & Demirci, 2016). But today, the greatest support of biotechnology to be among the most important technologies has been provided by gene technologies developed in the 20th century. Genetic technologies that accelerated rapidly in the second half of the 20th century played a major role in making biotechnology one of the most important technologies (Cebesoy & Oztekin, 2016).

Due to the high level of investment in gene technology, commercial practices could not be carried out in the US until 1980, which allowed it to become widespread in new plants, including plant parts, tissues and genes. He performed the first experimental gene transplantation on a plant by a company in the USA (Kolsto, 2006). It took about 10 years for the experimental process to be completed and commercial products to be on the market. In the early 1990s, the first commercial transgenic plant by the Calgene company, Flavr Savr domates was placed on the shelves. Nowadays, plants such as cotton, corn, soy, canola which are resistant to drought and plant damage, quality and genetically modified are produced by different countries around the world (Lederman, Antink & Bartos, 2014).

While there are some limitations to the application of the essential equivalence approach in safety assessments, it is also noted that this approach can provide an equal or superior assurance of the safety of genetically modified organism (GMO)-derived foods relative to conventional food or food ingredients (Akgul, Afacan & Mertoglu, 2013). The competition of developed countries' technological applications increases the need for qualified manpower in the field of science. This need has developed educational programmes; with these programmes, students want to memorise the basic principles and concepts of knowledge rather than containing the basic principles and concepts of scientific research, allowing students to think independently by enabling the students to obtain information itself and so that the science can be achieved (Albe, 2008).

Developing countries have taken into consideration the importance of biotechnology and have evaluated the knowledge and attitudes of societies and students about biotechnology and educational resources have been produced through many organisations. For example; Studies in Europe have shown that citizens concentrate on the risks of biotechnology applications (Sonmez & Pektas, 2017). This was thought to be a result of the lack of knowledge of the public on biotechnology. Therefore, some European Union countries have included biotechnology subjects in their school programmes. A project called the European Initiative for Biotechnology Education was initiated and was financially supported by the European Commission (Ozkan, 2011). Approximately 25 units on different biotechnological issues have been established by an international group of educators and scientists. In the units, subjects and materials were related to questions not only in the scientific aspect but also in moral, social, legal and economic aspects were developed according to the interdisciplinary approach (Randler, Kummer & Wilhelm, 2012).

One of the most important aims of science education is to educate individuals to make their own decisions about the problems they face in daily life (Bayazit, Bayram & Cumaoglu, 2018). In parallel with the recent developments in biotechnology, students need to know more about the social, ethical and economic effects of biotechnology in areas such as genetic engineering, cloning and genetically modified foods (Usak, Erdogan, Prokop & Ozel, 2009).

Countries will be highly rewarded for the importance they attach to biology education, teaching and research (Ozkan, 2011). In developed countries, knowledge of biology makes itself felt at every stage of life and affects the economy. Increasing productivity in agriculture, breeding studies,

treatment of hereditary diseases and pharmaceutical industry, such as the work done in many areas can be given as examples.

Biology, genetics, physiology, biochemistry, molecular biology, as well as science by making use of engineering technology, plants, animals and microorganisms used in the development of all the technologies used in biotechnology is called (Akkaya & Pazarlioglu, 2012). Although many definitions have been made about biotechnology, the common point of these definitions is that biotechnology is a field of study that will make changes in the genetic structures of all living things while allowing people to have a healthier life (Harms, 2002; Yesilbag, 2004).

World population continues to increase rapidly day by day. In contrast to this increase, it is seen that human beings, which are the most valuable asset of the earth with the effect of climate change and drought, arise from various problems from nutrition to health (Bayraktar & Bayram, 2019). Therefore, it is seen that various institutions and organisations working on behalf of people are in search of solutions to these negativities. One of the most important solutions is mentioned as biotechnological inventions and applications (Arda, 1994; Kaynar, 2010).

Today, with the changes in science and technology, there are also rapid developments in the field of biotechnology. As a result of these developments, new information is gained about the benefits and risks of biotechnology applications. (Pardo Midden & Miller, 2002). The interaction of biotechnology with individuals shows that biotechnology is among the controversial issues, the importance of biotechnology and the need for effective and efficient biotechnology education in educational institutions (Coban, 2004; Saez, Nino & Carretero, 2008; Steele & Aubusson, 2004).

The main purpose of biotechnology teaching is to prepare the ground for students to form and share their own views by using the correct and reliable information available based on the risks, benefits and harms of biotechnology (Chen & Raffan, 1999). Biotechnology education is thought to contribute to the development of students' reasoning skills and to make rational decisions (Harms, 2002). However, students will be able to comment when they encounter issues related to biotechnology (Akcay, 2016). Therefore, with a good biotechnology education, individuals will actively participate in public debates (Kidman, 2010). Students will be educated on issues such as the use of biotechnology in daily life, their impact on society, their beliefs that the information they have obtained as a result of these training are accurate and complete, the acceptability of biotechnological products, that is, the attitudes towards biotechnology (Ozgen, Emiroglu, Yildiz, Stone & Purutcuoglu, 2007).

In this research, the features, disciplines, subjects, methods, data collection tools, sampling and data analysis methods of biotechnology teaching articles were examined and the answers to the following research questions were sought.

1. How does the number of articles investigating biotechnology teaching change over the years in Turkey?
2. How do the articles investigating biotechnology teaching vary according to the language of publication in Turkey?
3. What are the research methods used in articles investigating biotechnology teaching in Turkey?
4. What are the data collection tools used in articles investigating biotechnology teaching in Turkey?
5. What is the sample or working group used in articles investigating biotechnology teaching in Turkey?
6. What are the data analysis methods used in articles investigating biotechnology teaching in Turkey?

2. Methods

In this study, 64 articles were documented. Content analysis is divided into three categories as meta-analysis, meta-synthesis (thematic content analysis) and descriptive content analysis (Cepni, 2012). Thematic content analysis involves the synthesis and interpretation of research on a subject by

creating themes. Thus, the comparative analysis of similarities and differences in the research studies carried out in a certain field is included. In thematic content analysis studies, the number of studies that are examined is limited. With the meta-synthesis (thematic content analysis) studies, it is possible to synthesise and interpret the research studies on the same subject from a critical point of view through theme or main templates (Calik & Sozbilir, 2014). The reason for the selection of meta-synthesis (thematic content analysis) in the study is to determine the similarities and differences in the subject area studies that can be reached with certain criteria, and to try to examine in depth the existing situation with the similar or different dimensions. Another reason is that there are not enough publications for descriptive content analysis due to the currentity of the subject.

2.1. Process of the study

The full text can be accessed from the web between the years 2003 and 2018. Biotechnology education in Turkey was also made broadcasting thematic content analysis of 64 articles in 45 different journals.

2.2. Data collection tool

The publication classification form (consisting of seven chapters: descriptive information about the identity of the article, discipline, subject matter, method, data collection tools, sample and data analysis methods) was used to examine the articles related to biotechnology teaching. In order to increase the reliability of the classified articles, the classifications were analysed. Each classified article was checked periodically.

2.3. Data analysis

The data obtained with the publication classification form adapted for the research studies on biotechnology teaching were recorded in a database. The recorded data were analysed. The results are presented in graphical, frequency and percentage tables.

3. Findings

The findings obtained in this study conducted by the thematic content analysis of the study of the biotechnology education in Turkey are presented below under six headings.

3.1. Distribution of articles for biotechnology teaching between 2003 and 2018

The distribution of articles for biotechnology teaching between 2003 and 2018 by years is given in Table 1.

Table 1. Total number of articles examined for biotechnology teaching between 2003–2018

Years	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2015	2016	2017	2018
f	3	1	3	3	1	1	4	3	5	8	4	4	7	8	9
Total								64							

f = frequency.

According to the studies carried out between 2003 and 2018 academic year for biotechnology, although not examined in Turkey in the distribution of publications between the years 2003 and 2018 than in 2016, 2017 and a significant increase in the number of publications belonging to 2018 is observed. As seen in Table 1, the highest number of publications was reached in 2018 (14.06%). Furthermore, the number of publications increased rapidly in 2012 (12.5%). The years after 2012 were

replaced by a decline. Again in 2016, there was an increase in the number of publications (10.9%). After 2016, the number of publications increased regularly.

Although the number of studies on biotechnology teaching in 2003–2018 is small, especially the increase in the last 3 years shows that the studies on biotechnology education will increase in future studies. When these findings are considered, it can be said that biotechnology teaching is important and worth investigating.

3.2. Published languages of articles between 2003 and 2018 for biotechnology teaching

The publication languages of the articles for biotechnology teaching between 2003 and 2018 are given in Table 2.

Table 2. Distribution of articles language examined for biotechnology teaching between 2003 and 2018

Years	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2015	2016	2017	2018
Languages	2T	1T	2T	3T	1I	1I	3Y	3T	4T	7T	3T	4T	6T	8T	9T
	1I		1I				1I		1I	1I	1I		1I		
Total								64							

T = Turkish publication, I = English publication.

The publication language of the articles related to biotechnology teaching was examined and it was observed that most of the articles (89.06%) were published in Turkish. The language of 10.9% of the articles is English. In recent studies, it has been observed that there is a limited number of publications in English. Especially after 2009, there was an increase in the number of English publications. This information shows that there has been a tendency to work on biotechnology teaching at the international level in recent years.

3.3. Research methods used in articles between 2003 and 2018 for biotechnology teaching

Table 3 shows the research methods used in articles for biotechnology teaching between 2003 and 2018.

Table 3. Distribution of research methods used in articles

Methods	*f*	%
Quantitative methods	40	63
Qualitative methods	20	31
Mixed methods	4	6
Total	64	

According to Table 3, researchers used 63% quantitative, 31% qualitative, and 6% mixed methods. According to these data, it was determined that the articles used the most quantitative method (63%). Very few (6%) were found to be using mixed methods.

3.4. Data collection techniques used in articles between 2003 and 2018 for biotechnology teaching and extent of scopes of these techniques

Findings related to data collection techniques used in articles between 2003 and 2018 for biotechnology teaching are given in Table 4. Since more than one data collection technique is used in most of the studies, it is seen that the total number of data collection techniques is more than the number of articles in Table 4.

Table 4. Distribution of data collection techniques used in the articles reviewed

Data collection techniques	*f*	%
Survey	55	50
Achievement test	20	18
İnterview	15	14
Observation	5	4
Document review	15	14

According to Table 4, researchers mostly used survey (50%), achievement test (18%), interview (14%) and document analysis (14%). In addition, it was observed that the researchers preferred the observation method (4%). An important part of the questionnaires used in the research is attitude survey, interest survey and perception survey. Nearly all of the interviews used semi-structured interviews.

3.5. Samples and working groups used in articles between 2003 and 2018 for biotechnology teaching

The sample and working groups used in articles between 2003 and 2018 for biotechnology teaching are shown in Table 5.

Table 5. Distribution of sample and working group used in articles

Sample and working group	*f*	%
Primary school	2	3
Middle school	10	16
High school	12	19
License	14	22
Graduate	-	-
Teacher candidate	20	31
Teacher	6	9

As can be seen in Table 5, it is seen that the researchers mostly work with prospective teachers (31%) and undergraduate students (22%) on a sample basis. The least studied sample groups were teachers (9%) and primary school students (3%). In addition, the researchers worked with middle school (16%) and high school (19%) students. In addition, it is seen that the researchers did not prefer to work with the graduate (0%) sample group. Sampling groups were mentioned in most of the articles but the sample size was not mentioned.

3.6. Data analysis methods used in articles between 2003 and 2018 for biotechnology teaching

The data analysis methods used in articles for biotechnology teaching between 2003 and 2018 are given in Table 6.

Table 6. Distribution of data analysis methods used in articles for biotechnology teaching

Data collection methods		*f*	%
Descriptive		30	30
	% and frequency tables	20	20
	Central tendency measurements	5	5
	Graphics	5	5
Forecasted		50	50
	Correlation	14	14

	Anova	12	12
	Manova/Mancova	4	4
	Factor analysis	5	5
	Regression	7	7
	Non-parametric test	8	8
Qualitative		20	20
	Content analysis	12	12
	Qualitative descriptive analysis	8	8

According to Table 6, it is seen that the articles investigating biotechnology teaching use different data analysis methods. Accordingly, it is seen that the researchers use descriptive statistical methods (30%), predictive statistical methods (50%) and qualitative data analysis methods (20%). Descriptive statistical methods (% 20), correlation (14%), ANOVA/ANCOVA (12%) and qualitative statistical methods (8%) and content analysis (12%) were used.

4. Discussion and conclusion

In this study, published in Turkey, articles for academic research have examined various aspects of biotechnology. Descriptive information about the identity of the articles, method, data collection tools, sample and data analysis methods were searched for answers to a total of six research questions. In this study, findings related to each research question were discussed one by one and results and recommendations were made. As shown in Table 2, the broadcast language of the work done in this field in Turkey is mainly Turkish.

As can be seen from Table 1, the work carried out for the biotechnology education in Turkey it said that increased in the last 3 years. However, the number of studies in this field is not sufficient. However, the number of publications increased significantly in 2016. The reason for this increase, especially in recent years in the world and Turkey is said to be the influence of important studies in the field of biotechnology (Camur, 2016).

Most of the sample groups used in the research were the teacher candidates. This is followed by undergraduate students, high school students and middle school students. In the majority of the studies examined, not enough information was given about the number of sample groups.

It has been determined that most of the quantitative methods are used in the studies on biotechnology teaching. Qualitative research studies are more common than mixed studies. In quantitative studies, the relationship between the factors is revealed, but the underlying causes of the relationship are not elaborated (Darcin, 2011; Sicaker & Aydin, 2015). Mixed studies are the studies in which qualitative and quantitative study data are handled in a single study and different data sources are validated (Dogru, 2010).

Nevertheless, Turkey has seen in quite a limited number of mixed work is done in research on this subject. Both qualitative and quantitative support of the studies will reveal more clearly what needs to be known about biotechnology teaching.

In the articles analysed, descriptive analysis techniques are frequently used in the data analysis section since they mostly use quantitative research methods. The single data analysis method is frequently used in research studies. This situation is a problem in terms of both validity and reliability of the studies. However, it is seen that the information about the data analysis methods used in the studies is not sufficient. In this sense, it is thought that the thematic content analysis study of the research studies about biotechnology teaching will be beneficial for the new researchers who will make research on this subject.

5. Recommendations

Biotechnology research for the teaching of various sizes in this study that examined the articles published in Turkey, the following recommendations were made in the movement of the results obtained.

1. It is considered that it would be beneficial for education and training to include studies conducted with pre-school and undergraduate and graduate sample groups in studies investigating biotechnology teaching.
2. It is recommended that researchers use more than one data collection tool in order to increase the reliability of the findings of biotechnology studies and to reach more valid results.
3. Researchers in this field may be advised to do more clearly in terms of their scope and methodology.
4. Since the research studies are mostly made by a quantitative method, a similar study can be supported by the qualitative method and the results obtained by using different measurement tools can be compared.
5. Further research should be conducted for teachers involved in biotechnology education and the results should be compared.
6. Biotechnology and its sub-topics, cloning, GMOs, biotechnological vaccines, genetic engineering and microbiology, can be included in curricula at early learning levels.
7. Further research on biotechnology education, dissertations and articles should be published.
8. The findings obtained in this study were produced by thematic content analysis of the articles that were scanned in the indexes in the determined databases. Different research findings can be reached by scanning larger and more comprehensive databases.

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